# K.S.Rangasamy College of Technology

**(Autonomous)**

# Curriculum & Syllabus

# of

## Electronics and Communication Engineering Department

**(For the batch admitted in 2024 – 25)**

# R 2022

**Courses Accredited by NBA, Accredited by NAAC with 'A++' Grade, Approved by AICTE, Affiliated to Anna University, Chennai.**

**KSR Kalvi Nagar, Tiruchengode – 637 215.**
**Namakkal District, Tamil Nadu, India.**

# Department of Electronics and Communication Engineering

**Vision**

To become recognized as a leader in Electronics and Communication Engineering education and research

**Mission**

- To craft professionals and technology leaders adherent to the professional ethical code in the areas of Electronics and communication Engineering
- To address the needs of the society while advancing boundaries of disciplinary and multidisciplinary research and cultivate universal moral values

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

**PEO1:** **Career Growth:** Graduates will be able to have successful technical and professional career growth

**PEO2:** **Knowledge and Skills:** Graduates will be able to apply the scientific, mathematical and engineering fundamentals to provide solutions to the problems in Electronics and Communication Engineering and related fields.

**PEO3:** **Ethics and Life-long Learning:** Graduates will be able to engage in independent learning, exhibit creativity and innovation with ethical and professional behaviour while addressing societal needs**.**

**PROGRAMME OUTCOMES (POs)**
**Engineering Graduates will be able to:**

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design /development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

Engineering Graduates will be able to:

**PSO1:** **Solutions for Complex Problems**: Solve complex engineering problems by applying engineering knowledge in the field of Signal/Image processing and Communication.

**PSO2:** **Development of products**: Design system components and develop products that meet the specific needs of industry and society in Electronics and Communication Engineering

**PSO3:** **Interpersonal Skills**: Develop essential interpersonal skills and attitude needed for ethical leadership and teamwork such as effective listening and communication, presentation, team building and assertiveness.

**MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) WITH PROGRAMMEOUTCOMES (POs)**

The B.E. Electronics and Communication Engineering Programme outcomes leading to the achievement of the objectives are summarized in the following Table.

| Programme Educational Objectives | Programme Outcomes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| PEO 1 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 |
| PEO 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| PEO 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |

**Contributions:** 3 - Strong; 2 - Medium; 1 - Some

**MAPPING: Electronics and Communication Engineering (UG)**

| YEAR | SEM | COURSE CODE | COURSE NAME | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | I | 60 EN 001 | Professional English I | | | | | | | | 2 | 3 | 3 | 2 | 3 |
| | | 60 MA 001 | Matrices and Calculus | 3 | 2 | | | 2 | | | | | | | |
| | | 60 PH 003 | Physics for Electrical Engineering | 3 | | | | | | | 2 | 2 | | | |
| | | 60 CH 003 | Chemistry for Electronic Engineering | 3 | 2.6 | | | | | | | | | | |
| | | 60 CS 001 | C Programming | 3 | 3 | 3 | | 3 | | | | 2 | 2 | | 2 |
| | | 60 MY 001 | Environmental Studies and Climate Change | 3 | 2 | | | 3 | 2.7 | 2.8 | 2 | | | | 2 |
| | | 61 GE 001 | Heritage of Tamils / தமிழர் மரபு | 2 | | | | | 1.5 | 1 | 2.4 | 2 | 2 | | 1.8 |
| | | 60 CS 0P1 | C Programming Laboratory | 3 | 3 | 3 | | 3 | | | | 2 | 2 | | 2 |
| | | 60 CP 0P2 | Engineering Physics and Chemistry Laboratory | 3 | | | | | | | | 2 | | | |
| | II | 60 EN 002 | Professional English II | | | | | | | | 2 | 3 | 3 | 2 | 3 |
| | | 60 MA 003 | Integrals, Partial Differential Equations and Laplace Transform | 3 | 2 | | | 2 | | | | | | | |
| | | 60 ME 002 | Engineering Graphics | 3 | 2.8 | 3 | | 3 | | | 3 | | | | |
| | | 60 ME 005 | Foundation of Mechanical Engineering | 3 | 3 | | | | | | 2 | 3 | 3 | | |
| | | 60 EC 201 | Electronic Devices | 3 | 2.6 | 3 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 GE 002 | Tamils and Technology / தமிழரும் தொழில்நுட்பமும் | 3 | | | | 3 | 2 | 2.8 | 3 | 2.5 | 2.2 | | 3 |
| | | 61 ME 0P1 | Fabrication and Reverse Engineering Laboratory | 3 | 2 | 3 | | | 2 | 2 | | 3 | | | 3 |
| | | 60 EC 2P1 | Electronic Devices Laboratory | 3 | 3 | 3 | 3 | 3 | 3 | | 3 | 3 | 3 | | 3 |
| | | 60 CG 0P1 | Career Skill Development – I | | | | | | | | 2 | 3 | 3 | 2 | 3 |
| II | III | 60 MA 009 | Linear Algebra and Numerical Methods | 3 | 2 | | | 2 | | | | | | | |
| | | 60 CS 002 | Data Structures and Algorithms | 3 | 3 | 2 | 2.6 | 2 | 2 | 2 | 2.4 | 2.6 | 2 | | 2 |
| | | 60 EC 301 | Electronic Circuits | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | | 3 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 61 EC 302 | Circuit Analysis | 3 | 3 | 3 | 3 | 2.6 | | | | 3 | 3 | | 2 |
| | | 60 EC 303 | Digital System Design | 2.8 | 2.8 | 3 | 3 | 3 | | | 3 | 3 | 3 | | |
| | | 60 MY 002 | Universal Human Values | | | | | | 3 | 3 | 3 | 2.8 | 3 | 2 | 3 |
| | | 60 EC 3P1 | Analog and Digital Electronics Laboratory | 2.8 | 2.8 | 3 | 3 | 2.6 | | | | 3 | 3 | | 3 |
| | | 61 CS 0P2 | Data Structures and Algorithms Laboratory | 3 | 3 | 2 | 2.7 | 2 | 2 | 2 | 3 | 2.6 | 2 | | 2 |
| | | 60 CG 0P2 | Career Skill Development – II | | | | | | | | 2 | 3 | 3 | 2 | 3 |
| | | 60 CG 0P6 | Internship | | | | | | | | | | | | |
| | IV | 60 MA 016 | Probability and Inferential Statistics | 3 | 2 | | | 2 | | | | | | | |
| | | 60 EC 401 | Signals and Systems | 3 | 3 | 3 | 3 | 2 | 2 | | | 3 | 3 | | |
| | | 60 EC 402 | Linear Integrated Circuits | 2.6 | 2.8 | 3 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 EC 403 | Electromagnetic Waves | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 61 EC 404 | Analog Communication | 3 | 3 | 3 | 3 | 3 | | | | 3 | 3 | | 3 |
| | | 60 OE L1* | Open Elective I | | | | | | | | | | | | |
| | | 60 EC 4P1 | Linear Integrated Circuits and Electromagnetics Laboratory | 3 | 3 | 3 | 3 | 3 | 2.8 | | | 3 | 3 | | 3 |
| | | 60 EC 4P2 | Electronic Design Project Laboratory | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | 60 CG 0P3 | Career Skill Development – III | 2.6 | 2.6 | 2.6 | 2.8 | | 2.4 | | | | 2 | 3 | 3 |
| | | 60 CG 0P6 | Internship | | | | | | | | | | | | |
| III | V | 60 EC 501 | Control Systems Engineering | 3 | 3 | 3 | 3 | 2 | | | | 3 | 3 | | |
| | | 60 EC 502 | VLSI and Chip Design | 3 | 3 | 3 | 3 | 3 | | 3 | 3 | 3 | 3 | | 3 |
| | | 60 EC 503 | Digital Signal Processing | 3 | 3 | 3 | 3 | 3 | 2 | | | 3 | 3 | | 2 |
| | | 60 EC 504 | Microprocessors and Microcontrollers | 3 | 3 | 2.8 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 EC E1* | Professional Elective I | | | | | | | | | | | | |
| | | 60 OE L2* | Open Elective II | | | | | | | | | | | | |
| | | 60 MY 003 | Startups and Entrepreneurship | 2.8 | 2.6 | 3 | 2.4 | 2.2 | 2.5 | 1.7 | 1.8 | 1.3 | 2 | 2.2 | 2.4 |
| | | 60 EC 5P1 | Microcontrollers Laboratory | 3 | 3 | 3 | 3 | 3 | | | | 3 | 3 | | |
| | | 60 EC 5P2 | VLSI Laboratory | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 EC 5P3 | Signal Processing Laboratory | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 CG 0P4 | Career Skill Development – IV | 2.6 | 2.6 | 2.6 | 2.8 | | 2.4 | | | | 2 | 3 | 3 |
| | | 60 CG 0P6 | Internship | | | | | | | | | | | | |
| | VI | 60 EC 601 | Embedded systems | 3 | 3 | 2.8 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 EC 602 | Digital Communication | 2.8 | 2.4 | 3 | 2.6 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 EC 603 | Mobile Communication and Networks | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | 3 |
| | | 60 EC 604 | Machine Learning Techniques | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 EC E2* | Professional Elective II | | | | | | | | | | | | |
| | | 60 OE L3* | Open Elective III | | | | | | | | | | | | |
| | | 60 EC 6P1 | Innovation Engineering Laboratory | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | 60 EC 6P2 | Embedded systems Laboratory | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | 3 | 3 |
| | | 60 EC 6P3 | Digital Communication Laboratory | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 |
| | | 60 CG 0P5 | Comprehension Test | 3 | 3 | 2 | 2 | | | | | 1 | 2 | 2 | 3 |
| | | 60 CG 0P6 | Internship | | | | | | | | | | | | |
| IV | VII | 60 HS 002 | Engineering Economics and Financial Accounting | 2.7 | 3 | 2.5 | 2.8 | 3 | 2 | 2.3 | 2 | | | 2.8 | 2.5 |
| | | 60 EC 701 | Antennas and Microwave Engineering | 3 | 3 | 3 | 3 | 3 | | 2 | | 3 | 3 | | |
| | | 60 EC 702 | Computer Networks | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 EC E3* | Professional Elective III | | | | | | | | | | | | |
| | | 60 EC E4* | Professional Elective IV | | | | | | | | | | | | |
| | | 60 AB 00* | NCC\NSS\NSO\YRC\ RRC\Yoga\Fine Arts | | | | | | | | | | | | |
| | | 60 AC 001 | Research Skill Development | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | | 3 |
| | | 60 EC 7P1 | RF Laboratory | 3 | 3 | 3 | 3 | 3 | | 2 | | 3 | 3 | | 3 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 60 EC 7P2 | Networks Laboratory | 3 | 3 | 3 | 3 | 3 | | | 3 | 3 | 3 | | 3 |
| | | 60 EC 7P3 | Project Work - Phase I | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | 60 CG 0P6 | Internship | | | | | | | | | | | | |
| | VIII | 60 EC E5* | Professional Elective V | | | | | | | | | | | | |
| | | 60 EC 8P1 | Project Work - Phase II | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | 60 CG 0P6 | Internship | | | | | | | | | | | | |

# K.S. RANGASAMY COLLEGE OF TECHNOLOGY

## Credit Distribution for B.E (ECE) Programme – 2024 –2025 Batch

| S.No. | Category | Credits Per Semester | | | | | | | | Total Credits | Percentage % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | | |
| 1. | HS | 2 | 2 | - | - | - | - | 3 | - | 7 | 4.32 |
| 2. | BS | 12 | 4 | 4 | 4 | - | - | - | - | 24 | 14.81 |
| 3. | ES | 5 | 9 | 5 | - | - | - | - | - | 19 | 11.73 |
| 4. | PC | - | 5 | 12 | 15 | 18 | 16.5 | 8 | - | 74.5 | 45.99 |
| 5. | PE | - | - | - | - | 3 | 3 | 6 | 3 | 15 | 9.26 |
| 6. | OE | - | - | - | 3 | 3 | 3 | - | - | 9 | 5.56 |
| 7. | CG | - | - | - | 2 | - | 1.5 | 2 | 8 | 13.5 | 8.33 |
| 8. | MC | MC I | - | MC II | - | MC III | - | - | - | - | - |
| 9. | AC | - | - | - | - | - | - | AC | | - | - |
| 10. | GE | GE I | GE II | - | - | - | - | - | - | - | - |
| Total | | 19 | 20 | 21 | 24 | 24 | 24 | 19 | 11 | 162 | 100 |

**HS - HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES**
**BS - BASIC SCIENCE COURSES**
**ES - ENGINEERING SCIENCE COURSES**
**PC - PROFESSIONAL CORE COURSES**
**PE - PROFESSIONAL ELECTIVE COURSES**
**OE - OPEN ELECTIVE COURSES**
**CG - CAREER GUIDANCE COURSES**
**MC - MANDATORY COURSES**
**AC - AUDIT COURSES**
**GE - GENERAL ELECTIVE COURSES**

- Open Electives are courses offered by different departments that do not have any prerequisites and could be of interest to students of any branch.

## K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE – 637215

### (Autonomous)
### DEPARTMENT OF ECE
### MINOR DEGREE PROGRAMME - INTERNET OF THINGS
### LIST OF COURSES

| S.No. | Course Code | Course Name | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC M01 | Internet of Things and its Application | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | 60 EC M02 | Security of Cyber Physical Systems | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | 60 EC M03 | Embedded Systems for IoT | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | 60 EC M04 | IoT Processors | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | 60 EC M05 | IoT Device Development and Integration | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | 60 EC M06 | Industrial IoT and Industry 4.0 | PE | 3 | 3 | 0 | 0 | 3 |
| | | | | Total | 18 | 0 | 0 | 18 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S.RANGASAMY COLLEGE OF TECHNOLOGY,TIRUCHENGODE -637215**
**(An Autonomous Institution affiliated to Anna University)**

**HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HS)**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 EN 001 | Professional English I | HS | 3 | 1 | 0 | 2 | 2 | Basic knowledge of reading and writing in English |
| 2. | 60 EN 002 | Professional English II | HS | 3 | 1 | 0 | 2 | 2 | Basic knowledge of reading and writing in English and should have completed Professional English I. |
| 3. | 60 HS 002 | Engineering Economics and Financial Accounting | HS | 3 | 3 | 0 | 0 | 3 | NIL |
| 4. | 60 AB 001 | National Cadet Corps (Air wing) | HS | 4 | 2 | 0 | 2 | 3 | NIL |
| 5. | 60 AB 002 | National Cadet Corps (Army Wing) | HS | 4 | 2 | 0 | 2 | 3 | NIL |

**BASIC SCIENCE (BS)**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 MA 001 | Matrices and Calculus | BS | 5 | 3 | 1 | 0 | 4 | NIL |
| 2. | 60 PH 003 | Physics for Electrical Engineering | BS | 3 | 3 | 0 | 0 | 3 | NIL |
| 3. | 60 MA 003 | Integrals, Partial Differential Equations and Laplace Transform | BS | 5 | 3 | 1 | 0 | 4 | NIL |
| 4. | 60 CH 003 | Chemistry for Electronic Engineering | BS | 3 | 3 | 0 | 0 | 3 | NIL |
| 5. | 60 CP 0P2 | Engineering Physics and Chemistry Laboratory | BS | 4 | 0 | 0 | 4 | 2 | NIL |
| 6. | 60 MA 009 | Linear Algebra and Numerical Methods | BS | 5 | 3 | 1 | 0 | 4 | NIL |
| 7. | 60 MA 016 | Probability and Inferential Statistics | BS | 5 | 3 | 1 | 0 | 4 | NIL |

**ENGINEERING SCIENCES (ES)**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 ME 002 | Engineering Graphics | ES | 6 | 2 | 0 | 4 | 4 | NIL |
| 2. | 60 CS 001 | C Programming | ES | 3 | 3 | 0 | 0 | 3 | NIL |
| 3. | 60 CS 0P1 | C Programming Laboratory | ES | 4 | 0 | 0 | 4 | 2 | NIL |
| 4. | 61 ME 0P1 | Fabrication and Reverse Engineering Laboratory | ES | 4 | 0 | 0 | 4 | 2 | NIL |
| 5. | 60 ME 005 | Foundation of Mechanical Engineering | ES | 3 | 3 | 0 | 0 | 3 | NIL |
| 6. | 60 CS 002 | Data Structures and Algorithms | ES | 3 | 3 | 0 | 0 | 3 | NIL |
| 7. | 61 CS 0P2 | Data Structures and Algorithms Laboratory | ES | 4 | 0 | 0 | 4 | 2 | Programming knowledge in C language |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**PROFESSIONAL CORE (PC)**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC 201 | Electronic Devices | PC | 3 | 3 | 0 | 0 | 3 | Physics for Electrical Engineering |
| 2. | 60 EC 2P1 | Electronic Devices Laboratory | PC | 4 | 0 | 0 | 4 | 2 | NIL |
| 3. | 60 EC 301 | Electronic Circuits | PC | 3 | 3 | 0 | 0 | 3 | Electronic Devices |
| 4. | 61 EC 302 | Circuit Analysis | PC | 6 | 2 | 1 | 2 | 4 | NIL |
| 5. | 60 EC 303 | Digital System Design | PC | 4 | 2 | 1 | 0 | 3 | NIL |
| 6. | 60 EC 3P1 | Analog and Digital Electronics Laboratory | PC | 4 | 0 | 0 | 4 | 2 | Electronic Devices Laboratory |
| 7. | 60 EC 401 | Signals and Systems | PC | 4 | 2 | 1 | 0 | 3 | Integrals, Partial Differential Equations and Laplace transform |
| 8. | 60 EC 402 | Linear Integrated Circuits | PC | 3 | 3 | 0 | 0 | 3 | Electronic Circuits |
| 9. | 60 EC 403 | Electromagnetic Waves | PC | 5 | 3 | 1 | 0 | 4 | Circuit Analysis |
| 10. | 61 EC 404 | Analog Communication | PC | 4 | 2 | 0 | 2 | 3 | NIL |
| 11. | 60 EC 4P1 | Linear Integrated Circuits and Electromagnetics Laboratory | PC | 4 | 0 | 0 | 4 | 2 | Electronic Circuits |
| 12. | 60 EC 501 | Control Systems Engineering | PC | 5 | 3 | 1 | 0 | 4 | Integrals, Partial Differential Equations and Laplace Transform and Signals and Systems |
| 13. | 60 EC 502 | VLSI and Chip Design | PC | 3 | 3 | 0 | 0 | 3 | Digital System Design |
| 14. | 60 EC 503 | Digital Signal Processing | PC | 5 | 3 | 1 | 0 | 4 | Signals and Systems |
| 15. | 60 EC 504 | Microprocessors and Microcontrollers | PC | 3 | 3 | 0 | 0 | 3 | Digital System Design |
| 16. | 60 EC 5P1 | Microcontrollers Laboratory | PC | 3 | 0 | 0 | 3 | 1.5 | Microprocessors and Microcontrollers |
| 17. | 60 EC 5P2 | VLSI Laboratory | PC | 2 | 0 | 0 | 2 | 1 | Digital System Design |
| 18. | 60 EC 5P3 | Signal Processing Laboratory | PC | 3 | 0 | 0 | 3 | 1.5 | Signals and Systems |
| 19. | 60 EC 601 | Embedded systems | PC | 3 | 3 | 0 | 0 | 3 | Microprocessors and Microcontrollers, Basics of C Programming |
| 20. | 60 EC 602 | Digital Communication | PC | 5 | 3 | 1 | 0 | 4 | Analog Communication |
| 21. | 60 EC 603 | Mobile Communication and Networks | PC | 3 | 3 | 0 | 0 | 3 | NIL |
| 22. | 60 EC 604 | Machine Learning Techniques | PC | 5 | 3 | 0 | 2 | 4 | NIL |
| 23. | 60 EC 6P2 | Embedded systems Laboratory | PC | 3 | 0 | 0 | 3 | 1.5 | Microprocessors and Microcontrollers, Basics of C Programming |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 24. | 60 EC 6P3 | Digital Communication Laboratory | PC | 2 | 0 | 0 | 2 | 1 | Analog Communication |
| 25. | 60 EC 701 | Antennas and Microwave Engineering | PC | 3 | 3 | 0 | 0 | 3 | Electromagnetic Waves |
| 26. | 60 EC 702 | Computer Networks | PC | 3 | 3 | 0 | 0 | 3 | NIL |
| 27. | 60 EC 7P1 | RF Laboratory | PC | 2 | 0 | 0 | 2 | 1 | Electromagnetic Waves |
| 28. | 60 EC 7P2 | Networks Laboratory | PC | 2 | 0 | 0 | 2 | 1 | NIL |

**PROFESSIONAL ELECTIVES (PE) / HONOURS***

**SEMESTER V, PROFESSIONAL ELECTIVE I**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC E11 | Wearable Devices | PE | 4 | 2 | 0 | 2 | 3 | Electronic Devices |
| 2. | 60 EC E12 | IoT Hardware | PE | 5 | 1 | 0 | 4 | 3 | Electronic devices and circuits, Basics of C Programming |
| 3. | 60 EC E13 | Radar Technologies | PE | 4 | 2 | 0 | 2 | 3 | Electromagnetic Waves |
| 4. | 60 EC E14 | Optical Communication and Networks | PE | 4 | 2 | 0 | 2 | 3 | Electromagnetic Waves |
| 5. | 60 EC E15 | Data Science | PE | 4 | 2 | 0 | 2 | 3 | NIL |
| 6. | 60 EC E16 | Consumer Electronics | PE | 4 | 2 | 0 | 2 | 3 | Basic knowledge of Electrical and Electronics Engineering |
| 7. | 60 EC E17 | Speech and Audio Processing | PE | 4 | 2 | 0 | 2 | 3 | Digital Signal Processing |

**SEMESTER VI, PROFESSIONAL ELECTIVE II**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC E21 | Human Assist Devices | PE | 3 | 3 | 0 | 0 | 3 | Electronic Devices |
| 2. | 60 EC E22 | IoT Product Development | PE | 5 | 1 | 0 | 4 | 3 | Electronic devices and circuits, Basics of C Programming, IoT Hardware |
| 3. | 60 EC E23 | Avionics Systems | PE | 3 | 3 | 0 | 0 | 3 | Radar Technologies |
| 4. | 60 EC E24 | Wireless Sensor Networks | PE | 3 | 3 | 0 | 0 | 3 | NIL |
| 5. | 60 EC E25 | Digital Image Processing | PE | 4 | 2 | 0 | 2 | 3 | Signals and Systems |
| 6. | 60 EC E26 | Optoelectronic Devices | PE | 3 | 3 | 0 | 0 | 3 | Electronic Devices |
| 7. | 60 EC E27 | Therapeutic Equipment | PE | 3 | 3 | 0 | 0 | 3 | NIL |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**SEMESTER VII, PROFESSIONAL ELECTIVE III**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC E31 | Medical Imaging Systems | PE | 3 | 3 | 0 | 0 | 3 | Digital Image Processing |
| 2. | 60 EC E32 | Wireless Broadband Networks | PE | 3 | 3 | 0 | 0 | 3 | NIL |
| 3. | 60 EC E33 | Satellite Communication | PE | 3 | 3 | 0 | 0 | 3 | Digital Communication |
| 4. | 60 EC E34 | 5G Communication Networks | PE | 3 | 3 | 0 | 0 | 3 | Mobile Communication and Networks |
| 5. | 60 EC E35 | Artificial Intelligence | PE | 4 | 2 | 0 | 2 | 3 | Machine Learning Techniques |
| 6. | 60 EC E36 | Ad hoc and Sensor Networks | PE | 3 | 3 | 0 | 0 | 3 | NIL |
| 7. | 60 EC E37 | Fundamentals of Nanoelectronics | PE | 3 | 3 | 0 | 0 | 3 | NIL |

**SEMESTER VII, PROFESSIONAL ELECTIVE IV**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC E41 | Brain Computer Interface and Applications | PE | 3 | 3 | 0 | 0 | 3 | NIL |
| 2. | 60 EC E42 | Industrial IoT and Industry 4.0 | PE | 3 | 3 | 0 | 0 | 3 | Internet of Things |
| 3. | 60 EC E43 | Remote Sensing | PE | 3 | 3 | 0 | 0 | 3 | NIL |
| 4. | 60 EC E44 | Advanced Wireless Communication Techniques | PE | 3 | 3 | 0 | 0 | 3 | Wireless Communication |
| 5. | 60 EC E45 | Computer Vision: Algorithms and Applications | PE | 4 | 2 | 0 | 2 | 3 | Digital Image Processing |
| 6. | 60 EC E46 | VLSI Testing | PE | 3 | 3 | 0 | 0 | 3 | VLSI and Chip Design |
| 7. | 60 EC E47 | Positioning and Navigation Systems | PE | 3 | 3 | 0 | 0 | 3 | Digital Communication |

**SEMESTER VIII, PROFESSIONAL ELECTIVE V**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC E51 | Wireless Body Area Networks | PE | 3 | 3 | 0 | 0 | 3 | NIL |
| 2. | 60 EC E52 | Micro Electro Mechanical Systems | PE | 3 | 3 | 0 | 0 | 3 | NIL |
| 3. | 60 EC E53 | Rocketry and Space Mechanics | PE | 3 | 3 | 0 | 0 | 3 | Satellite Communication |
| 4. | 60 EC E54 | Software Defined Networks | PE | 3 | 3 | 0 | 0 | 3 | Mobile Communication and Networks |
| 5. | 60 EC E55 | Deep Learning | PE | 4 | 2 | 0 | 2 | 3 | Machine Learning Techniques |
| 6. | 60 EC E56 | Biomedical Instrumentation | PE | 3 | 3 | 0 | 0 | 3 | NIL |
| 7. | 60 EC E57 | Massive MIMO Networks | PE | 3 | 3 | 0 | 0 | 3 | Mobile Communication and Networks |

*Students can opt for honour degree without specialization by completing 18 credits choosing the necessary courses from the list of electives given above. Courses can be chosen from any of the elective list as per the interest of the students.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

## SEMESTER VII - AUDIT COURSES (AC)

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 AC 001 | Research Skill Development | AC | 1 | 1 | 0 | 0 | 0 | NIL |

## MANDATORY COURSES (MC)

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 MY 001 | Environmental Studies and Climate Change | MC | 2 | 2 | 0 | 0 | 0 | NIL |
| 2. | 60 MY 002 | Universal Human Values | MC | 3 | 3 | 0 | 0 | 3 | NIL |
| 3. | 60 MY 003 | Startups and Entrepreneurship | MC | 2 | 2 | 0 | 0 | 2 | Basic knowledge of reading and writing in English |

## GENERAL ELECTIVE COURSES (GE)

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 61 GE 001 | Heritage of Tamils / தமிழர் மரபு | GE | 1 | 1 | 0 | 0 | 1 | NIL |
| 2. | 60 GE 002 | Tamils and Technology / தமிழரும் தொழில்நுட்பமும் | GE | 1 | 1 | 0 | 0 | 1 | NIL |

## OPEN ELECTIVES I / II / III (OE)

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC L01 | Internet of Things | OE | 5 | 1 | 0 | 4 | 3 | Microprocessors and Microcontrollers, Basics of C Programming |
| 2. | 60 EC L02 | Wearable Devices | OE | 3 | 3 | 0 | 0 | 3 | NIL |
| 3. | 60 EC L03 | Next Generation Wireless Networks | OE | 3 | 3 | 0 | 0 | 3 | NIL |
| 4. | 60 EC L04 | Microprocessor and Microcontroller | OE | 3 | 3 | 0 | 0 | 3 | NIL |
| 5. | 60 EC L05 | 5G Communications and MIMO | OE | 3 | 3 | 0 | 0 | 3 | NIL |
| 6. | 60 EC L06 | Mobile Robotics | OE | 3 | 3 | 0 | 0 | 3 | NIL |

## INTEGRATED COURSES

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 61 EC 302 | Circuit Analysis | PC | 6 | 2 | 1 | 2 | 4 | NIL |
| 2. | 61 EC 404 | Analog Communication | PC | 4 | 2 | 0 | 2 | 3 | NIL |
| 3. | 60 EC 604 | Machine Learning Techniques | PC | 5 | 3 | 0 | 2 | 4 | NIL |
| 4. | 60 EC E11 | Wearable Devices | PE | 4 | 2 | 0 | 2 | 3 | Electronic Devices |
| 5. | 60 EC E13 | Radar Technologies | PE | 4 | 2 | 0 | 2 | 3 | Electromagnetic Waves |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6. | 60 EC E14 | Optical Communication and Networks | PE | 4 | 2 | 0 | 2 | 3 | Electromagnetic Waves |
| 7. | 60 EC E15 | Data Science | PE | 4 | 2 | 0 | 2 | 3 | NIL |
| 8. | 60 EC E16 | Consumer Electronics | PE | 4 | 2 | 0 | 2 | 3 | Basic knowledge of Electrical and Electronics Engineering |
| 9. | 60 EC E17 | Speech and Audio Processing | PE | 4 | 2 | 0 | 2 | 3 | Digital Signal Processing |
| 10. | 60 EC E25 | Digital Image Processing | PE | 4 | 2 | 0 | 2 | 3 | Signals and Systems |
| 11. | 60 EC E35 | Artificial Intelligence | PE | 4 | 2 | 0 | 2 | 3 | Machine Learning Techniques |
| 12. | 60 EC E45 | Computer Vision: Algorithms and Applications | PE | 4 | 2 | 0 | 2 | 3 | Digital Image Processing |
| 13. | 60 EC E55 | Deep Learning | PE | 4 | 2 | 0 | 2 | 3 | Machine Learning Techniques |

**PROJECT BASED COURSES**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC E12 | IoT Hardware | PE | 5 | 1 | 0 | 4 | 3 | Electronic devices and circuits, Basics of C Programming |
| 2. | 60 EC E22 | IoT Product Development | PE | 5 | 1 | 0 | 4 | 3 | Electronic devices and circuits, Basics of C Programming, IoT Hardware |
| 3. | 60 EC L01 | Internet of Things | OE | 5 | 1 | 0 | 4 | 3 | Microprocessors and Microcontrollers, Basics of C Programming |

**CAREER GUIDANCE COURSES (CG)**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Prerequisite |
|---|---|---|---|---|---|---|---|---|---|
| 4. | 60 CG 0P1 | Career Skill Development – I | CG | 2 | 0 | 0 | 2 | 1 | Basic knowledge of reading and writing in English |
| 5. | 60 CG 0P2 | Career Skill Development – II | CG | 2 | 0 | 0 | 2 | 1 | Basic knowledge of reading and writing in English |
| 6. | 60 CG 0P3 | Career Skill Development – III | CG | 2 | 0 | 0 | 2 | 1 | Basic knowledge of Arithmetic and Logical Reasoning |
| 7. | 60 CG 0P4 | Career Skill Development – IV | CG | 2 | 0 | 0 | 2 | 1 | Basic knowledge of Arithmetic and Logical Reasoning |
| 8. | 60 CG 0P5 | Comprehension Test | CG | 2 | 0 | 0 | 2 | 1 | Fundamental knowledge in all core subjects. |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 9. | 60 EC 4P2 | Electronic Design Project Laboratory | CG | 4 | 0 | 0 | 4 | 2 | Analog and Digital Electronics Laboratory |
| 10. | 60 EC 6P1 | Innovation Engineering Laboratory | CG | 3 | 0 | 0 | 3 | 1.5 | NIL |
| 11. | 60 EC 7P3 | Project Work - Phase I | CG | 4 | 0 | 0 | 4 | 2 | NIL |
| 12. | 60 EC 8P1 | Project Work - Phase II | CG | 16 | 0 | 0 | 16 | 8 | NIL |
| 13. | 60 CG 0P6 | Internship | CG | 0 | 0 | 0 | 0 | 1\2 \3 | NIL |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S. RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE -637215**

**(An Autonomous Institution affiliated to Anna University)**

**COURSES OF STUDY**

**(For the candidates admitted in 2024-2025)**

**SEMESTER I**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| | | Induction Programme | - | - | - | - | - | 0 |
| **THEORY** | | | | | | | | |
| 1. | 60 EN 001 | Professional English I | HS | 3 | 1 | 0 | 2 | 2 |
| 2. | 60 MA 001 | Matrices and Calculus | BS | 5 | 3 | 1 | 0 | 4 |
| 3. | 60 PH 003 | Physics for Electrical Engineering | BS | 3 | 3 | 0 | 0 | 3 |
| 4. | 60 CH 003 | Chemistry for Electronic Engineering | BS | 3 | 3 | 0 | 0 | 3 |
| 5. | 60 CS 001 | C Programming | ES | 3 | 3 | 0 | 0 | 3 |
| 6. | 60 MY 001 | Environmental Studies and Climate Change | MC | 2 | 2 | 0 | 0 | 0 |
| 7. | 61 GE 001 | Heritage of Tamils / *தமிழர் மரபு* | GE | 1 | 1 | 0 | 0 | 1[&] |
| **PRACTICALS** | | | | | | | | |
| 8. | 60 CS 0P1 | C Programming Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 9. | 60 CP 0P2 | Engineering Physics and Chemistry Laboratory | BS | 4 | 0 | 0 | 4 | 2 |
| | | | Total | 28 | 16 | 1 | 10 | 19 |

**I to VII semester**

NCC[%] - Course can be waived with 3 credits in VII semester or offered as extra credits

NSS/NSO/YRC/RRC/Fine Arts[%] 3 credits is not accounted for CGPA

Career Skill Development (CSD)* - additional credit is offered not accounted for CGPA.

**I to VIII semester**

Internship[$] 3 additional credits not accounted for CGPA is offered based on the Internship duration

Heritage of Tamils[&] additional 1 credit is offered and not account for CGPA.

**SEMESTER II**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 EN 002 | Professional English II | HS | 3 | 1 | 0 | 2 | 2 |
| 2. | 60 MA 003 | Integrals, Partial Differential Equations and Laplace Transform | BS | 5 | 3 | 1 | 0 | 4 |
| 3. | 60 ME 002 | Engineering Graphics | ES | 6 | 2 | 0 | 4 | 4 |
| 4. | 60 ME 005 | Foundation of Mechanical Engineering | ES | 3 | 3 | 0 | 0 | 3 |
| 5. | 60 EC 201 | Electronic Devices | PC | 3 | 3 | 0 | 0 | 3 |
| 6. | 60 GE 002 | Tamils and Technology / *தமிழரும் தொழில்நுட்பமும்* | GE | 1 | 1 | 0 | 0 | 1[&] |
| **PRACTICALS** | | | | | | | | |
| 7. | 61 ME 0P1 | Fabrication and Reverse Engineering Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 8. | 60 EC 2P1 | Electronic Devices Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 9. | 60 CG 0P1 | Career Skill Development – I | CG | 2 | 0 | 0 | 2 | 1* |
| | | | Total | 31 | 13 | 1 | 16 | 20 |

- Tamils and Technology[&] additional 1 credit is offered and not account for CGPA.

Passed in BoS Meeting held on 13/05/2023

Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**SEMESTER III**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 MA 009 | Linear Algebra and Numerical Methods | BS | 5 | 3 | 1 | 0 | 4 |
| 2. | 60 CS 002 | Data Structures and Algorithms | ES | 3 | 3 | 0 | 0 | 3 |
| 3. | 60 EC 301 | Electronic Circuits | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | 61 EC 302 | Circuit Analysis | PC | 6 | 2 | 1 | 2 | 4 |
| 5. | 60 EC 303 | Digital System Design | PC | 4 | 2 | 1 | 0 | 3 |
| 6. | 60 MY 002 | Universal Human Values | MC | 3 | 3 | 0 | 0 | 3# |
| **PRACTICALS** | | | | | | | | |
| 7. | 60 EC 3P1 | Analog and Digital Electronics Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | 61 CS 0P2 | Data Structures and Algorithms Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 9. | 60 CG 0P2 | Career Skill Development – II | CG | 2 | 0 | 0 | 2 | 1* |
| 10. | 60 CG 0P6 | Internship | CG | 0 | 0 | 0 | 0 | 1\2 \3$ |
| | | | **Total** | **34** | **16** | **3** | **12** | **21** |

- UHV# additional 3 credit is offered and not accounted for CGPA.

**SEMESTER IV**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 MA 016 | Probability and Inferential Statistics | BS | 5 | 3 | 1 | 0 | 4 |
| 2. | 60 EC 401 | Signals and Systems | PC | 4 | 2 | 1 | 0 | 3 |
| 3. | 60 EC 402 | Linear Integrated Circuits | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | 60 EC 403 | Electromagnetic Waves | PC | 5 | 3 | 1 | 0 | 4 |
| 5. | 61 EC 404 | Analog Communication | PC | 4 | 2 | 0 | 2 | 3 |
| 6. | 60 OE L1* | Open Elective I | OE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | 60 EC 4P1 | Linear Integrated Circuits and Electromagnetics Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | 60 EC 4P2 | Electronic Design Project Laboratory | CG | 4 | 0 | 0 | 4 | 2 |
| 9. | 60 CG 0P3 | Career Skill Development – III | CG | 2 | 0 | 0 | 2 | 1* |
| 10. | 60 CG 0P6 | Internship | CG | 0 | 0 | 0 | 0 | 1\2 \3$ |
| | | | **Total** | **34** | **16** | **3** | **12** | **24** |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**SEMESTER V**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 EC 501 | Control Systems Engineering | PC | 5 | 3 | 1 | 0 | 4 |
| 2. | 60 EC 502 | VLSI and Chip Design | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | 60 EC 503 | Digital Signal Processing | PC | 5 | 3 | 1 | 0 | 4 |
| 4. | 60 EC 504 | Microprocessors and Microcontrollers | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | 60 EC E1* | Professional Elective I | PE | 4 | 2 | 0 | 2 | 3 |
| 6. | 60 OE L2* | Open Elective II | OE | 3 | 3 | 0 | 0 | 3 |
| 7. | 60 MY 003 | Startups and Entrepreneurship | MC | 2 | 2 | 0 | 0 | 2## |
| **PRACTICALS** | | | | | | | | |
| 8. | 60 EC 5P1 | Microcontrollers Laboratory | PC | 3 | 0 | 0 | 3 | 1.5 |
| 9. | 60 EC 5P2 | VLSI Laboratory | PC | 2 | 0 | 0 | 2 | 1 |
| 10. | 60 EC 5P3 | Signal Processing Laboratory | PC | 3 | 0 | 0 | 3 | 1.5 |
| 11. | 60 CG 0P4 | Career Skill Development – IV | CG | 2 | 0 | 0 | 2 | 1* |
| 12. | 60 CG 0P6 | Internship | CG | 0 | 0 | 0 | 0 | 1\2 \3$ |
| | | | **Total** | **35** | **19** | **2** | **12** | **24** |

##Startups and Entrepreneurship - additional 2 credit is offered and not accounted for CGPA

**SEMESTER VI**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 EC 601 | Embedded systems | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | 60 EC 602 | Digital Communication | PC | 5 | 3 | 1 | 0 | 4 |
| 3. | 60 EC 603 | Mobile Communication and Networks | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | 60 EC 604 | Machine Learning Techniques | PC | 5 | 3 | 0 | 2 | 4 |
| 5. | 60 EC E2* | Professional Elective II | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | 60 OE L3* | Open Elective III | OE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | 60 EC 6P1 | Innovation Engineering Laboratory | CG | 3 | 0 | 0 | 3 | 1.5 |
| 8. | 60 EC 6P2 | Embedded systems Laboratory | PC | 3 | 0 | 0 | 3 | 1.5 |
| 9. | 60 EC 6P3 | Digital Communication Laboratory | PC | 2 | 0 | 0 | 2 | 1 |
| 10. | 60 CG 0P5 | Comprehension Test | CG | 2 | 0 | 0 | 2 | 1* |
| 11. | 60 CG 0P6 | Internship | CG | 0 | 0 | 0 | 0 | 1\2 \3$ |
| | | | **Total** | **32** | **18** | **1** | **12** | **24** |

Comprehension Test* - one additional credit is offered and not accounted for CGPA calculation.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**SEMESTER VII**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 HS 002 | Engineering Economics and Financial Accounting | HS | 3 | 3 | 0 | 0 | 3 |
| 2. | 60 EC 701 | Antennas and Microwave Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | 60 EC 702 | Computer Networks | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | 60 EC E3* | Professional Elective III | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | 60 EC E4* | Professional Elective IV | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | 60 AB 00* | NCC\NSS\NSO\YRC\RRC\Yoga\Fine Arts | HS | 4 | 2 | 0 | 2 | 3% |
| 7. | 60 AC 001 | Research Skill Development | AC | 1 | 1 | 0 | 0 | 0 |
| **PRACTICALS** | | | | | | | | |
| 8. | 60 EC 7P1 | RF Laboratory | PC | 2 | 0 | 0 | 2 | 1 |
| 9. | 60 EC 7P2 | Networks Laboratory | PC | 2 | 0 | 0 | 2 | 1 |
| 10. | 60 EC 7P3 | Project Work - Phase I | CG | 4 | 0 | 0 | 4 | 2 |
| 11. | 60 CG 0P6 | Internship | CG | 0 | 0 | 0 | 0 | 1\2 \3$ |
| | | | **Total** | **24** | **16** | **0** | **8** | **19** |

NCC% - Course can be waived with 3 credits in VII semester or offered as extra 3 credits.
NSS/NSO/YRC/RRC/Fine Arts% 3 extra credits not accounted for CGPA

**SEMESTER VIII**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 EC E5* | Professional Elective V | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 2. | 60 EC 8P1 | Project Work - Phase II | CG | 16 | 0 | 0 | 16 | 8 |
| 3. | 60 CG 0P6 | Internship | CG | 0 | 0 | 0 | 0 | 1\2 \3$ |
| | | | **Total** | **19** | **3** | **0** | **16** | **11** |

**TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 162**

**Note**: HS-Humanities and Social Sciences including Management Courses, BS-Basic Science Courses, ES-Engineering Science Courses, PE-Professional Core Courses, PE-Professional Elective Courses, GE-General Elective Courses, OE-Open Elective Courses, CG-Career Guidance Courses, MC-Mandatory Courses

L: Lecture
T: Tutorial
P: Practical

**Note:**
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**

**(An Autonomous Institution affiliated to Anna University)**

B.E. / B.Tech. Degree Programme

**SCHEME OF EXAMINATIONS**

(For the candidates admitted in 2024-2025)

**FIRST SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1. | 60 EN 001 | Professional English I | 2 | 40 | 60 | 100 | 45 | 100 |
| 2. | 60 MA 001 | Matrices and Calculus | 2 | 40 | 60 | 100 | 45 | 100 |
| 3. | 60 PH 003 | Physics for Electrical Engineering | 2 | 40 | 60 | 100 | 45 | 100 |
| 4. | 60 CH 003 | Chemistry For Electronic Engineering | 2 | 40 | 60 | 100 | 45 | 100 |
| 5. | 60 CS 001 | C Programming | 2 | 40 | 60 | 100 | 45 | 100 |
| 6. | 60 MY 001 | Environmental Studies and Climate Change | 2 | 100 | 00 | 100 | 00 | 100 |
| 7. | 61 GE 001 | Heritage of Tamils / தமிழர்மரபு | 2 | 100 | 00 | 100 | 00 | 100 |
| **PRACTICAL** | | | | | | | | |
| 8. | 60 CS 0P1 | C Programming Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 9. | 60 CP 0P2 | Engineering Physics and Chemistry Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EN 001 | Professional English I | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | HS | 1 | 0 | 2 | 2 |

## Objectives

- To help learners improve their vocabulary and to enable them to use words appropriately in different academic and professional contexts
- To help learners develop strategies that could be adopted while reading texts
- To help learners acquire the ability to speak effectively in English in real life and career related situations
- To equip students with effective speaking and listening skills in English
- To facilitate learners to enhance their writing skills with coherence and appropriate format effectively

## Pre-requisites

- Basic knowledge of reading and writing in English.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Compare and interpret complex academic texts | Understand |
| CO2 | Recall the denotative and connotative meanings of technical texts | Remember |
| CO3 | Interpret definitions, descriptions, narrations, and essays on various topics | Understand |
| CO4 | Express fluently and accurately in formal and informal communicative contexts | Understand |
| CO5 | Summarize their opinions effectively in both oral and written medium of communication | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO2 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO3 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO4 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO5 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 50 | 50 | 80 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Common to All Branches** | | | | | | | | |
| **60 EN 001 - Professional English I** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| I | 1 | 0 | 2 | 45 | 2 | 40 | 60 | 100 |

| | |
|---|---|
| **Introduction to Fundamentals of Communication*** <br>**Listening:** General Information - Specific Details-Conversation - Introduction to Classmates – Audio - Video (Formal - Informal). <br>**Speaking:** Self Introduction - Introducing a Friend - Conversation - Politeness Strategies. <br>**Reading:** Reading Brochures (Technical Context), Telephone Messages - Social Media Messages Relevant to Technical Contexts and Emails. <br>**Writing:** Writing Letters – Informal and Formal – Basics and Format Orientation <br>**Language Focus:** Present Tenses - Word Formation (Affixes) - Synonyms, Antonyms and Contranyms - and Phrasal Verbs - Abbreviations - Acronyms (as Used in Technical Contexts). | [9] |
| **Narration and Summation*** <br>**Listening:** Podcast, Anecdotes - Stories - Event Narration; Documentaries and Interviews with Celebrities. <br>**Speaking:** Narrating Personal Experiences / Events; Interviewing a Celebrity; Reporting / and Summarizing of Documentaries / Podcasts/ Interviews. <br>**Reading:** Biographies, Travelogues - Newspaper Reports - Excerpts from Literature - and Travel - Technical Blogs. <br>**Writing:** Paragraph Writing - Short Report on an Event (Field Trip Etc.). <br>**Language Focus:** Past Tenses and Prepositions - One-Word Substitution. | [9] |
| **Description of A Process - Product*** <br>**Listening:** Listen to a Product and Process Descriptions; Advertisements about Products or Services <br>**Speaking:** Picture Description; Giving Instruction to use the Product; Presenting a Product. <br>**Reading:** Advertisements, Gadget Reviews and User Manuals. <br>**Writing:** Definitions; Instructions; and Product - Process Description. <br>**Language Focus:** Imperatives - Comparative Adjectives - Future Tenses. Homonyms - And Homophones - Discourse Markers (Connectives - Sequence Words) | [9] |
| **Classification and Recommendations *** <br>**Listening:** TED Talks; Scientific Lectures; and Educational Videos. <br>**Speaking:** Small Talk; Mini Presentations <br>**Reading:** Newspaper Articles and Journal Reports <br>**Writing:** Note-Making / Note-Taking; Recommendations; Transferring Information from Non-Verbal (Chart, Graph etc, to Verbal Mode) <br>**Language Focus:** Articles; Pronouns - Possessive - Relative Pronouns; Subject-Verb Agreement; Collocations | [9] |
| **Expression*** <br>**Listening:** Debates/ Discussions; Different Viewpoints on an Issue; and Panel Discussions. <br>**Speaking:** Group Discussions, Debates - Role Plays. <br>**Reading:** Editorials; and Opinion Blogs. <br>**Writing:** Essay Writing (Descriptive or Narrative). <br>**Language Focus:** Punctuation; Compound Nouns; Simple, Compound - Complex Sentences. Cause - Effect Expressions. | [9] |
| **Total Hours:** | 45 |

| **Text Book(s):** | |
|---|---|
| 1. | "English for Engineers & Technologists", Orient Blackswan Private Ltd. Department of English, Anna University, 2020. |
| 2. | Norman Lewis, "Word Power Made Easy - The Complete Handbook for Building a Superior Vocabulary Book", Penguin Random House India, 2020. |
| **Reference(s):** | |
| 1. | Paul Emmerson and Nick Hamilton, "Five Minute Activities for Business English", Cambridge University Press, New York, 2005. |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | |
|---|---|
| 2. | Arthur Brookes and Peter Grundy," Beginning to Write: Writing Activities for Elementary and Intermediate Learners", Cambridge University Press, New York, 2003 |
| 3. | Michael McCarthy and Felicity O Dell, "English Vocabulary in Use: Upper Intermediate", Cambridge University Press, N.York, 2012 |
| 4. | Lakshmi Narayanan, "A Course Book on Technical English", Scitech Publications (India) Pvt. Ltd., 2020. |

* SDG 4 - Quality Education

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Introduction to Fundamentals of Communication** | |
| 1.1 | Listening for General Information and Specific Details | 1 |
| 1.2 | Self-Introduction | 1 |
| 1.3 | Narrating Personal Experiences | 1 |
| 1.4 | Reading Relevant to Technical Contexts and Emails | 1 |
| 1.5 | Writing Letters – Informal | 1 |
| 1.6 | Writing Letters – Formal | 1 |
| 1.7 | Present Tenses | 1 |
| 1.8 | Synonyms, Antonyms and Contranyms, and Affixes | 1 |
| 1.9 | Phrasal Verbs; Abbreviations & Acronyms | 1 |
| **2** | **Narration and Summation** | |
| 2.1 | Listening to Podcasts, Documentaries and Interviews with Celebrities | 1 |
| 2.2 | Narrating Personal Experiences | 1 |
| 2.3 | Summarizing of Documentaries | 1 |
| 2.4 | Reading Travelogues, and Excerpts from Literature | 1 |
| 2.5 | Paragraph Writing | 1 |
| 2.6 | Short Report on an Event (Field Trip etc.). | 1 |
| 2.7 | Past Tenses | 1 |
| 2.8 | Prepositions | 1 |
| 2.9 | One-Word Substitution | 1 |
| 3 | **Description of a Process / Product** | |
| 3.1 | Listen to a Product and Process Descriptions | 1 |
| 3.2 | Picture Description | 1 |
| 3.3 | Giving Instruction to use the Product | 1 |
| 3.4 | Reading Advertisements, Gadget Reviews and User Manuals | 1 |
| 3.5 | Writing Definitions and Instructions | 1 |
| 3.6 | Future Tenses | 1 |
| 3.7 | Homonyms and Homophones | 1 |
| 3.8 | Imperatives | 1 |
| 3.9 | Comparative Adjectives, and Discourse Markers | 1 |
| **4** | **Classification and Recommendations** | |
| 4.1 | Listening to TED Talks and Educational Videos | 1 |
| 4.2 | Listening to Scientific Lectures | 1 |
| 4.3 | Small Talk and Mini Presentations | 1 |
| 4.4 | Reading Newspaper Articles and Journal Reports | 1 |
| 4.5 | Note-Making / Note-Taking | 1 |
| 4.6 | Recommendations | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.7 | Transferring Information from Non-Verbal | 1 |
| 4.8 | Articles and Pronouns | 1 |
| 4.9 | Subject-Verb Agreement and Collocations | 1 |
| 5 | **Expression** | |
| 5.1 | Listening to Debates and Panel Discussions | 1 |
| 5.2 | Group Discussions | 2 |
| 5.3 | Role Plays | 1 |
| 5.4 | Reading Editorials and Opinion Blogs | 1 |
| 5.5 | Essay Writing (Descriptive or Narrative) | 1 |
| 5.6 | Punctuation and Cause - Effect Expressions. | 1 |
| 5.7 | Compound Nouns | 1 |
| 5.8 | Simple, Compound & Complex Sentences | 1 |

**Course Designer(s)**

1. Dr.A.Palaniappan - palaniappan@Ksrct.ac.In

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 MA 001 | Matrices and Calculus | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | BS | 3 | 1 | 0 | 4 |

## Objectives

- To familiarize the students with basic concepts in cayley-hamilton theorem and orthogonal transformation.
- To get exposed to the fundamentals of differential calculus in various methods.
- To acquire skills to understand the concepts involved in jacobians and maxima and minima.
- To solve various linear differential equations and method of variation of parameters.
- To learn various techniques and methods in solving definite and indefinite integrals.

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Apply the concepts of Cayley-hamilton theorem and orthogonal transformation to the matrix | Apply |
| CO2 | Apply the concepts of differentiation in solving various Engineering problems | Apply |
| CO3 | Obtain Jacobians and maxima and minima of functions of two variables | Apply |
| CO4 | Employ various methods in solving differential equations | Apply |
| CO5 | Apply different techniques to evaluate definite and indefinite integrals | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO3 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO4 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO5 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| 3 - Strong;2 - Medium;1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 20 |
| Apply | 40 | 40 | 70 |
| Analyze | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common To MECH, ECE, EEE, CSE, MCT, CIVIL, IT, TXT, BT, FT, AI&DS, AI&ML**

**60 MA 001 - Matrices and Calculus**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 1 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Matrices**<br>Characteristic Equation – Eigen Values and Eigen Vectors of a Real Matrix – Properties of Eigen Values and Eigen Vectors –Cayley-Hamilton Theorem-Orthogonal Transformation of a Symmetric Matrix to Diagonal Form – Reduction of Quadratic Form to Canonical Form by an Orthogonal Transformation - Nature of Quadratic Form – Applications: Stretching of an Elastic Membrane.<br>**Hands - on:**<br>Matrix operations - Addition, Multiplication, Transpose, Inverse and Rank. | [9] |
| **Differentiation**<br>Representation of Functions - Limit of A Function - Continuity - Derivatives - Differentiation Rules (Sum, Product, Quotient, Chain Rules) – Successive Differentiation-Leibnitz's Theorem- **Applications: Maxima and Minima of Functions of One Variable*.**<br>**Hands - on:**<br>Determine the solution of system of linear equations | [9] |
| **Functions of Several Variables**<br>Partial Differentiation – Homogeneous Functions and Euler's Theorem – Jacobians – Taylor's Series for Functions of Two Variables – **Applications: Maxima and Minima of Functions of Two Variables – Constrained Maxima and Minima: Lagrange's Method of Undetermined Multipliers***.<br>**Hands - on:**<br>Compute the Eigen values and Eigen vectors of a Matrix | [9] |
| **Differential Equations**<br>Linear Differential Equations of Second And Higher Order with Constant Co-Efficient - R.H.S Is Of The Form $e^{\alpha x}, sin\,\alpha x, cos\,\alpha x,\ x^n, n > 0,$ - Differential Equations with Variable Coefficients: Cauchy's and Legendre's Form of Linear Equations – Method of Variation of Parameters.<br>**Hands - on:**<br>Solve the first and second order ordinary differential equations | [9] |
| Integration<br>Definite and Indefinite Integrals - Substitution Rule - Techniques of Integration: Integration by Parts, Integration of Rational Functions by Partial Fraction, Integration of Irrational Functions - Improper Integrals - Applications: Hydrostatic Force and Pressure, Moments and Centres of Mass.<br>**Hands-on:**<br>Compute the Maxima and Minima of a function of one variable | [9] |
| **Total Hours: (Lecture - 45; Hands - on - 05; Tutorial - 10)** | **60** |

**Text Book(s):**

| | |
|---|---|
| 1. | Grewal B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2017. |
| 2. | Kreyszig Erwin, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Limited, New Delhi, 2016. |

**Reference(s):**

| | |
|---|---|
| 1. | Dass H.K, "Higher Engineering Mathematics", 3rd (Revised) Edition, S.Chand & Company Ltd,New Delhi, 2014. |
| 2. | Veerarajan T, "Engineering Mathematics", for Semesters I & II, 1st Edition, Tata McGraw Hill Publishing Co., New Delhi, 2019. |
| 3. | Kandasamy P, Thilagavathy K and Gunavathy K, "Engineering Mathematics - I", S.Chand & Company Ltd, New Delhi, 2017. |
| 4. | Bali N P and Manish Goyal, "A text book of Engineering Mathematics",10th Edition, Laxmi Publications (P) Ltd, 2016. |

*SDG 4 – Quality Education

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. Of Hours |
|---|---|---|
| **1** | **Matrices** | |
| 1.1 | Characteristic equation | 1 |
| 1.2 | Eigen values and Eigen vectors of a real matrix | 1 |
| 1.3 | Properties of Eigen values and Eigen vectors | 1 |
| 1.4 | Cayley-Hamilton theorem | 1 |
| 1.5 | Orthogonal transformation of a symmetric matrix to diagonal form | 1 |
| 1.6 | Nature of quadratic form | 1 |
| 1.7 | Reduction of quadratic form to canonical form by Orthogonal transformation | 2 |
| 1.8 | Stretching of an elastic membrane | 1 |
| 1.9 | Tutorial | 2 |
| 1.10 | Hands-on | 1 |
| **2** | **Differentiation** | |
| 2.1 | Representation of functions | 1 |
| 2.2 | Limit of a function and Continuity | 1 |
| 2.3 | Differentiation rules (sum, product, quotient, chain rules) | 2 |
| 2.4 | Successive differentiation | 1 |
| 2.5 | Leibnitz's theorem | 2 |
| 2.6 | Maxima and minima of functions of one variable | 2 |
| 2.7 | Tutorial | 2 |
| 2.8 | Hands-on | 1 |
| 3 | **Functions of Several Variables** | |
| 3.1 | Partial differentiation | 1 |
| 3.2 | Homogeneous functions and Euler's theorem | 1 |
| 3.3 | Jacobians | 2 |
| 3.4 | Taylor's series for functions of two variables | 1 |
| 3.5 | Maxima and minima of functions of two variables | 2 |
| 3.6 | Lagrange's Method of Undetermined Multipliers | 2 |
| 3.7 | Tutorial | 2 |
| 3.8 | Hands-on | 1 |
| **4** | **Differential Equations** | |
| 4.1 | Linear differential equations of second and higher order with constant co-efficient | 1 |
| 4.2 | R.H.S is of the form $e^{\alpha x},\ sin\,\alpha\, x,\ cos\,\alpha\, x,\ x^n, n > 0$ | 2 |
| 4.3 | Differential equations with variable coefficients: Cauchy's form of linear equations | 2 |
| 4.4 | Differential equations with variable coefficients: Legendre's form of linear equations | 2 |
| 4.5 | Method of variation of parameters | 2 |
| 4.6 | Tutorial | 2 |
| 4.7 | Hands-on | 1 |
| **5** | **Integration** | |
| 5.1 | Definite and Indefinite integrals | 2 |
| 5.2 | Substitution rule | 1 |
| 5.3 | Techniques of Integration: Integration by parts | 1 |
| 5.4 | Integration of rational functions by partial fraction | 1 |
| 5.5 | Integration of irrational functions | 1 |
| 5.6 | Improper integrals | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.7 | Hydrostatic force. | 1 |
| 5.8 | Pressure, moments and centres of mass. | 1 |
| 5.9 | Tutorial | 2 |
| 5.10 | Hands-on | 1 |

**Course Designer(s)**


1. Dr.C.Chandran - cchandran@ksrct.ac.in
2. Mr.G.Mohan - mohan@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 PH 003 | Physics for Electrical Engineering (Common to ECE, EE & EEE) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | BS | 3 | 0 | 0 | 3 |

## Objectives

- To make the students to understand the basics of crystallography, crystal growth and its importance in semiconductor devices
- To enable the students in understanding the importance of quantum physics and its applications.
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications
- To understand the dielectric properties of materials including magnetic materials, applications of dielectrics and magnetic materials
- To introduce advanced materials and nano technology for various modern engineering applications

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Recognize the basics of crystallography, different crystal growth techniques and its applications | Understand |
| CO2 | Utilize the fundamentals of quantum mechanics and apply to one dimensional motion of particles | Apply |
| CO3 | Acquire knowledge on basics of semiconductor physics and its applications in various devices | Understand |
| CO4 | Realize the knowledge on magnetic and dielectric properties of materials and their applications | Understand |
| CO5 | Infer the properties of new engineering materials and nano materials for potential applications | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | - | - | - | - | - | - | 2 | 2 | - | - | - | - | - | - |
| CO2 | 3 | - | - | - | - | - | - | 2 | 2 | - | - | - | - | - | - |
| CO3 | 3 | - | - | - | - | - | - | 2 | 2 | - | - | - | - | - | - |
| CO4 | 3 | - | - | - | - | - | - | 2 | 2 | - | - | - | - | - | - |
| CO5 | 3 | - | - | - | - | - | - | 2 | 2 | - | - | - | - | - | - |

3 - Strong; 2 - Medium; 1 - Some

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 14 | 16 |
| Understand | 46 | 46 | 80 |
| Apply | 04 | - | 04 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to EEE, EE, ECE**

**60 PH 003 - Physics for Electrical Engineering**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Crystal Structure of Solids*** Lattice - Unit Cell – Crystal Systems and Bravais Lattice - Miller Indices - D Spacing in Cubic Lattice - Calculation of Number of Atoms Per Unit Cell - Atomic Radius - Coordination Number - Packing Factor for Hcp Structure - Production of Single Crystal Silicon by Melt Growth Techniques (Bridgman and Czochralski) - Basic Properties of Silicon Wafers - Wafer Orientation – Wafer Cleaning – Pattern Alignment - Imperfections in Crystals. | [9] |
| **Quantum Mechanics*** Black Body Radiation – Dual Nature of Light - De-Broglie Hypothesis - Properties of Matter Waves - Time -Dependent and Time Independent Schrodinger Equation for Wave Function - Applications: Particle in a Box (One Dimensional and Three Dimensional) - Physical Significance of Wave Function-Uncertainty Principle - Applications - Electron Microscope - Scanning Electron Microscope. | [9] |
| **Semiconducting Materials** Properties - Elemental and Compound Semiconductors - Carrier Concentration in Intrinsic and Extrinsic Semiconductors - Experimental Determinations of Resistivity of Semiconductor by Four Probe Method - Hall Coefficient-Experimental Determination of Hall Coefficient - Semiconductor Devices - P-N Junction Diode, **Solar Cell, LED****. | [9] |
| **Magnetic and Dielectric Materials*** Magnetic Materials: Origin of Magnetic Moment - Bohr Magnetron - Classification of Magnetic Materials - Domain Theory - Hysteresis - Soft and Hard Magnetic Materials - Applications - Giant Magneto Resistance (GMR). Dielectric Materials: Polarization - Electronic, Ionic, Orientational and Space Charge - Frequency and Temperature Dependence of Polarization - Breakdown Mechanisms - Applications of Dielectrics in Capacitor and Transformer. | [9] |
| **Advanced Materials and Nanotechnology*** Advanced Materials: Metallic Glasses – Preparation, Properties and Applications - Shape Memory Alloys (SMA) - Characteristics, Properties of NiTi Alloy Applications. Nano Technology: Properties - Top-Down Process: Ball Milling Method - Bottom-Up Process: Vapour Phase Deposition - Carbon Nano Tube (CNT): Properties, Preparation by Electric Arc Method - Application - Single Electron Phenomena and Single Electron Transistor (SET) | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**

| | |
|---|---|
| 1. | Avadhanulu.M.N, Kshirsagar.P.G, Arun Murthy. TVS, “A Text Book of Engineering Physics”, S Chand Publications, New Delhi, 2022. |
| 2. | Malik.H.K, Singh.A.K, “Engineering Physics”, Mcgraw Hill Education Private Limited, New Delhi. 2021. |
| 3. | Joshi.D.R, “Engineering Physics”, Mcgraw Hill Education Private Limited, New Delhi. 2010. |

**Reference(s):**

| | |
|---|---|
| 1. | Pillai.S.O, “A Textbook of Engineering Physics”, New Age International (P) Limited, New Delhi, 2014. |
| 2. | Laud.B.B, “Lasers and Non-Linear Optics”, New Age International Publications, New Delhi, 2015. |
| 3. | Palanisamy.P.K, “Physics of Materials”, Scitech Publications, Chennai. 2012. |

* SDG 4 - Quality Education

** SDG 7 - Sustainable and modern energy for all

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. Of Hours |
|---|---|---|
| 1.0 | **Crystal Structure of Solids** | |
| 1.1 | Lattice - Unit Cell – Crystal Systems and Bravais Lattice | 1 |
| 1.2 | Miller Indices - D Spacing in Cubic Lattice | 1 |
| 1.3 | Calculation of Number of Atoms Per Unit Cell | 1 |
| 1.4 | Atomic Radius - Coordination Number - Packing Factor for HCP Structure | 1 |
| 1.5 | Production of Single Crystal Silicon by Melt Growth Techniques | 1 |
| 1.6 | (Bridgman And Czochralski) | 1 |
| 1.7 | Basic Properties of Silicon Wafers | 1 |
| 1.8 | Wafer Orientation – Wafer Cleaning | 1 |
| 1.9 | Pattern Alignment - Imperfections in Crystals | 1 |
| 2.0 | **Quantum Mechanics** | |
| 2.1 | Black Body Radiation | 1 |
| 2.2 | Dual Nature of Light - De-Broglie Hypothesis | 1 |
| 2.3 | Properties of Matter Waves | 1 |
| 2.4 | Time-Dependent and Time Independent Schrodinger Equation for Wave Function | 1 |
| 2.5 | Applications: Particle in a Box (One Dimensional and Three Dimensional) | 1 |
| 2.6 | Physical Significance of Wave Function-Uncertainty Principle | 1 |
| 2.7 | Applications of Schrodinger Equation | 1 |
| 2.8 | Electron Microscope | 1 |
| 2.9 | Scanning Electron Microscope | 1 |
| 3.0 | **Semiconducting Materials** | |
| 3.1 | Properties of Semiconductor | 1 |
| 3.2 | Elemental and Compound Semiconductors | 1 |
| 3.3 | Carrier Concentration in Intrinsic and Extrinsic Semiconductors | 1 |
| 3.4 | Experimental Determinations of Resistivity of Semiconductor | 1 |
| 3.5 | Four Probe Method | 1 |
| 3.6 | Hall Coefficient | 1 |
| 3.7 | Experimental Determination of Hall Coefficient | 1 |
| 3.8 | Semiconductor Devices – P-N Junction Diode | 1 |
| 3.9 | Solar Cell, LED | 1 |
| 4.0 | **Magnetic and Dielectric Materials** | |
| 4.1 | Origin of Magnetic Moment - Bohr Magnetron | 1 |
| 4.2 | Classification of Magnetic Materials | 1 |
| 4.3 | Domain Theory - Hysteresis - Soft and Hard Magnetic Materials | 1 |
| 4.4 | Applications - Giant Magneto Resistance (*GMR*) | 1 |
| 4.5 | Electronic Polarization, Ionic Polarization | 1 |
| 4.6 | Orientational And Space Charge Polarization | 1 |
| 4.7 | Frequency and Temperature Dependence of Polarization | 1 |
| 4.8 | Breakdown Mechanisms | 1 |
| 4.9 | Applications of Dielectrics in Capacitor and Transformer | 1 |
| 5.0 | **Advanced Materials and Nanotechnology** | |
| 5.1 | Metallic Glasses – Preparation, Properties and Applications | 1 |
| 5.2 | Shape Memory Alloys (SMA) | 1 |
| 5.3 | Characteristics, Properties of NiTi Alloy Applications | 1 |
| 5.4 | Properties - Top-Down Process: Ball Milling Method | 1 |
| 5.5 | Bottom-Up Process: Vapour Phase Deposition | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.6 | Carbon Nano Tube (CNT): Properties | 1 |
| 5.7 | Preparation by Electric Arc Method | 1 |
| 5.8 | CNT-Application | 1 |
| 5.9 | Single Electron Phenomena and Single Electron Transistor (SET) | 1 |

**Course Designer(s)**


1. Dr. V. Vasudevan - vasudevanv@ksrct.ac.in
2. Mr.S. Vanchinathan - vanchinathan@ksrct.ac.in
3. Dr.P. Suthanthira Kumar - suthanthirakumar@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CH 003 | Chemistry for Electronic Engineering (Common to EEE, ECE & EE) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | BS | 3 | 0 | 0 | 3 |

## Objectives

- To help the learners to analyse the hardness of water and its removal
- To study the concepts of electrochemistry and its applications
- To study the types of batteries and fuel cells.
- To explain the characteristics and application of chemical sensors
- To study the working principles of smart materials and its applications

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Identify the types of hardness of water and its removal. | Apply |
| CO2 | Interpret the applications of electro chemistry. | Understand |
| CO3 | Illustrate the significance of the types of batteries and fuel cells. | Understand |
| CO4 | Categorize the types of sensors for various applications. | Apply |
| CO5 | Identify the properties, principles, and applications of various smart materials in modern technologies. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| CO2 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| CO3 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| CO4 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| CO5 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 20 |
| Understand | 30 | 40 | 60 |
| Apply | 10 | - | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R 2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Common to EEE, ECE & EE | | | | | | | | |
| 60 CH 003 – Chemistry for Electronic Engineering | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Water Technology*** <br> Introduction – Commercial and Industrial uses of Water – Hardness – Types – Estimation of Hardness by EDTA Method – Internal Conditioning (Colloidal, Phosphate, Calgon and Carbonate Conditioning Methods) – External Conditioning (Zeolite Process, Demineralization Process) – Desalination Methods (Reverse Osmosis and Electro dialysis). Flash Evaporation | [9] |
| **Electrochemistry**** <br> Electrode Potential – Nernst Equation – Derivation and Problems – Reversible and Irreversible cells – Types of Electrodes and its Applications – Reference Electrodes – pH, Conductometric and Potentiometric Titrations – Principles of Electro Plating and Electro Less Plating – Fabrication process of Printed Circuit Board. | [9] |
| **Energy Storage Devices ** ,*** &** **** <br> Batteries –Types of Batteries. Fabrication and Working of Alkaline Battery – Lead-Acid Battery-Ni-Cd-Lithium-Ion Batteries – Fuel Cells: Hydrogen-Oxygen Fuel Cell – Microbial Fuel Cell (MFC). Organic Solar Cells – Working Principle and Applications Organic Transistors – Construction - Working Principle and Applications in Electronic Industries. | [9] |
| **Chemical Sensors***** <br> Sensors – Chemical Sensors – Characteristics – Elements and Characterization - Potentiometric Sensors – Amperometric Sensors – Sensors Based on Electrochemical Methods – Electrochemical Biosensors – Optical Biosensors: Enzyme Sensors – Bio Affinity Sensors – DNA Sensors. Chemical Sensors as Detectors and Indicators: Indicators for Titration Processes – Separation Methods. Nano technology in Chemical Sensors. | [9] |
| **Electronic Materials** *** <br> Liquid Crystal Polymers – Organic Light Emitting Diode (OLED) - [Polythiopene] - Working and Applications – Conductive Polymers and Semi Conducting Polymers: Principle and Applications- Organic: Organic Dielectric Material [Polystyrene, PMMA]. Smart Screen Materials: Inorganic Rare Earth Metals [Yttrium, Lanthanum, Cerium] - Conductive Components: Indium Tin Oxide [Properties and Applications] - Touch Screen [Resistive and Capacitive] - Magnetic Storage [Iron Oxide, Cobalt Alloy] – Optical Storage [Photo Chromic Materials] - Solid Storage. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | O.G. Palanna, “Engineering Chemistry”, Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 2017. |
| 2. | Jain. P.C. and Monica Jain, “Engineering Chemistry”, 14th Edition, Dhanpatrai publishing co. New Delhi, 2015. |
| **Reference(s):** | |
| 1. | Pletcher D and Walsh F C, “Industrial Electrochemistry”, 2nd Edition, Chapman and Hall, New York, 1990. |
| 2. | O.V. Roussak and H.D. Gesser, “Applied Chemistry-A Text Book for Engineers and Technologists”, 2nd Edition, Springer Science Business Media, New York, 2013. |
| 3. | Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, 2nd Edition, Cambridge University Press, Delhi, 2019. |
| 4. | Hagen Klauk, “Organic Electronics: Materials, Manufacturing and Applications”, Wiley-VCH, 2006. |

* SDG 6 - Improve Clean Water and Sanitation

**SDG 7 - Affordable and clean energy

***SDG 9 - Industry, innovation and infrastructure

****SDG 12 - Responsible consumption and production

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| 1.0 | **Water Technology** | |
| 1.1 | Introduction – Commercial and Industrial uses of water | 1 |
| 1.2 | Hardness - types | 1 |
| 1.3 | Estimation of Hardness of water by EDTA method | 1 |
| 1.4 | Internal conditioning (Colloidal, Phosphate, Calgon and Carbonate) | 1 |
| 1.5 | External conditioning (Zeolite process ) | 1 |
| 1.6 | Demineralization process | 1 |
| 1.7 | Desalination methods - Reverse Osmosis | 1 |
| 1.8 | and Electro dialysis | 1 |
| 1.9 | Flash Evaporation | 1 |
| 2.0 | **Electrochemistry** | |
| 2.1 | Electrode Potential - Nernst Equation - Derivation and Problems | 2 |
| 2.2 | Reversible and Irreversible Cells | 1 |
| 2.3 | Types of Electrodes and its Applications | 1 |
| 2.4 | Reference Electrodes - pH | 1 |
| 2.5 | Conductometric and Potentiometric Titrations | 1 |
| 2.6 | Principles of Electro Plating and Electro Less Plating- | 2 |
| 2.7 | Fabrication Process of Printed Circuit Board. | 1 |
| 3.0 | **Energy Storage Devices** | |
| 3.1 | Batteries - Types of Batteries. | 2 |
| 3.2 | Fabrication and Working of Alkaline Battery | 1 |
| 3.3 | Lead-Acid Battery | 1 |
| 3.4 | Ni-Cd-Lithium Ion Batteries | 1 |
| 3.5 | Fuel Cells: Hydrogen-Oxygen fuel cell | 1 |
| 3.6 | Microbial fuel cell (MFC). | 1 |
| 3.7 | Organic Solar Cells-Working Principle and Applications Organic Transistors | 1 |
| 3.8 | Construction-Working Principle and Applications in Electronic Industries. | 1 |
| 4.0 | **Chemical Sensors** | |
| 4.1 | Sensors – Chemical Sensors - Characteristics | 1 |
| 4.2 | Elements and Characterization | 1 |
| 4.3 | Potentiometric Sensors, Amperometric Sensors | 1 |
| 4.4 | Sensors Based on Electrochemical Methods | 1 |
| 4.5 | Electrochemical Biosensors | 1 |
| 4.6 | Optical Biosensors: Enzyme Sensors – Bio affinity Sensors | 1 |
| 4.7 | DNA Sensors. Chemical Sensors as Detectors and Indicators | 1 |
| 4.8 | Indicators for Titration Processes | 1 |
| 4.9 | Separation Methods. Nano technology in Chemical Sensors. | 1 |
| 5.0 | **Electronic Materials** | |
| 5.1 | Liquid Crystal Polymers - Organic Light Emitting Diode (OLED) - [polythiopene] - Working and Applications | 2 |
| 5.2 | Conductive Polymers and Semi Conducting Polymers: Principle and Applications | 2 |
| 5.3 | Organic: Organic Dielectric Material [Polystyrene, PMMA]. | 1 |
| 5.4 | Smart Screen Materials: Inorganic Rare Earth Metals [Yttrium, Lanthanum, Cerium] | 1 |
| 5.5 | Conductive Components: Indium tin Oxide [properties and applications] - Touch Screen [resistive and capacitive] | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.6 | Magnetic Storage [Iron oxide, Cobalt alloy] | 1 |
| 5.7 | Optical Storage [photo chromic materials] - Solid Storage. | 1 |

**Course Designer(s)**


1. Dr.T.A.Sukantha - sukantha@ksrct.ac.in
2. Dr.B.Srividhya - srividhya@ksrct.ac.in
3. Dr.S.Meenachi - meenachi@ksrct.ac.in
4. Ms.D.Kirthiga - kiruthiga@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CS 001 | C Programming | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ES | 3 | 0 | 0 | 3 |

## Objectives

- To learn most fundamental element of the C language and to examine the execution of branching, looping statements
- To examine the concepts of arrays, its characteristics and types and strings
- To understand the concept of functions, pointers and the techniques of putting them to use
- To apply the knowledge of structures and unions to solve basic problems in C language
- To enhance the knowledge in file handling functions for storage and retrieval of data

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Construct the fundamental building blocks of structured Programming in C | Apply |
| CO2 | Implement the different operations on arrays and strings | Apply |
| CO3 | Develop simple real world applications utilizing functions, recursion and pointers | Apply |
| CO4 | Demonstrate the concepts of structures, unions, user defined data types and preprocessor | Apply |
| CO5 | Interpret the file concepts using proper standard library functions for a given application | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | 2 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 10 | 10 | 20 |
| Apply | 40 | 40 | 60 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to All Branches**

**60 CS 001 – C Programming**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Basics of C, I/O, Branching and Loops*** Structure of a C Program - Data Types - Keywords - Variables - Type Qualifiers - Constants – Operators - Expressions and Precedence - Console I/O - Unformatted and Formatted Console I/O - Conditional Branching and Loops - Writing and Evaluation of Conditionals and Consequent Branching | [9] |
| **Arrays and Strings*** Arrays: One Dimensional Arrays - Two Dimensional Arrays - Matrix Manipulation - Character Arrays - Strings: String Manipulation with and Without String Handling Functions. | [7] |
| **Functions and Pointers*** Functions: Scope of a Function - Library Functions and User Defined Functions - Function Prototypes – Call by Value and Call by Reference - Function Categorization - Arguments to Main Function - Recursion and Application - Passing Arrays to Functions - Storage Class Specifiers. Introduction to Pointer Variables - the Pointer Operators - Pointer Expressions - Pointers and Arrays - Generating a Pointer to an Array - Indexing Pointers - Function and Pointers - Dynamic Memory Allocation. | [11] |
| **Structures, Unions, Enumerations, Typedef and Preprocessors*** Structures - Introduction to Structures and Initialization - Arrays of Structures - Arrays and Structures, Nested Structures - Passing Structures to Functions - Structure Pointers - Unions - Bit Fields - Enumerations - Typedef - The Preprocessor and Commands. | [9] |
| **File Handling*** File: Streams - Reading and Writing Characters - Reading and Writing Strings - File System Functions - File Manipulation - Sequential Access - Random Access Files - Command Line Arguments. | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**


1. Herbert Schildt, “The Complete Reference C”, 4th Edition, Tata Mcgraw Hill Edition, 2010.
2. Byron Gottfried, “Programming with C”, 3rd Edition, Mcgraw Hill Education, 2014.


**Reference(s):**


1. E.Balagurusamy, “Programming in ANSI C”, 7th Edition, Tata Mcgraw Hill Edition, New Delhi, 2016.
2. Brian W. Kernighan and Dennis M. Ritchie, “C Programming Language”, Prentice-Hall.
3. Reemathareja, “Computer Fundamentals and Programming in C”, 2nd Edition, Oxford Higher Education, 2016.
4. K N King, “C Programming: A Modern Approach”, 2nd Edition, W.W.Norton, New York, 2008.


*SDG 4 - Quality Education

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

## Course Contents and Lecture Schedule

| | | |
|---|---|---|
| **1** | **Basics of C, I/O, Branching and Loops** | |
| 1.1 | Structure of a C Program, Keywords | 1 |
| 1.2 | Data Types, Type Qualifiers | 1 |
| 1.3 | Variables and Constants | 1 |
| 1.4 | Operators–Expressions and Precedence | 1 |
| 1.5 | Console I/O– Unformatted and Formatted Console I/O | 1 |
| 1.6 | Conditional Branching | 1 |
| 1.7 | Iteration and Loops | 2 |
| 1.8 | Writing and Evaluation of Conditionals and Consequent Branching | 1 |
| **2** | **Arrays and Strings** | |
| 2.1 | One Dimensional Array | 1 |
| 2.2 | Two-Dimensional Array and Matrix Manipulation | 1 |
| 2.3 | Character Arrays and Strings Basics | 1 |
| 2.4 | String Manipulation Without String Handling Functions | 2 |
| 2.5 | String Manipulation with String Handling Functions | 2 |
| **3** | **Functions and Pointers** | |
| 3.1 | Scope of A Function – Library Functions,<br>User Defined Functions and Function Prototypes | 1 |
| 3.2 | Function Call by Value and Function Call by Reference,<br>Function Categorization | 2 |
| 3.3 | Arguments to Main Function | 1 |
| 3.4 | Recursion and Application | 1 |
| 3.5 | Passing Arrays to Functions | 1 |
| 3.6 | Storage Class Specifiers | 1 |
| 3.7 | Introduction to Pointer Variables - The Pointer Operators - Pointer Expressions | 1 |
| 3.8 | Pointers and Arrays - Generating a Pointer to an Array - Indexing Pointers | 1 |
| 3.9 | Function and Pointers | 1 |
| 3.10 | Dynamic Memory Allocation | 1 |
| **4** | **Structures, Unions, Enumerations, Typedef and Preprocessors** | |
| 4.1 | Introduction to Structures and Initialization | 1 |
| 4.2 | Arrays and Structures, Arrays of Structures | 1 |
| 4.3 | Structures within Structures, Passing Structures to Functions | 2 |
| 4.4 | Structure Pointers | 1 |
| 4.5 | Unions and Bit Fields. | 1 |
| 4.6 | Enumerations - Typedef | 1 |
| 4.7 | Preprocessor Commands | 2 |
| **5** | **File Handling** | |
| 5.1 | File Streams –Reading and Writing Characters - Reading and Writing Strings | 2 |
| 5.2 | File System Functions and File Manipulation | 2 |
| 5.3 | Sequential Access | 2 |
| 5.4 | Random Access Files | 2 |
| 5.5 | Command Line Arguments and Files | 1 |

## Course Designer(s)

1. Dr.P.Kaladevi - kaladevi@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 MY 001 | Environmental Studies and Climate Change | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | MC | 2 | 0 | 0 | 0 |

## Objectives

- To understand the impact climate changes in ecosystem and biodiversity.
- To analyze the impacts of pollution, control and legislation.
- To explain the importance of sustainable development practices.
- To explore the significance of organic farming.
- To identify the Geo-spatial tools for resource management.

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Interpret the impacts of pollution on climate change | Understand |
| CO2 | Categorize the wastes and its management. | Analyze |
| CO3 | Identify the different types of sustainable practices | Apply |
| CO4 | Classify the organic farming techniques | Apply |
| CO5 | Categorize the Geo-spatial tools for resource management | Analyze |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | - | - | - | - | 3 | - | - | - | - | 2 | - | - | - |
| CO2 | 3 | 2 | - | - | - | 3 | 3 | 2 | - | - | - | 2 | - | - | - |
| CO3 | 3 | 2 | - | - | - | 3 | 3 | 2 | - | - | - | 2 | - | - | - |
| CO4 | 3 | 2 | - | - | - | 2 | 3 | - | - | - | - | 2 | - | - | - |
| CO5 | 3 | 2 | - | - | 3 | - | 2 | - | - | - | - | 2 | - | - | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (30 Marks) | | Quiz (20 marks) | | Seminar presentation (50 marks) |
|---|---|---|---|---|---|
| | Case Study | Activity Report | Quiz 1 | Quiz 2 | |
| Remember | 10 | 10 | 5 | 5 | 10 |
| Understand | 30 | 20 | 10 | 10 | 15 |
| Apply | - | 30 | - | 5 | 15 |
| Analyse | 20 | - | 5 | - | 10 |
| Evaluate | - | - | - | | - |
| Create | - | - | - | | - |
| Total | 60 | 60 | 20 | 20 | 50 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to all branches**

**60 MY 001 - Environmental Studies and Climate Change**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| I | 2 | 0 | 0 | 30 | 0 | 100 | - | 100 |

| | |
|---|---|
| **Pollution and its Impact on Climate Change*** <br> Pollution: Sources and Impacts of Air Pollution – Green House Effect- Global Warming - Climate Change - Ozone Layer Depletion - Acid Rain. Carbon Footprint - Climate Change on Various Sectors - Agriculture, Forestry and Ecosystem – Climate Change Mitigation and Adaptation. Action Plan on Climate Change. IPCC, UNFCCC, Kyoto Protocol, Montreal Protocol on Climatic Changes. <br> *Activity*: Study of carbon emission nearby place or industry. | [6] |
| **Integrated Waste Management**** <br> Waste - Types and Classification. Principles of Waste Management (5R Approach) - Swachh Bharat Abhiyan - Commercial Waste, Plastic Waste, Domestic Waste, E-Waste and Biomedical Waste - Risk Management: Collection, Segregation, Treatment and Disposal Methods. Waste Water Treatment - ASP <br> *Activity*: Analysis and design of waste management systems, prepare a model / project - wealth from waste | [6] |
| **Sustainable Development Practices***** <br> Sustainable Development Goals (SDGs) **-** Green Computing- Carbon Trading - Green Building – Eco- Friendly Plastic – Alternate Energy: Hydrogen – Bio-Fuels – Solar Energy – Wind – Hydroelectric Power. Water Scarcity- Watershed Management, Ground Water Recharge and Rainwater Harvesting. <br> *Activity*: Select a topic and analyze the value of sustainable development. | [6] |
| **Environment and Agriculture****** <br> Organic Farming - Bio-Pesticides - Composting, Bio Composting, Vermi - Composting, Roof Gardening and Irrigation. Waste Land Reclamation. Climate Resilient Agriculture. Green Auditing <br> *Activity*: Prepare a Green Auditing Report on Energy, Water Etc. | [6] |
| **Geo-Science in Natural Resource Management** <br> Data Base Software in Environment Information, Digital Image Processing Applications in Forecasting. GPS, Remote Sensing and Geographical Information System (GIS), World Wide Web (WWW), Environmental Information System (ENVIS). <br> *Activity*: Prepare the report using IT Tool. | [6] |
| **Total Hours:** | **30** |

**Text Book(s):**

| | |
|---|---|
| 1. | Anubha Kaushik , C P Kaushik. "Perspectives in Environmental Studies", 6th Edition New Age International Publishers, January 2018. |

**Reference(s):**

| | |
|---|---|
| 1. | G.Tyler Miller, "Environmental Science", 14th Edition Cengage Publications, Delhi, 2013. |
| 2. | Gilbert M.Masters and Wendell P. Ela, "Environmental Engineering and Science", 3rd Edition, PHI Learning Private Limited, 2015. |
| 3. | Erachbharucha. Textbook of Environmental Studies for Undergraduate Courses, Universities Press, 2000. |

*SDG 13 – Climate Action

**SDG 4 – Clean Water and Sanitation

***SDG 6 – Affordable and Clean Energy

****SDG 3 – Good Health and Well-being

Passed in BoS Meeting held on 13/05/2023

Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

## Course Contents and Lecture Schedule

| S.No | Topic | No. Of Hours |
|---|---|---|
| **1** | **Pollution and Its Impact on Climate Change** | |
| 1.1 | Pollution: Sources and Impacts of Air Pollution – Green House Effect- Global Warming- Climate Change - Ozone Layer Depletion - Acid Rain | 2 |
| 1.2 | Climate Change on Various Sectors: Agriculture, Forestry and Ecosystem. – Climate Change Mitigation and Adaptation | 2 |
| 1.3 | Action Plan on Climate Change - IPCC, UNFCCC, KYOTO Protocol, Montreal Protocol on Climatic Changes | 2 |
| **2** | **Integrated Waste Management** | |
| 2.1 | Waste - Types and Classification. Principles of Waste Management (5R Approach) - Swachh Bharat Abhiyan | 2 |
| 2.2 | Commercial Waste, Plastic Waste, Domestic Waste, E-Waste and Biomedical Waste | 2 |
| 2.3 | Risk Management: Collection, Segregation, Treatment and Disposal Methods. | 1 |
| 2.4 | Waste Water Treatment- ASP | 1 |
| 3 | **Sustainable Development Practices** | |
| 3.1 | Sustainable Development Goals (SDGs) - Green Computing - Carbon Trading - Green Building - Eco- Friendly Plastic | 2 |
| 3.2 | Alternate Energy: Hydrogen - Bio-Fuels - Solar Energy - Wind - Hydroelectric Power | 2 |
| 3.3 | Water Scarcity- Watershed Management, Ground Water Recharge and Rainwater Harvesting | 2 |
| **4** | **Environment and Agriculture** | |
| 4.1 | Organic Farming - Bio-Pesticides | 2 |
| 4.2 | Composting, Bio Composting, Vermi-Composting | 2 |
| 4.3 | Roof Gardening and Irrigation | 1 |
| 4.4 | Waste Land Reclamation. Climate Resilient Agriculture, Green Auditing | 1 |
| 5 | **Geo-Science in Natural Resource Management** | |
| 5.1 | Data Base Software in Environment Information, Digital Image Processing Applications in Forecasting | 2 |
| 5.2 | GPS, Remote Sensing and Geographical Information System (GIS) | 2 |
| 5.3 | World Wide Web (WWW), Environmental Information System (ENVIS) | 2 |

## Course Designers


1. Dr.T.A.Sukantha - sukantha@ksrct.ac.in
2. Dr.B.Srividhya - srividhya@ksrct.ac.in
3. Dr.S.Meenachi - meenachi@ksrct.ac.in
4. Ms.D.Kirthiga - kiruthiga@ksrct.ac.in



Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023


CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 61 GE 001 | தமிழர் மரபு (அனைத்து துறைகளும் பொதுவானது) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | GE | 1 | 0 | 0 | 1 |

**பாடத்தின் நோக்கங்கள்**

- தமிழ் மொழியின் இலக்கணச் செறிவைக் கற்றுணர்தல், வாழ்க்கைத் திறன்கள் **மற்றும்** நெறிமுறைகள் தெரிதல்.
- தமிழர் பண்பாட்டின் நுண்கலைகள் பற்றிய ஒரு மீள்பார்வை.
- தமிழர்களின் நாட்டுப்புறக்கலைகள் மற்றும் வீரவிளையாட்டுகள் குறித்து அறிதல்
- தமிழர்களின் திணைக் கோட்பாடுகள், சங்ககால வணிகம் மற்றும் சோழர்களின் வெற்றிகள் குறித்த தகவல்களை தெரிதல்.
- இந்திய சுதந்திரப் போராட்டத்தில் தமிழர்களின் பங்களிப்பை உணருதல்

**முன்கூட்டிய துறை சார் அறிவு**

- தேவை இல்லை

**பாடம் கற்றதின் விளைவுகள்**

- பாடத்தை வெற்றிகரமாக கற்றுமுடித்த பின்பு, மாணவர்களால் முடியும் விளைவுகள்

| | | |
|---|---|---|
| CO1 | தமிழ் மொழியின் செந்தண்மை மற்றும் இலக்கியம் குறித்தும் . வாழ்க்கைத் திறன்கள் **மற்றும்** நெறிமுறைகள் குறித்தும் தெரிதல் | செயல் படுத்துதல் |
| CO2 | தமிழர்களின் சிற்பக்கலை, ஓவியக்கலை மற்றும் இசைக்கருவிகள் குறித்த தெளிவு. | புரிதல் |
| CO3 | தமிழர்களின் நாட்டுப்புறக்கலைகள் மற்றும் வீரவிளையாட்டுகள் குறித்த தெளிவு. | புரிதல் |
| CO4 | தமிழர்களின் திணைக் கோட்பாடுகள், சங்ககால வணிகம் மற்றும் சோழர்களின் வெற்றிகள் குறித்த தகவல்கள். | புரிதல் |
| CO5 | இந்திய தேசிய இயக்கம், சுயமரியாதை இயக்கம் மற்றும் சித்த மருத்துவம் பற்றிய புரிதல். | புரிதல் |

**Mapping with Programme Outcome**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | - | - | - | - | - | 2 | - | 3 | 2 | - | - | 1 | - | - | 3 |
| CO2 | - | - | - | - | - | 1 | 1 | 1 | - | - | - | 3 | - | - | 3 |
| CO3 | - | - | - | - | - | 2 | - | 3 | 3 | 2 | - | 2 | - | - | 3 |
| CO4 | 2 | - | - | - | - | 1 | 1 | 2 | 1 | 2 | - | 1 | - | - | 3 |
| CO5 | - | - | - | - | - | - | - | 3 | 2 | 2 | - | 2 | - | - | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Test (Marks) | End Semester Examination (Marks) |
|---|---|---|
| Remember | 40 | 40 |
| Understand | 40 | 40 |
| Apply | 20 | 20 |
| Analysis | - | - |
| Evaluate | - | - |
| Create | - | - |
| Total | 100 | 100 |

**Note**: Those who **studied Tamil as language subject in +2** should write the exams (CA Test and End Semester Exams) **in** Tamil Language only. Those who **did not study Tamil as language subject in +2** and **other state students** can write the exams in English Language. It is mandatory.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology - Autonomous R2022**

**Common to all Departments**

**61 GE 001- Heritage of Tamils**

| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| I | 1 | 0 | 0 | 15 | 1# | 40 | 60 | 100 |

| | |
|---|---|
| **Language, Literature, Life Skills & Ethics*** <br> Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan-Life, Responsibility, Self-exploration, Attitude, Self-confidence, Goals, Relationships, Leadership, Gender equality | [3] |
| **Heritage - Rock Art Paintings to Modern Art – Sculpture*** <br> Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making -Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils. | [3] |
| **Folk and Martial Arts*** <br> Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils. | [3] |
| **Thinai Concept of Tamils*** <br> Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas. | [3] |
| **Contribution of Tamils to Indian National Movement and Indian Culture*** <br> Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books. | [3] |
| **Total Hours:** | 15 |

**Text Book(s) and Reference Book(s)**


| | |
|---|---|
| 1. | முனைவர் கே. கே. பிள்ளை, "தமிழக வரலாறு - மக்களும் பண்பாடும்", தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 18th Edition, 2022. |
| 2. | முனைவர் இல. சுந்தரம், "கணினித்தமிழ்",விகடன் பிரசுரம், 2nd Edition, 2021 |
| 3. | முனைவர் இரா.சிவானந்தம், மு.சேரன், "கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்", தொல்லியல் துறை வெளியீடு, 6th Edition, 2020. |
| 4. | முனைவர் இரா.சிவானந்தம் , முனைவர் ஜெ.பாஸ்கர், "பொருநை - ஆற்றங்கரை நாகரிகம்", தொல்லியல் துறை வெளியீடு,1st Edition ,2022. |
| 5. | ஈரோடு கதிர், "உயர்தல் உரிமை", சிக்ஸ் ப்ளஸ் ஒன் ட்ரெயினிங் அகாடமி,1st Edition, 2024. |
| 6. | Dr.K.K.Pillay, "Social Life of Tamils", TNTB & ESC and RMRL – (In print). |
| 7. | Dr.S.Singaravel, "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies, 1st Edition, 2001. |
| 8. | Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu, "Historical Heritage of the Tamils", International Institute of Tamil Studies, 2nd Edition, 2010. |
| 9. | Dr.M.Valarmathi, "The Contributions of the Tamils to Indian Culture", International Institute of Tamil Studies. |
| 10. | Dr.R.Sivanantham, "Keeladi - Sangam City Civilization on the banks of river Vaigai", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation. |
| 11. | Dr.K.K.Pillay, "Studies in the History of India with Special Reference to Tamil Nadu", K.K. Pillay( Published by the Author. |
| 12. | Dr.R.Sivanantham, Dr.J.Baskar, "Porunai Civilization", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation. |
| 13 | R.Balakrishnan, "Journey of Civilization Indus to Vaigai", Roja Muthiah Research Library,3rd Edition, 2022. |


*SDG 4 – Quality Education

#For Heritage of Tamils, additional 1 credit is offered and not accounted for CGPA

Passed in BoS Meeting held on 13/05/2023

Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous - R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| அனைத்து துறைகளும் பொதுவானது | | | | | | | | |
| **61 GE 001 - தமிழர் மரபு** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total hrs** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| I | 1 | 0 | 0 | 15 | 1# | 40 | 60 | 100 |

| | |
|---|---|
| **மொழி, இலக்கியம், வாழ்க்கைத் திறன்கள் மற்றும் நெறிமுறைகள்:*** இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ் காப்பியங்கள் - தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு. வாழ்வியல், பொறுப்புணர்வு, சுய ஆய்வு, மனோபாவம், தன்னம்பிக்கை, இலக்குகள், உறவுகள், தலைமைப்பண்பு, பாலின சமநிலை. | [3] |
| ***மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை- சிற்பக் கலை.*** * நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு. | [3] |
| ***நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுள்:*** * தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள் . | [3] |
| ***தமிழர்களின் திணைக் கோட்பாடுகள்:*** * தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி . | [3] |
| ***இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:*** * இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ் புத்தகங்களின் அச்சு வரலாறு | [3] |
| **Total Hours:** | 15 |

**Text Book(s):**

| | |
|---|---|
| 1. | முனைவர் கே. கே. பிள்ளை, "தமிழக வரலாறு - மக்களும் பண்பாடும்", தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 18th Edition, 2022. |
| 2. | முனைவர் இல. சுந்தரம், "கணினித்தமிழ்",விகடன் பிரசுரம், 2nd Edition, 2021 |
| 3. | முனைவர் இரா.சிவானந்தம், மு.சேரன், "கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்", தொல்லியல் துறை வெளியீடு, 6th Edition, 2020. |
| 4. | முனைவர் இரா.சிவானந்தம் , முனைவர் ஜெ.பாஸ்கர், "பொருநை - ஆற்றங்கரை நாகரிகம்", தொல்லியல் துறை வெளியீடு,1st Edition ,2022. |
| 5. | ஈரோடு கதிர், "உயர்தல் உரிமை", சிக்ஸ் ப்ளஸ் ஒன் ட்ரெயினிங் அகாடமி,1st Edition, 2024. |
| 6. | Dr.K.K.Pillay, "Social Life of Tamils", TNTB & ESC and RMRL – (In print). |
| 7. | Dr.S.Singaravel, "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies, 1st Edition, 2001. |
| 8. | Dr.S.V.Subaramanian, Dr.K.D. Thirunavukkarasu, "Historical Heritage of the Tamils", International Institute of Tamil Studies, 2nd Edition, 2010. |
| 9. | Dr.M.Valarmathi, "The Contributions of the Tamils to Indian Culture", International Institute of Tamil Studies. |
| 10. | Dr.R.Sivanantham, "Keeladi - Sangam City Civilization on the banks of river Vaigai", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation. |
| 11. | Dr.K.K.Pillay, "Studies in the History of India with Special Reference to Tamil Nadu", K.K. Pillay( Published by the Author. |
| 12. | Dr.R.Sivanantham, Dr.J.Baskar, "Porunai Civilization", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation. |
| 13 | R.Balakrishnan, "Journey of Civilization Indus to Vaigai", Roja Muthiah Research Library,3rd Edition, 2022. |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CS 0P1 | C Programming Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ES | 0 | 0 | 4 | 2 |

## Objectives

- To enable the students to apply the concepts of C to solve simple problems
- To use selection and iterative statements in C programs
- To apply the knowledge of library functions in C programming
- To implement the concepts of arrays, functions, structures and pointers in C
- To implement the file handling operations through C

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Implement computational problems using selection and iterative statements | Apply |
| CO2 | Demonstrate C program to manage collection of related data. | Apply |
| CO3 | Design and implement different ways of passing arguments to functions, Recursion and implement pointers concepts. | Apply |
| CO4 | Develop a C program to manage collection of different data using structures, Union, user-defined data types and preprocessor directives. | Apply |
| CO5 | Demonstrate C program to store and retrieve data using file concepts. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | - |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | - |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | - |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | - |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|
| | Lab | Activity | | | |
| Remember | - | - | - | - | - |
| Understand | - | 12 | - | - | - |
| Apply | 50 | 13 | 100 | | 100 |
| Analyse | - | - | - | | - |
| Evaluate | - | - | - | - | - |
| Create | - | - | - | - | - |
| Total | 50 | 25 | 100 | - | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Common to All Branches | | | | | | | | |
| 60 CS 0P1 – C Programming Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| I | 0 | 0 | 4 | 60 | 2 | 60 | 40 | 100 |

**List of Experiments:**

1. Implementation of Simple computational problems using various formulas*.
2. Implementation of Problems involving Selection statements*.
3. Implementation of Iterative problems e.g., sum of series*.
4. Implementation of 1D Array manipulation*.
5. Implementation of 2D Array manipulation*.
6. Implementation of String operations*.
7. Implementation of Simple functions and different ways of passing arguments to functions and Recursive Functions*.
8. Implementation of Pointers*.
9. Implementation of structures and Union*.
10. Implementation of Bit Fields, Typedef and Enumeration*.
11. Implementation of Preprocessor directives*.
12. Implementation of File operations*.

* SDG 4 - Quality Education

**Course Designer(s)**

1. Dr.P.Kaladevi - Kaladevi@Ksrct.Ac.In

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CP 0P2 | Engineering Physics and Chemistry Laboratory (CSE, IT, AIML, EEE, ECE, EE) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | BS | 0 | 0 | 4 | 2 |

## Objectives

- To infer the practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To demonstrate an ability to make physical measurements and understand the limits of precision in measurements
- To analyze the behavior and characteristics of various materials for its optimum utilization
- Test the knowledge of theoretical concepts and develop the experimental skills of the learners
- To facilitate data interpretation and expose the learners to various industrial and environmental Applications

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Analyze the properties of semiconducting materials for its potential applications | Apply |
| CO2 | Realize the interference and diffraction phenomena by Air wedge and laser experiments | Apply |
| CO3 | Recognize the magnetic properties by experimental verification | Apply |
| CO4 | Apply different techniques of qualitative and quantitative chemical analysis to generate experimental skills and apply these skills to various analysis | Apply |
| CO5 | Explain and analyze instrumental techniques for chemical analysis | Analyze |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| CO2 | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| CO3 | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| CO4 | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| CO5 | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |

3 - Strong; 2 - Medium; 1 – Some

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | 10 | - | 10 | 10 |
| Understand | 30 | 30 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 20 | 30 | 20 | 20 |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |
| Total | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Common to CSE, IT, EEE, ECE, EE | | | | | | | | |
| 60 CP 0P2 - Engineering Physics and Chemistry Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| I | 0 | 0 | 4 | 60 | 2 | 60 | 40 | 100 |

**List of Experiments(Physics):***

1. Determination of Hall coefficient of a given semiconductor and its charge carrier density
2. V-I Characteristics of Zener diode and Solar cell
3. Air wedge - Determination of thickness of a thin sheet/wire
4. a) Laser- Determination of the wave length of the laser using grating
   b) Optical fibre -Determination of numerical aperture and acceptance angle
5. Magnetic field along the axis of current carrying coil – Stewart and Gee.

* SDG 4- Quality Education

**List of Experiments(Chemistry):***

1. Estimation of HCl by pH meter.
2. Estimation of mixture of acids by conductivity meter
3. Determination of ferrous ion by Potentiometric titration.
4. Determination of corrosion by weight loss method.
5. Estimation of ferrous ion by spectrophotometer.

**Case studies/Activity report**

1. Activity using chemdraw software.
2. Activity report on cheminformatic structure.
3. Case study on ion selective electrodes.
4. Assembling of cell or battery.

* SDG 6 - Improve Clean Water and Sanitation
* SDG 9 - Industry, Innovation, and Infrastructure
* SDG 8 - Decent Work and Economic Growth

| **Lab Manual** | |
|---|---|
| 1. | "Engineering Physics Lab Manual", Department of Physics, KSRCT. |
| 2. | "Chemistry Lab Manual Volume I & II", Department of Chemistry, KSRCT. |

**Course Designer(s) - Physics**


1. Dr. V. Vasudevan - vasudevanv@ksrct.ac.in
2. Mr. S. Vanchinathan - vanchinathan@ksrct.ac.in
3. Dr. P. Suthanthira Kumar - suthanthirakumar@ksrct.ac.in


**Course Designer(s) - Chemistry**


1. Dr.T.A.Sukantha – sukantha@ksrct.ac.in
2. Dr.B.Srividhya - srividyab@ksrct.ac.in
3. Dr.S.Meenachi - meenachi@ksrct.ac.in



Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023


CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**

**(An Autonomous Institution affiliated to Anna University)**

B.E. / B.Tech. Degree Programme

**SCHEME OF EXAMINATIONS**

(For the candidates admitted in 2024-2025)

**SECOND SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1. | 60 EN 002 | Professional English II | 2 | 40 | 60 | 100 | 45 | 100 |
| 2. | 60 MA 003 | Integrals, Partial Differential Equations and Laplace Transform | 2 | 40 | 60 | 100 | 45 | 100 |
| 3. | 60 ME 002 | Engineering Graphics | 2 | 40 | 60 | 100 | 45 | 100 |
| 4. | 60 ME 005 | Foundation of Mechanical Engineering | 2 | 40 | 60 | 100 | 45 | 100 |
| 5. | 60 EC 201 | Electronic Devices | 2 | 40 | 60 | 100 | 45 | 100 |
| 6. | 60 GE 002 | Tamils and Technology / தமிழரும் தொழில்நுட்பமும் | 2 | 40 | 60 | 100 | 45 | 100 |
| **PRACTICAL** | | | | | | | | |
| 7. | 61 ME 0P1 | Fabrication and Reverse Engineering Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 8. | 60 EC 2P1 | Electronic Devices Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 9. | 60 CG 0P1 | Career Skill Development – I | 2 | 100 | 00 | 100 | 00 | 100 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EN 002 | Professional English II | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | HS | 1 | 0 | 2 | 2 |

## Objectives

- To help learners improve their vocabulary and enable them to use words appropriately in different academic and professional contexts.
- To help learners develop strategies that could be adopted while reading texts.
- To help learners acquire the ability to speak and write effectively in English in real life and career related situations.
- Improve listening, observational skills, and problem-solving capabilities
- Develop message generating and delivery skills

## Pre-requisites

- Basic knowledge of reading and writing in English and should have completed Professional English I

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Compare and contrast products and ideas in technical texts. | Understand |
| CO2 | Illustrate cause and effects in events, industrial processes through technical texts | Understand |
| CO3 | Infer problems in order to arrive at feasible solutions and communicate them orally and in the written format. | Understand |
| CO4 | Relate events and the processes of technical and industrial nature. | Remember |
| CO5 | Demonstrate their opinions in a planned and logical manner, and draft effective résumés in context of job search. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO2 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO3 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO4 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO5 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 50 | 50 | 80 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R 2022**

**Common to All Branches**

**60 EN 002 – Professional English II**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| II | 1 | 0 | 2 | 45 | 2 | 40 | 60 | 100 |

| | |
|---|---|
| **Making Comparisons*** <br>**Listening:** Evaluative Listening: Advertisements, Product Descriptions – Audio / Video; Filling a Graphic Organiser (Choosing a Product or Service by Comparison) <br>**Speaking:** Marketing a Product, Persuasive Speech Techniques. <br>**Reading:** Reading Advertisements, User Manuals and Brochures. <br>**Writing:** Professional Emails, Email Etiquette - Compare and Contrast Essay. <br>**Language Focus:** Mixed Tenses, Prepositional Phrases, Same Words Used in Different Contexts and Discourse Markers | [9] |
| **Expressing Causal Relations in Speaking and Writing*** <br>**Listening:** Listening to Longer Technical Talks and Completing – Gap Filling Exercises. Listening Technical Information from Podcasts – Listening to Process/Event Descriptions to Identify Cause & Effects. <br>**Speaking:** Describing and Discussing the Reasons of Accidents or Disasters based on News Reports. <br>**Reading:** Longer Technical Texts – Cause and Effect Essays, and Letters / Emails of Complaint. <br>**Writing:** Writing responses to complaints <br>**Language Focus:** Active Passive Voice Transformations, Infinitive and Gerunds – Word Formation (Noun-Verb-Adj-Adv), Adverbs. | [9] |
| **Problem Solving*** <br>**Listening:** Listening to / Watching Movie Scenes/ Documentaries Depicting a Technical Problem and Suggesting Solutions. <br>**Speaking:** Group Discussion (based on Case Studies) – Techniques and Strategies. <br>**Reading:** Case Studies, Excerpts from Literary Texts, News Reports etc. <br>**Writing:** Letter to the Editor, Checklists, Problem Solution Essay / Argumentative Essay <br>**Language Focus:** Error Correction; If Conditional Sentences - Compound Words, Sentence Completion. | [9] |
| **Reporting of Events and Research*** <br>**Listening:** Listening Comprehension Based on New Report and Documentaries – <br>**Speaking:** Interviewing, Presenting Oral Reports, Mini Presentations on Select Topics. <br>**Reading:** Newspaper Articles. <br>**Writing:** Recommendations, Transcoding, Accident Report, Precis writing and Summarising, and Plagiarism <br>**Language Focus:** Reported Speech – Modals - Conjunctions- use of Prepositions | [9] |
| **The Ability to put Ideas or Information Coherently*** <br>**Listening:** Listening to TED Talks, Presentations, Formal job interviews, (Analysis of the Interview Performance). <br>**Speaking:** Participating in Role Plays, Virtual Interviews, Making Presentations with Visual Aids <br>**Reading:** Excerpts of Interview with Professionals <br>**Writing:** Job / Internship Application – Cover letter & Résumé <br>**Language Focus:** Numerical Adjectives, Question Types: Wh/ Yes or No/ and Tags; Relative Clauses - Idioms. | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**

| | |
|---|---|
| 1. | "English for Engineers & Technologists", Orient Blackswan Private Ltd. Department of English, Anna University, 2020. |
| 2. | Norman Lewis, "Word Power Made Easy - The Complete Handbook for Building a Superior Vocabulary Book", Penguin Random House India, 2020. |

**Reference(s):**

| | |
|---|---|
| 1. | Raman. Meenakshi, Sharma. Sangeeta, "Professional English", Oxford university press, New Delhi, 2019. |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | |
|---|---|
| 2. | Arthur Brookes and Peter Grundy, “Beginning to Write: Writing Activities for Elementary and Intermediate Learners”, Cambridge University Press, New York, 2003. |
| 3. | Prof. R.C. Sharma & Krishna Mohan, “Business Correspondence and Report Writing”, Tata McGraw Hill & Co. Ltd., New Delhi, 2001. |
| 4. | Arora.V.N and Laxmi Chandra, “Improve Your Writing”, Oxford University Press, New Delhi, 2001. |


* SDG 4 - Quality Education

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Making Comparisons** | |
| 1.1 | Evaluative Listening | 1 |
| 1.2 | Product Descriptions and Filling a Graphic Organiser | 1 |
| 1.3 | Marketing a Product by using Persuasive Techniques | 2 |
| 1.4 | Reading Advertisements, User Manuals and Brochures | 1 |
| 1.5 | Writing Professional Emails | 1 |
| 1.6 | Compare and Contrast Essay | 1 |
| 1.7 | Mixed Tenses and Prepositional Phrases | 1 |
| 1.8 | Same Words used in Different Contexts | 1 |
| **2** | **Expressing Causal Relations in Speaking and Writing** | |
| 2.1 | Listening to Longer Technical Talks | 1 |
| 2.2 | Listening to Process/Event Descriptions | 1 |
| 2.3 | Describing and Discussing the Reasons of Accidents or Disasters | 1 |
| 2.4 | Reading Longer Technical Texts – Cause and Effect Essays | 1 |
| 2.5 | Writing Responses to Complaints | 1 |
| 2.6 | Active Passive Voice Transformations | 2 |
| 2.7 | Infinitive and Gerunds | 1 |
| 2.8 | Word Formation (Noun-Verb-Adj-Adv), Adverbs. | 1 |
| 3 | **Problem Solving** | |
| 3.1 | Listening to Documentaries and Suggesting Solutions | 1 |
| 3.2 | Group Discussion (based on case studies) | 2 |
| 3.3 | Reading Case Studies, Excerpts from Literary Texts and News Reports | 1 |
| 3.4 | Letter to the Editor | 1 |
| 3.5 | Checklists | 1 |
| 3.6 | Problem Solution and Argumentative Essays | 1 |
| 3.7 | Error Correction and Sentence Completion | 1 |
| 3.8 | If Conditional Sentences | 1 |
| **4** | **Reporting of Events and Research** | |
| 4.1 | Listening Comprehension | 1 |
| 4.2 | Interviewing and Presenting Oral Reports | 1 |
| 4.3 | Mini Presentations on Select Topics | 1 |
| 4.4 | Reading Newspaper Articles | 1 |
| 4.5 | Recommendations | 1 |
| 4.6 | Transcoding | 1 |
| 4.7 | Precis Writing, Summarising and Plagiarism | 1 |
| 4.8 | Reported Speech, Modals | 1 |
| 4.9 | Conjunctions | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5 | **The Ability to put Ideas or Information Coherently** | |
| 5.1 | Listening to Formal Job Interviews | 1 |
| 5.2 | Role Plays | 2 |
| 5.3 | Virtual Interviews | 1 |
| 5.4 | Reading Company Profiles | 1 |
| 5.5 | Writing Statement of Purpose (SoPs) | 1 |
| 5.6 | Writing Résumé | 1 |
| 5.7 | Numerical Adjectives and Relative Clauses - Idioms | 1 |
| 5.8 | Question types: Wh/ Yes or No/ and Tags | 1 |

**Course Designer(s)**

1. Dr.A.Palaniappan - palaniappan@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 MA 003 | Integrals, Partial Differential Equations and Laplace Transform | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | BS | 3 | 1 | 0 | 4 |

## Objectives

- To acquire the knowledge about multiple integrals.
- To familiarize the basic concepts of vector calculus.
- To get exposed to the fundamentals of analytic functions.
- To solve various types of partial differential equations.
- To familiarize the concepts of Laplace transform.

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Interpret the basic concepts of double and triple integrals. | Apply |
| CO2 | Interpret the basic concepts of vector calculus. | Apply |
| CO3 | Construct the Analytic functions and evaluate the complex integrals. | Apply |
| CO4 | Compute the solutions of partial differential equations using different methods. | Apply |
| CO5 | Apply Laplace transform techniques for solving differential equations. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO3 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO4 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO5 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 20 |
| Apply | 40 | 40 | 70 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R 2022**

**Common to Mech, ECE, EE, EEE, CSE, MCT, CIVIL, IT, TXT, BT, FT**

**60 MA 003 – Integrals, Partial Differential Equations and Laplace Transform**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 1 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Multiple Integrals**<br>Double integration – Cartesian and Polar Co-ordinates – Change of Order of Integration – Area as Double Integral – Triple Integration in Cartesian Co-ordinates – Change of Variables - Cartesian to Polar Co-ordinates and Cartesian to Cylindrical Co-ordinates.<br>**Hands - on:**<br>Evaluating double integrals, triple integrals, area as double integrals and volume as triple integrals | [9] |
| **Vector Calculus***<br>Introduction - Gradient of a Scalar Point Function –Directional Derivative – Angle of Intersection of Two Surfaces – Divergence and Curl (excluding vector identities) – Solenoidal and irrotational Vectors – Application: Green's Theorem in the Plane – Gauss Divergence Theorem -Stokes' Theorem (statement only).<br>**Hands – on:**<br>Evaluating gradient, divergence and curls. | [9] |
| **Analytic Functions and Integrals**<br>Analytic Function – Necessary and Sufficient Conditions (statement only)-Properties – Harmonic Function – Construction of an Analytic Function – Cauchy's Integral Theorem (statement only) – Cauchy's Integral Formula – Classification of Singularities – Application: Cauchy's Residue Theorem.<br>**Hands - on:**<br>Plotting and visualizing functions of single variable, two and three variables. | [9] |
| **Partial Differential Equations***<br>Formation of Partial Differential Equations by Eliminating Arbitrary Constants and Arbitrary Functions – Non- Linear Partial Differential Equations of First Order – Lagrange's Linear Equations – Application: Homogeneous Linear Partial Differential Equations with Constant Coefficients.<br>**Hands - on:**<br>Calculate homogeneous linear partial differential equations. | [9] |
| **Laplace Transform**<br>Conditions for Existence – Transforms of Elementary Functions – Basic Properties – Derivatives and Integrals of Transforms – Initial and Final Value Theorem – Transform of Periodic Functions. Inverse Laplace Transform – Convolution Theorem (excluding proof) – Application: Solution of Second Order Ordinary Differential Equations with Constant Co-efficients.<br>**Hands – on:**<br>Evaluating Laplace, inverse Laplace Transforms and solve differential equations | [9] |
| **Total Hours (Lecture - 45; Hands-on - 05; Tutorial - 10):** | **60** |

**Text Book(s):**


1. Grewal B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2017.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Limited,New Delhi, 2016.


**Reference(s):**


1. Dass H.K, "Higher Engineering Mathematics", 3rd (Revised) Edition, S.Chand& Company Ltd, New Delhi, 2014.
2. Veerarajan T, "Engineering Mathematics", for Semesters I & II, 1st Edition, Tata McGraw Hill Publishing Co., New Delhi, 2019.
3. Kandasamy P, Thilagavathy K and Gunavathy K, "Engineering Mathematics - I", S.Chand& Company Ltd, New Delhi, 2017
4. Bali N P and Manish Goyal, A text book of Engineering Mathematics",10th Edition, Laxmi Publications(P) Ltd, 2016.


* SDG 4 – Quality Education

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S.No | Topic | No. of Hours |
|---|---|---|
| **1** | **Multiple Integrals** | |
| 1.1 | Double Integration | 1 |
| 1.2 | Cartesian and Polar Coordinates | 1 |
| 1.3 | Change of Order of Integration | 1 |
| 1.4 | Area as Double Integral | 1 |
| 1.5 | Triple Integration in Cartesian Coordinates | 1 |
| 1.6 | Change of Variables | 2 |
| 1.7 | Cartesian to Polar Coordinates | 1 |
| 1.8 | Cartesian to Cylindrical Coordinates | 1 |
| 1.9 | Tutorial | 2 |
| 1.10 | Hands-on | 1 |
| **2** | **Vector Calculus** | |
| 2.1 | Introduction: Gradient of a Scalar Point Function | 1 |
| 2.2 | Directional Derivative | 1 |
| 2.3 | Angle of Intersection of Two Surfaces | 1 |
| 2.4 | Divergence and Curl (Excluding Vector Identities) | 1 |
| 2.5 | Solenoidal and Irrotational Vectors | 1 |
| 2.6 | Application: Green's Theorem in The Plane | 1 |
| 2.7 | Gauss Divergence Theorem | 2 |
| 2.8 | Stokes' Theorem (Statement Only) | 1 |
| 2.9 | Tutorial | 2 |
| 2.10 | Hands-on | 1 |
| **3** | **Analytic Functions and Integrals** | |
| 3.1 | Analytic Function | 1 |
| 3.2 | Necessary and Sufficient Conditions (Statement Only) | 1 |
| 3.3 | Properties | 1 |
| 3.4 | Harmonic Function | 1 |
| 3.5 | Construction of an Analytic Function | 1 |
| 3.6 | Cauchy's Integral Theorem (Statement Only), Cauchy's Integral Formula | 2 |
| 3.7 | Classification of Singularities | 1 |
| 3.8 | Applications: Cauchy's Residue Theorem. | 1 |
| 3.9 | Tutorial | 2 |
| 3.10 | Hands-on | 1 |
| **4** | **Partial Differential Equations** | |
| 4.1 | Formation of Partial Differential Equations by Eliminating Arbitrary Constants | 1 |
| 4.2 | Formation of Partial Differential Equations by Eliminating Arbitrary Functions | 2 |
| 4.3 | Non- Linear Partial Differential Equations of First Order | 3 |
| 4.4 | Lagrange's Linear Equations | 1 |
| 4.5 | Application: Homogeneous Linear Partial Differential Equations with Constant Coefficients. | 2 |
| 4.6 | Tutorial | 2 |
| 4.7 | Hands-on | 1 |
| **5** | **Laplace Transform** | |
| 5.1 | Conditions for existence | 1 |
| 5.2 | Transforms of Elementary Functions | 1 |
| 5.3 | Basic Properties | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.5 | Derivatives and Integrals of Transforms, Initial and Final Value Theorem | 1 |
| 5.6 | Transform of Periodic Functions | 1 |
| 5.7 | Inverse Laplace Transform | 1 |
| 5.8 | Convolution Theorem (Excluding Proof) | 1 |
| 5.9 | Application: Solution of Second Order Ordinary Differential Equation with Constant Co-Efficient. | 2 |
| 5.10 | Tutorial | 2 |
| 5.11 | Hands-on | 1 |

**Course Designer(s)**


1. Dr. C. Chandran – cchandran@ksrct.ac.in
2. Dr. K. Prabakaran – prabakaran@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 ME 002 | Engineering Graphics | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ES | 2 | 0 | 4 | 4 |

## Objectives

- To acquire various concepts of dimensioning, conventions and standards.
- To impart the graphic skills for converting pictorial views of solids in to orthographic views.
- To learn the concept in projection of solids, section of solids and development of different types of surfaces.
- To learn the concept of isometric projection.
- To learn the geometry and topology of engineered components

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Demonstrate the Impact of computer technologies on graphical communication | Apply |
| CO2 | Convert the pictorial views in to orthographic views using drafting software | Apply |
| CO3 | Draw the projection of simple solids, true shape of sections and development of surfaces | Apply |
| CO4 | Construct the isometric projections of objects using drafting software. | Apply |
| CO5 | Interpret a design project illustrating engineering graphical skills. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 3 | - | - | - | - | - | - | - | - | - | 2 | 3 | - |
| CO2 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 2 | 3 | - |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | - | - | - | - | 2 | 3 | - |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | - | - | - | - | 2 | 3 | - |
| CO5 | 3 | 3 | 3 | - | - | - | - | | - | - | - | - | 2 | 3 | - |

3 - Strong; 2 - Medium; 1 - Some

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 20 | 20 | 30 |
| Apply | 30 | 30 | 50 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to All Branches**

**60 ME 002 - Engineering Graphics**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| II | 2 | 0 | 4 | 90 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Introduction to Computer Aided Drafting (CAD) Software*** <br> Theory of CAD Software - Menu System, Tool Bars (Standard, Object Properties, Draw, Modify and Dimension) - Drawing Area (Background, Crosshairs, Coordinate System) - Dialog Boxes and Windows - Shortcut Menus (Button Bars) - The Command Line and Status Bar - Different Methods of Zoom - Select and Erase Objects. | [6+12] |
| **Orthographic Projection*** <br> Theory of Projection - Terminology and Methods of Projection - First Angle and Third Angle Projection - Conversion of Pictorial Views into Orthographic Views | [6+12] |
| **Projection of Solids and Sections of Solids*** <br> Projections of Simple Solids: Prism, Pyramid, Cylinder and Cone (Axis Parallel to One Plane and Perpendicular to Other, Axis Inclined to One Plane and Parallel to Other). Sections of Simple Solids: Prism, Pyramid, Cylinder and Cone in Simple Positions (Cutting Plane Is Inclined to One of The Principal Planes and Perpendicular to The Other) – True Shape of Sections <br> **Development of Surfaces*** <br> Principle of Development-Methods of Development: Parallel Line Development-Cube, Prism and Cylinder. Radial Line Development - Pyramid and Cone | [6+12] |
| **Isometric Projection*** <br> Principles of Isometric Projection - Isometric Scale, Isometric Views, Conventions - Isometric Views of Lines, Planes, Simple and Compound Solids - Conversion of Orthographic Views in to Isometric View | [6+12] |
| **Application of Engineering Graphics*** <br> Geometry and Topology of Engineered Components: Creation of Engineering Models and Their Presentation in Standard 2D Blueprint Form, 3D Wire - Frame and Shaded Solids - Geometric Dimensioning and Tolerance - Use of Solid Modelling Software for Creating Associative Models - Floor Plans: Windows, Doors, and Fixtures such as Water Closet (WC), Bath Sink, Shower, etc. - Applying Colour Coding According to Building Drawing Practice - Drawing Sectional Elevation Showing Foundation to Ceiling – Introduction to Building Information Modelling (BIM). | [6+12] |
| **Total Hours: (Lecture - 30; Practical - 60)** | **90** |

**Text Book(s):**

| | |
|---|---|
| 1. | Bhatt N.D, "Engineering Drawing", 53rd Edition, Charotar Publishing House Pvt. Ltd., Gujarat, 2019. |
| 2. | Venugopal K., "Engineering Graphics", New Age International (P) Limited, 2014. |

**Reference(s):**

| | |
|---|---|
| 1. | Shah M.B, Rana B.C., and V.K.Jadon., "Engineering Drawing", Pearson Education, 2011. |
| 2. | Natarajan K.V, "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2014. |
| 3. | Agrawal B. &Agrawal C. M, "Engineering Graphics", TMH Publication, 2012. |
| 4. | Narayana, K.L & Kannaiah p, "Text Book on Engineering Drawing", Scitech Publishers, 2008. |

*SDG 9 – Industry Innovation and Infrastructure

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. Of Hours |
|---|---|---|
| **1** | **Introduction to Computer Aided Drafting (CAD) Software** | |
| 1.1 | Theory of CAD Software | 1 |
| 1.2 | Menu System, Tool bars (Standard, Object Properties, Draw, Modify and Dimension) | 4 |
| 1.3 | Drawing Area (Background, Crosshairs, Coordinate System) | 4 |
| 1.4 | Dialog Boxes and Windows – Shortcut Menus | 4 |
| 1.5 | The Command Line and Status Bar | 1 |
| 1.6 | Different Methods of Zoom – Select and Erase Objects. | 4 |
| **2** | **Orthographic Projection** | |
| 2.1 | Introduction to Orthographic Projections | 2 |
| 2.2 | Planes of Projection | 2 |
| 2.3 | Projection of Points | 2 |
| 2.4 | Projection of Lines Inclined to Both Planes | 2 |
| 2.5 | Projection of Planes | 2 |
| 2.6 | Projection of Planes Inclined to Both Planes | 2 |
| 2.7 | Conversions of Pictorial Views to Orthographic Views | 2 |
| 2.8 | Practice Class for Pictorial Views to Orthographic Views | 2 |
| 2.9 | Practice Class for Pictorial Views to Orthographic Views | 2 |
| **3** | **Projection of Solids** | |
| 3.1 | Projections of Simple Solids: Prism | 1 |
| 3.2 | Projections of Simple Solids: Cylinder | 1 |
| 3.3 | Projections of Simple Solids: Pyramid | 1 |
| 3.4 | Projections of Simple Solids: Cone | 1 |
| 3.5 | Practice Class for Projection of Solids | 1 |
| 3.6 | Axis of Solid Inclined to Both HP And VP | 2 |
| 3,7 | Section of Solids for Prism | 1 |
| 3,8 | Section of Solids for Cylinder | 1 |
| 3,9 | Section of Solids for Pyramid | 1 |
| 3,10 | Section of Solids for Cone | 1 |
| 3,11 | Auxiliary Views - Draw the Sectional Orthographic Views of Geometrical Solids | 2 |
| 3.12 | Draw The Sectional Orthographic Views of Objects from Industry | 1 |
| 3,13 | Development of Surfaces of Right Solids Prism | 1 |
| 3.14 | Development of Surfaces of Right Solids Pyramid | 1 |
| 3.15 | Development of Surfaces of Right Solids Cylinder and Cone | 2 |
| **4** | **Isometric Projection and Introduction to Autocad** | |
| 4.1 | Principles of Isometric Projection | 2 |
| 4.2 | Isometric Scale | 2 |
| 4.3 | Isometric Projections of Simple Solids: Prism, | 2 |
| 4.4 | Isometric Projections of Simple Solids: Pyramid, | 2 |
| 4.5 | Isometric Projections of Simple Solids: Cylinder | 2 |
| 4.6 | Isometric Projections of Simple Solids: Cone | 2 |
| 4.7 | Isometric Projections of Frustum | 2 |
| 4.8 | Isometric Projections of Truncated Solids | 2 |
| 4.9 | Combination of Two Solid Objects in Simple Vertical Positions | 2 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5 | **Application of Engineering Graphics** | |
| 5.1 | Geometry and Topology of Engineered Components: | 2 |
| 5.2 | Creation Of Engineering Models and Their Presentation in Standard 2D Blueprint Form, | 2 |
| 5.3 | 3D Wire-Frame and Shaded Solids – Geometric Dimensioning and Tolerance – Use of Solid Modeling Software for Creating Associative Models | 4 |
| 5.4 | Floor Plans: Windows, Doors, And Fixtures Such as Water Closet (WC), Bath Sink, Shower, etc. | 2 |
| 5.5 | Applying Colour Coding According to Building Drawing Practice | 2 |
| 5.6 | Drawing Sectional Elevation Showing Foundation to Ceiling | 4 |
| 5.7 | Introduction to Building Information Modelling (BIM). | 2 |

**Course Designer(s)**

1. Dr.K.Mohan - mohank@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 ME 005 | Foundation of Mechanical Engineering | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ES | 3 | 0 | 0 | 3 |

## Objectives

- To learn a process for analysis of static objects, concepts of force and motion of particles.
- To acquire knowledge on thermodynamics process, laws and entropy.
- To impart the concept of heat transfer mechanism through simple and composite geometries
- To learn the concept of refrigeration & Air-conditioning with its application.
- To identify the different sources of energy and to know the working principle of power plants

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Apply basic knowledge on static and dynamic systems. | Apply |
| CO2 | Explain thermodynamic systems, properties and laws of thermodynamics. | Apply |
| CO3 | Apply the principles of basic modes of heat transfer in solving heat transfer problems. | Apply |
| CO4 | Identify the types of refrigeration and air-conditioning systems and explain its working principles. | Understand |
| CO5 | Classify sources of energy and demonstrate method of power generation. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | - | - | - | 2 | - | - | - | - | 3 | 3 | - |
| CO2 | 3 | 3 | - | - | - | - | - | 2 | - | - | - | - | 3 | 3 | - |
| CO3 | 3 | 3 | - | - | - | - | - | 2 | - | - | - | - | 3 | 3 | - |
| CO4 | 3 | 3 | - | - | - | - | - | 2 | 3 | 3 | - | - | 3 | 3 | - |
| CO5 | 3 | 3 | - | - | - | - | - | 2 | 3 | 3 | - | - | 3 | 3 | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 40 | 40 | 60 |
| Apply | 10 | 10 | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R 2022**

**Common to ECE and EE**

**60 ME 005 – Foundation of Mechanical Engineering**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Basics of Statics and Dynamics of Particles**<br>Introduction – Units and Dimensions-Laws of Mechanics – Principle of Transmissibility-Lame's Theorem, Parallelogram and Triangular Law of Forces. Displacement, Velocity, Acceleration and their Relationship – Relative Motion. | [9] |
| **Thermodynamics – Laws and Entropy**<br>Basic concepts – Thermodynamic Systems – Laws of Thermodynamics: Zeroth law of Thermodynamics, First law of thermodynamics – Second law of Thermodynamics – Cyclic heat engine, heat pump, Carnot cycle - Entropy. | [9] |
| **Heat Transfer**<br>Introduction – Modes of Heat Transfer: Conduction, Convection and Radiation – Laws of Conduction – Types of Convection – Laws of Radiation – Radiation Shields – Fourier Law of Heat Conduction in Simple and Composite Wall Geometrics, Types of Boundary and Initial Conditions – Fins: Types – Fin Efficiency. | [9] |
| **Refrigeration and Air-Conditioning****<br>Introduction – Terminology of Refrigeration and Air Conditioning Systems – Working Principle of Vapour Compression and Absorption System – Layout of Typical Domestic Refrigerator. Window, Split and Central Air Conditioners. | [9] |
| **Sources of Energy* and Power Plants*****<br>Introduction – Energy- Classification of Energy Sources – Conventional Energy Sources: Working Principle of Thermal, Gas, Diesel, Hydro-Electric and Nuclear Power Plants. Non – Conventional Energy Sources: Working Principle of Solar, Wind, Tidal and Geothermal Power Plants. | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**


| | |
|---|---|
| 1. | Pravin Kumar, ''Basic Mechanical Engineering", 2nd Edition, Pearson India Education Services Pvt. Ltd, Chennai, 2018. |
| 2. | Rajasekaran, S., Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", 3rd Edition Vikas Publishing House Pvt. Ltd., 2017. |


**Reference(s):**


| | |
|---|---|
| 1. | YunusA.Cengel, ''Heat Transfer: A Practical Approach'', 2nd Edition, Mc graw-Hill, 2002. |
| 2. | Arora.C.P., ''Refrigeration and Airconditioning'', 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2008. |
| 3. | Arora, S. C., Domkundwar.S., ''A Course in Power Plant Engineering'', Dhanpatrai& Co., New Delhi, 2014. |
| 4. | Jayakumar, V. and Kumar, M, ''Engineering Mechanics'', PHI Learning Private Ltd, New Delhi, 2012. |


*SDG 9 – Industry Innovation and Infrastructure

**SDG 3 – Good Health and Well Being

***SDG 12 – Responsible Consumption and Production

Passed in BoS Meeting held on 13/05/2023

Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| 1.0 | **Basics of Statics and Dynamics of Particles** | |
| 1.1 | Introduction -Units and Dimensions | 1 |
| 1.2 | Laws of Mechanics–Principle of Transmissibility | 1 |
| 1.3 | Lame ‘s Theorem | 1 |
| 1.4 | Parallelogram Law of forces | 1 |
| 1.5 | Triangular Law of forces | 1 |
| 1.6 | Displacement, Velocity, Acceleration and their Relationship | 2 |
| 1.7 | Relative Motion | 2 |
| 2.0 | **Thermodynamics – Laws and Entropy** | |
| 2.1 | Basic Concepts – Thermodynamic Systems | 2 |
| 2.2 | Laws of Thermodynamics: Zeroth Law of Thermodynamics, First Law of Thermodynamics | 2 |
| 2.3 | Laws of Thermodynamics: Second law of Thermodynamics | 1 |
| 2.4 | Cyclic Heat Engine and Heat Pump | 2 |
| 2.5 | Carnot Cycle and Entropy | 2 |
| 3.0 | **Heat Transfer** | |
| 3.1 | Introduction to Heat Transfer | 1 |
| 3.2 | Modes of Heat Transfer: Conduction, Convection and Radiation | 1 |
| 3.3 | Laws of Conduction - Types of Convection– Laws of Radiation | 1 |
| 3.4 | Radiation Shields | 1 |
| 3.5 | Fourier Law of Heat Conduction in Simple Wall | 1 |
| 3.6 | Fourier Law of Heat Conduction in Composite Wall | 1 |
| 3.7 | Types of Boundary and Initial Conditions | 1 |
| 3.8 | Fins: Types and Efficiency | 2 |
| **4.0** | **Refrigeration and Air-Conditioning** | |
| 4.1 | Introduction to Refrigeration and Air-Conditioning and its Terminology | 2 |
| 4.2 | Working Principle of Vapour Compression | 1 |
| 4.3 | Working Principle of Absorption System | 1 |
| 4.4 | Layout of typical Domestic Refrigerator | 2 |
| 4.5 | Window and Split air Conditioners. | 2 |
| 4.6 | Central Air Conditioners | 1 |
| 5.0 | **Sources of Energy and Power Plants** | |
| 5.1 | Introduction to Energy Resources and Classification | 1 |
| 5.2 | Working Principle of Thermal and Gas Power Plants | 2 |
| 5.3 | Working Principle of Diesel and Hydro-Electric Power Plants | 2 |
| 5.4 | Nuclear Power Plants | 1 |
| 5.5 | Working Principle of Solar and Wind Power Plants | 2 |
| 5.6 | Tidal and Geothermal Power Plants. | 1 |

**Course Designer(s)**


1. Dr.A.Murugesan – murugesana@ksrct.ac.in
2. Mr.M.Gnanaseakran – gnanasekaran@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 201 | Electronic Devices<br>Common to ECE and EE | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objectives

- To understand the physics of junction diodes and to learn to implement them in various applications
- To learn different configurations of BJT and FET and applications of MOSFET
- To identify the use of various transducers and sensors.
- To study the construction and operation of various opto devices
- To familiarize the operation of power devices and convertors

## Pre-requisites

- Physics for Electrical Engineering

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Construct circuits with diodes for various applications | Apply |
| CO2 | Discuss the operation of transistors and their configurations | Understand |
| CO3 | Identify the type of transducers and sensors used for various application | Understand |
| CO4 | Explain the operation of various opto devices | Understand |
| CO5 | Discuss the operation of power electronics devices and convertors and their applications | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | - | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | - | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 2 | - | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | - | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 50 |
| Understand | 40 | 50 | 40 |
| Apply | 10 | - | 10 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R 2022**

**Common to ECE and EE**

**60 EC 201 – Electronic Devices**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Diodes*** <br> PN junction Diode – Current Voltage Characteristics and Analysis, Diode Logic Gates, Modelling the Diode Forward Characteristics – Graphical Analysis, Small Signal model, Zener Diode, Varactor Diode and Diode applications. <br> **Hands - on:** <br> 1. Simulation of VI characteristics of PN junction diode | [9] |
| **Transistors*** <br> Construction and Operation of a Transistor, Input and Output Characteristics of a Transistor in CE Configuration, Operation of CB and CC Configurations, Construction and Characteristics of n Channel JFET, Basic MOSFET Operation, Characteristics of Depletion type MOSFET and Enhancement type MOSFET and **MOSFET applications.**** <br> **Hands - on:** <br> 1. Simulation of input- output characteristics of BJT <br> 2. Simulation of I-V characteristics of MOSFET | [9] |
| **Transducers and Sensors*** <br> Classification of Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Noise introduced by transducers and their reduction. smart sensors, fiber optic sensors, MEMS, Ultrasonic Sensors and their typical applications | [9] |
| **Opto Devices*** <br> Introduction, Photo Emitters, **LASER, LED, Photoconductive Cell, Opto Coupler, Solid State Relays (light operated relay) and Optical Fibre***.** | [9] |
| **Power Devices and Convertors*** <br> Construction and Operation of Switching Devices – **SCR, MOSFET and IGBT**** – Static characteristics of SCR – Switching Mode Regulators: **Buck regulator, Boost regulator, Buck-Boost Regulators, Chopper***** | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**

| | |
|---|---|
| 1. | Anil K. Maini, Varsha Agrawal, ''Electronics Devices and Circuits'', 2nd Edition, Wiley India Pvt.Ltd, 2019. |
| 2. | Patranabis. D, "Sensors and Transducers", Prentice Hall of India, 1999. |
| 3. | Mohammad H Rashid, "Power Electronics, Circuits, Devices and Applications", 3rd /4th Edition, Pearson Education Inc, 2014, ISBN: 978-93-325-1844-5. |

**Reference(s):**

| | |
|---|---|
| 1. | Robert L. Boylestad, Louis Nashelsky, ''Electronic Devices and circuit theory'',11th Edition, Pearson Education, 2017. |
| 2. | Singh M.D and Khanchandani K.B, "Power Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009. |
| 3. | Umanand L, "Power Electronics, Essentials and Applications", John Wiley India Pvt. Ltd, 2009. |
| 4. | Dr. P. S. Bimbhra, "Power Electronics", Khanna Publishers, Delhi, 2012. |

*SDG 4 - Quality Education

**SDG 8 - Decent work and economic growth

***SDG 9 - Industry innovation and Infrastructure

**Assignment activity:**

Assignment 1 Covers Module 1 & 2:

1. Problems on PN junction diode, Relation between α &β of the BJT, parameters of JFET.
2. Simulation on diode logic gates and diode applications like two way clipper, voltage tripler, Zener diode as voltage regulator using Multisim.

Assignment 2 Covers Module 3,4 & 5:

1. Problems on Resistive, Capacitive, Inductive and Hall Effect transducers, LED and optical fibre.
2. Simulate MOSFET model and describe the switching application of MOSFET with its IV characteristics using Simulink.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S.No | Topic | No. of Hours |
|---|---|---|
| **1** | **Diodes** | |
| 1.1 | PN Junction Diode | 1 |
| 1.2 | Current Voltage Characteristics and Analysis | 1 |
| 1.3 | Diode Logic Gates | 1 |
| 1.4 | Modelling the Diode Forward Characteristics | 1 |
| 1.5 | Graphical Analysis, Small Signal Model | 1 |
| 1.6 | Zener Diode | 1 |
| 1.7 | Varactor Diode | 1 |
| 1.8 | Diode Applications | 2 |
| **2** | **Transistors** | |
| 2.1 | Construction and Operation of a Transistor | 1 |
| 2.2 | Input and Output Characteristics of a Transistor in CE Configuration | 1 |
| 2.3 | Operation of CB and CC Configurations | 1 |
| 2.4 | Construction and Characteristics of n Channel JFET | 1 |
| 2.5 | Basic MOSFET Operation | 1 |
| 2.6 | Characteristics of Depletion type MOSFET | 1 |
| 2.7 | Characteristics of Enhancement type MOSFET | 1 |
| 2.8 | MOSFET applications | 2 |
| **3** | **Transducers and Sensors** | |
| 3.1 | Classification of Transducers | 1 |
| 3.2 | Transducers Actuating Mechanisms | 1 |
| 3.3 | Resistance Transducers, Variable Inductance Transducers | 1 |
| 3.4 | Capacitive Transducers, Piezoelectric Transducers | 1 |
| 3.5 | Hall Effect Transducers | 1 |
| 3.6 | Noise Introduced by Transducers and their Reduction | 1 |
| 3.7 | Smart Sensors, Fiber Optic Sensors, MEMS | 1 |
| 3.8 | Ultrasonic Sensors | 1 |
| 3.9 | Applications | 1 |
| **4** | **Optodevices** | |
| 4.1 | Introduction | 1 |
| 4.2 | Photo Emitters | 1 |
| 4.3 | LASER. | 1 |
| 4.4 | LED | 1 |
| 4.5 | Photoconductive Cell | 1 |
| 4.6 | Opto Coupler | 1 |
| 4.7 | Solid State Relays (light operated relay) | 1 |
| 4.8 | Optical Fibre | 2 |
| **5** | **Power Devices and Convertors** | |
| 5.1 | Construction and Operation of Switching Devices - SCR | 2 |
| 5.2 | MOSFET. | 1 |
| 5.3 | IGBT | 1 |
| 5.5 | Static Characteristics of SCR | 1 |
| 5.6 | Switching Mode Regulators: Buck Regulator | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.7 | Boost Regulator | 1 |
| 5.8 | Buck-Boost Regulators | 1 |
| 5.9 | Chopper | 1 |

**Course Designer(s)**


1. Dr.K.B.Jayanthi – jayanthikb@ksrct.ac.in
2. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 GE 002 | தமிழரும் தொழில்நுட்பமும் (அனைத்து துறைகளுக்கும் பொதுவானது) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | GE | 1 | 0 | 0 | 1 |

பாடத்தின் நோக்கங்கள்:

- தமிழர்களின் சங்ககால நெசவு, பானை வனைதல் குறித்து அறிதல்.
- தமிழர்களின் கட்டிடத் தொழில் நுட்பம் குறித்து அறிதல்.
- தமிழர்களின் உற்பத்தி முறைகள் குறித்து அறிதல்.
- தமிழர்களின் சங்ககால வேளாண்மை, நீர்ப்பாசனம் குறித்து கற்றல்.
- நவீன அறிவியல் தமிழ் மற்றும் கணித்தமிழ் குறித்த புரிதல்.

முன்கூட்டிய துறைசார் அறிவு:

- தேவை இல்லை

பாடம் கற்றதின் விளைவுகள்:

பாடத்தை வெற்றிகரமாக கற்று முடித்த பின்பு, மாணவர்களால் முடியும் விளைவுகள்

| | | |
|---|---|---|
| CO1 | சங்ககாலத் தமிழர்களின் நெசவு மற்றும் பானை வனைதல் தொழில்நுட்பம் குறித்த கற்றுணர்தல். | புரிதல் |
| CO2 | சங்ககாலத் தமிழர்களின் கட்டிட தொழில்நுட்பம் கட்டுமானப் பொருட்கள் மற்றும் அவற்றை விளக்கும் தளங்கள் குறித்த அறிவு. | புரிதல் |
| CO3 | சங்ககாலத் தமிழர்களின் உலோகத் தொழில் நாணயங்கள் மற்றும் மணிகள் சார்ந்த தொல்லியல் சான்றுகள் பற்றிய அறிவு. | புரிதல் |
| CO4 | சங்ககாலத் தமிழர்களின் வேளாண்மை, நீர்ப்பாசன முறைகள் மற்றும் முத்து குளித்தல் குறித்த தெளிவு. | புரிதல் |
| CO5 | நவீன அறிவியல் தமிழ் மற்றும் கணித்தமிழ் குறித்த புரிந்துகொள்ளலும் மற்றும் பயன்படுத்துதலும். | செயல்படுத்துதல் |

**Mapping with Programme Outcomes**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | - | - | - | - | - | - | 3 | 3 | 3 | 2 | - | 3 | - | - | 3 |
| CO2 | 3 | - | - | - | - | - | 2 | 3 | 2 | 2 | - | 3 | - | - | 3 |
| CO3 | 3 | - | - | - | - | - | 3 | 3 | 3 | 2 | - | 3 | - | - | 3 |
| CO4 | 3 | - | - | - | - | 2 | 3 | 3 | 2 | 2 | - | 3 | - | - | 3 |
| CO5 | 3 | - | - | - | 3 | - | - | 3 | - | 3 | - | 3 | - | - | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Test (Marks) | End Semester Examination (Marks) |
|---|---|---|
| Remember | 40 | 40 |
| Understand | 40 | 40 |
| Apply | 20 | 20 |
| Analyze | - | - |
| Evaluate | - | - |
| Create | - | - |
| Total | 100 | 100 |

**Note**: Those who **studied Tamil as language subject in +2** should write the exams (CA Test and End Semester Exams) **in** Tamil Language only. Those who **did not study Tamil as language subject in +2** and **other state students** can write the exams in English Language. It is mandatory.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K. S. Rangasamy College of Technology – Autonomous R2022**

(அனைத்து துறைகளுக்கும் பொதுவானது)

**60 GE 002 – தமிழரும் தொழில்நுட்பமும்**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| II | 1 | 0 | 0 | 15 | 1# | 40 | 60 | 100 |

| | |
|---|---|
| **நெசவு மற்றும் பானைத் தொழில்நுட்பம்*** <br> சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள். | [3] |
| **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்*** <br> சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கல் - நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை. | [3] |
| **உற்பத்தித் தொழில் நுட்பம்*** <br> கப்பல் கட்டும் கலை – உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் , கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள். | [3] |
| **வேளாண்மை மற்றும் நீர்பாசனத் தொழில் நுட்பம்*** <br> அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்கான வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம். | [3] |
| **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்*** <br> அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம். | [3] |
| **Total Hours:** | **15** |

**Text Book(s):**

| | |
|---|---|
| 1. | முனைவர் கே. கே. பிள்ளை, "தமிழக வரலாறு - மக்களும் பண்பாடும்", தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 18th Edition, 2022. |
| 2. | முனைவர் இல. சுந்தரம், "கணினித்தமிழ்",விகடன் பிரசுரம், 2nd Edition, 2021. |
| 3. | முனைவர் இரா.சிவானந்தம், மு.சேரன், "கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்", தொல்லியல் துறை வெளியீடு, 6th Edition, 2020. |
| 4. | முனைவர் இரா.சிவானந்தம் , முனைவர் ஜெ.பாஸ்கர், "பொருநை - ஆற்றங்கரை நாகரிகம்", தொல்லியல் துறை வெளியீடு,1st Edition, 2022. |
| 5. | Dr.Pillay K.K, "Social Life of Tamils", TNTB & ESC and RMRL – (In print). |
| 6. | Dr.Singaravel.S, "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies, 1st Edition, 2001. |
| 7. | Dr.Subaramanian S.V, Dr.Thirunavukkarasu K.D, "Historical Heritage of the Tamils", International Institute of Tamil Studies, 2nd Edition, 2010. |
| 8. | Dr.Valarmathi M, "The Contributions of the Tamils to Indian Culture", International Institute of Tamil Studies. |
| 9. | Dr.Sivanantham R, "Keeladi - Sangam City Civilization on the banks of river Vaigai", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation. |
| 10. | Dr.Pillay K.K, "Studies in the History of India with Special Reference to Tamil Nadu", K.K. Pillay( Published by the Author. |
| 11. | Dr.Sivanantham R, Dr.Baskar J, "Porunai Civilization", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation. |
| 12. | Balakrishnan R, "Journey of Civilization Indus to Vaigai", Roja Muthiah Research Library,3rd Edition, 2022. |

*SDG 4 – Quality Education

# For Tamils and Technology, additional 1 credit is offered and not accounted for CGPA.

Passed in BoS Meeting held on 13/05/2023

Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K. S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Common to all Branches** | | | | | | | | |
| **60 GE 002 – Tamils and Technology** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| II | 1 | 0 | 0 | 15 | 1# | 40 | 60 | 100 |

| | |
|---|---|
| **Weaving and Ceramic Technology*** Weaving Industry during Sangam Age – Ceramic Technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries. | [3] |
| **Design and Construction Technology*** Designing and Structural construction House & Designs in Household Materials during Sangam Age – Building Materials and Hero Stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other Worship places – Temples of Nayaka Period – Type Study (Madurai Meenakshi Temple)- ThirumalaiNayakar Mahal – Chetti Nadu Houses , Indo – Saracenic Architecture at Madras during British Period. | [3] |
| **Manufacturing Technology*** Art of Ship Building – Metallurgical studies – Iron Industry – Iron smelting ,Steel - Copper and Gold Coins as Source of History – Minting of Coins – Beads Making – Industries Stone Beads – Glass beads – Terracotta beads – Shell beads/Bone beats – Archeological evidences - Gem stone types Described in Silappathikaram. | [3] |
| **Agriculture and Irrigation Technology*** Dam,Tank,Ponds, Sluice,Significance of KumizhiThoompu of CholaPeriod,Animal Husbandry – Wells Designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea- Fisheries – Pearl – Conche diving -Ancient Knowledge of Ocean – Knowledge Specific Society. | [3] |
| **Scientific Tamil & Tamil Computing*** Development of Scientific Tamil – Tamil Computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy- Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project. | [3] |
| **Total Hours:** | **15** |

**Text Book(s):**


| | |
|---|---|
| **1.** | முனைவர் கே. கே. பிள்ளை, "தமிழக வரலாறு - மக்களும் பண்பாடும்", தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 18th Edition, 2022. |
| **2.** | முனைவர் இல. சுந்தரம், "கணினித்தமிழ்",விகடன் பிரசுரம், 2nd Edition, 2021. |
| 3. | முனைவர் இரா.சிவானந்தம், மு.சேரன், "கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்", தொல்லியல் துறை வெளியீடு, 6th Edition, 2020. |
| 4. | முனைவர் இரா.சிவானந்தம் , முனைவர் ஜெ.பாஸ்கர், "பொருநை - ஆற்றங்கரை நாகரிகம்", தொல்லியல் துறை வெளியீடு,1st Edition, 2022. |
| 5. | Dr.Pillay K.K, "Social Life of Tamils", TNTB & ESC and RMRL – (In print). |
| 6. | Dr.Singaravel.S, "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies, 1st Edition, 2001. |
| 7. | Dr.Subaramanian S.V, Dr.Thirunavukkarasu K.D, "Historical Heritage of the Tamils", International Institute of Tamil Studies, 2nd Edition, 2010. |
| 8. | Dr.Valarmathi M, "The Contributions of the Tamils to Indian Culture", International Institute of Tamil Studies. |
| 9. | Dr.Sivanantham R, "Keeladi - Sangam City Civilization on the banks of river Vaigai", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation. |
| 10. | Dr.Pillay K.K, "Studies in the History of India with Special Reference to Tamil Nadu", K.K. Pillay( Published by the Author. |
| 11. | Dr.Sivanantham R, Dr.Baskar J, "Porunai Civilization", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation. |
| 12. | Balakrishnan R, "Journey of Civilization Indus to Vaigai", Roja Muthiah Research Library,3rd Edition, 2022. |


*SDG 4- Quality Education

# For Tamils and Technology, additional 1 credit is offered and not accounted for CGPA.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 61 ME 0P1 | Fabrication and Reverse Engineering Laboratory (Common to All branches) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ES | 0 | 0 | 4 | 2 |

## Objectives

- To provide hands-on training on Carpentry, Sheet metal, Fitting and Welding.
- To offer real time activity on plumbing connections and power tools in domestic applications.
- To provide hands-on training on CNC Wood Router and 3D Printing
- To provide hands-on training on household wiring and dismantling and assembling the home appliances.
- To offer real time activity on embedded programming using Arduino

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Make a wooden model using carpentry, Sheet metal Process. | Apply |
| CO2 | Mate a model using filing and joining using MS Plate and repair & maintenances of water lines, power tools for home applications. | Apply |
| CO3 | Cultivate the skills necessary for developing innovative and desirable products, including the ability to integrate user needs, market trends and technological advancement into the design process. | Apply |
| CO4 | Trouble shoot the electrical and electronic circuits, electrical appliances and facilitate the house wiring. | Apply |
| CO5 | Acquire practical knowledge on embedded programming using Arduino. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 3 | - | - | 2 | 2 | - | 3 | - | - | 3 | - | 3 | 3 |
| CO2 | 3 | 2 | 3 | - | - | 2 | 2 | - | 3 | - | - | 3 | - | 3 | 3 |
| CO3 | 3 | 2 | 3 | - | - | 2 | 2 | - | 3 | - | - | 3 | - | 3 | 3 |
| CO4 | 3 | - | 3 | - | - | 2 | 2 | - | 3 | - | - | 3 | - | 3 | 3 |
| CO5 | 3 | - | 3 | - | - | 2 | 2 | - | 3 | - | - | 3 | - | 3 | 3 |

3 - Strong; 2 - Medium; 1 - Some

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|
| | Lab | Activity | | | |
| Remember | | - | - | - | - |
| Understand | 25 | 12 | 50 | - | 50 |
| Apply | 25 | 13 | 50 | - | 50 |
| Analyse | - | - | - | - | - |
| Evaluate | - | - | - | - | - |
| Create | - | - | - | - | - |
| Total | 50 | 25 | 100 | - | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (Common to All branches) | | | | | | | | |
| 61 ME 0P1 – Fabrication and Reverse Engineering Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| II | 0 | 0 | 4 | 60 | 2 | 60 | 40 | 100 |

**List of Experiments:**

**1. Making of Metal Model and Carpentry Process**

a) Making of Tray using Sheet Metal Process

b) Making of T / Cross Joint using Carpentry Process.

**2. Mating of Square Joint using the Filling Process**

**3. Fabrication of Welded model**

**4. Repair and Maintenance of Pipe Fitting for Home Applications**

a) Assembly of GI pipes/PVC, Pipe Fitting and Cutting of Threads in GI pipes.

b) Fitting of Pipe with Clamps using Power Tools

**5. Making of Model using CNC Wood Router**

a) 2D profile cutting on plywood/MDF (6-12 mm) for press fit design

b) Machining of 3D geometry on soft material such as softwood

**6. 3D Printing of scanned geometry using FDM or SLA Printer.**

**7. Dismantling and Assembling of**

a) Iron Box

b) Mixer Grinder

c) Ceiling Fan

d) Table Fan

e) Water Heater

f) Induction Stove

**8. Design and Execution of Residential house wiring with UPS.**

a) 1 BHK

b) 2 BHK

**9. Design and fabrication of domestic LED lamps**

a) Schematic and PCB layout design of the given circuit and fabrication and testing of the same.

b) Soldering

**10. Embedded programming using Arduino**

| **Lab Manual** | |
|---|---|
| 1. | "Fabrication and Reverse Engineering Laboratory Manual", Department of Mechanical Engineering, KSRCT. |

*SDG 9 – Industry Innovation and Infrastructure

**Course Designer(s)**


1. Mr.S Sakthivel - sakthivel_s@ksrct.ac.in
2. Dr.G.Vijayagowri – vijayagowri@ksrct.ac.in
3. Mr. K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 2P1 | Electronic Devices Laboratory<br>Common to ECE and EE | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 4 | 2 |

## Objectives

- To analyse the operation of the circuits with diodes in series and parallel combinations
- To design and implement various circuits using diodes
- To design and implement various circuits using BJT& FET
- To analyse the characteristics of various Optical devices
- To implement the application circuits using Power devices

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Analyse the circuits with diodes in series and parallel | Understand |
| CO2 | Implement the application circuits using diodes | Apply |
| CO3 | Implement the application circuits using BJT& FET | Apply |
| CO4 | Analyse the characteristics of optical devices | Understand |
| CO5 | Implement the application circuits using power devices | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | - | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | - | 3 | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|
| | Lab | Activity | | | |
| Remember | - | - | - | - | - |
| Understand | 25 | - | 50 | | 50 |
| Apply | 25 | 25 | 50 | | 50 |
| Analyse | - | - | - | - | - |
| Evaluate | - | - | - | - | - |
| Create | - | - | - | - | - |
| Total | 50 | 25 | 100 | - | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Common to ECE and EE | | | | | | | | |
| 60 EC 2P1 - Electronic Devices Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| II | 0 | 0 | 4 | 60 | 2 | 60 | 40 | 100 |

**List of Experiments:**

Students have to design application circuits using analog electronic components /MOKU GO Kit/ Multisim software

1. *Diode circuit analysis
2. *Application circuits using Diodes***
3. *Application circuits using BJT & FET
4. *Analyse the characteristics of Optical devices
5. *Application circuits using Power devices**

*SDG 4 – Quality Education

** SDG 8 – Decent work and economic growth

***SDG 9 – Industry innovation and infrastructure

**Course Designer(s)**

1. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CG 0P1 | Career Skill Development – I | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 2 | 1 |

## Objectives

- To help learners improve their vocabulary and to enable them to use words appropriately in different academic and professional contexts
- To help learners develop strategies that could be adopted while reading texts
- To help learners acquire the ability to speak effectively in English in real life and career related situations
- To equip students with effective speaking and listening skills in English
- To facilitate learners to enhance their writing skills with coherence and appropriate format effectively

## Pre-requisites

- Basic knowledge of reading and writing in English.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Listen and comprehend complex academic texts | Understand |
| CO2 | Read and infer the denotative and connotative meanings of technical texts | Analyze |
| CO3 | Write definitions, descriptions, narrations, and essays on various topics | Apply |
| CO4 | Speak fluently and accurately in formal and informal communicative contexts | Apply |
| CO5 | Appraise the verbal ability skills in the career development and professional contexts | Analyze |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | - | - | - |
| CO2 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | - | 2 | - |
| CO3 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | - | 2 | - |
| CO4 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | - | - |
| CO5 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |

3 - Strong; 2 - Medium; 1 – Some

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Common to All Branches** | | | | | | | | |
| **60 CG 0P1 - Career Skill Development - I** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| II | 0 | 0 | 2 | 30 | 1 | 100 | 00 | 100 |

| | |
|---|---|
| **Listening*** Listening For General Information - Specific Details - Audio / Video (Formal & Informal) - Listen to Podcasts/ TED Talks/ Anecdotes / Stories / Event Narration / Documentaries and Interviews with Celebrities - Listen to a Product and Process Descriptions, Advertisements About Products or Services. | [6] |
| **Speaking*** Self Introduction; Introducing a Friend; Conversation - Politeness Strategies - Narrating Personal Experiences / Events; Interviewing A Celebrity; Reporting / And Summarizing of Documentaries / Podcasts/ Interviews - Picture Description; Giving Instruction to Use the Product; Presenting A Product - Small Talk; Mini Presentations - Group Discussions, Debates & Role Plays. | [6] |
| **Reading*** Loud Reading Vs Silent Reading, Skimming & Scanning of Passages, Reading Brochures (Technical Context), Social Media Messages Relevant to Technical Contexts and Emails - Biographies, Travelogues, Newspaper Reports and Travel & Technical Blogs - Advertisements, Gadget Reviews and User Manuals - Newspaper Articles and Journal Reports - Editorials; and Opinion Blogs | [6] |
| **Writing*** Writing Letters - Informal and Formal - Basics and Format Orientation - Paragraph Texting, Short Report on An Event (Field Trip Etc.) - Definitions; Instructions; and Product /Process Description - Note-Making / Note-Taking; Recommendations; Transferring Information from Non-Verbal (Charts, Graphs to Verbal Mode) - Essay Texting | [6] |
| **Verbal Ability I*** Reading Comprehension (MCQS) - Cloze Test - Sequencing of Sentences - Summarizing And Paraphrase - Error Detection - Spelling Test - Sentence Improvement - Preposition | [6] |
| **Total Hours:** | 30 |

**Reference(s):**


| | |
|---|---|
| 1. | "English for Engineers & Technologists", Orient Blackswan Private Ltd. Department of English, Anna University, 2020 |
| 2. | Norman Lewis, "Word Power Made Easy - The Complete Handbook for Building a Superior Vocabulary Book", Penguin Random House India, 2020 |
| 3. | Michael McCarthy and Felicity O Dell, "English Vocabulary in Use: Upper Intermediate", Cambridge University Press, N.York, 2012 |
| 4. | Lakshmi Narayanan, "A Course Book on Technical English", Scitech Publications (India) Pvt. Ltd. 2020. |


* SDG 4 - Quality Education

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Listening** | |
| 1.1 | Listening for General Information and Specific Details | 1 |
| 1.2 | Listening to Podcasts, Documentaries and Interviews with Celebrities | 1 |
| 1.3 | Narrating Personal Experiences | 1 |
| 1.4 | Reading Relevant to Technical Contexts and Emails | 1 |
| 1.5 | Listen to a Product and Process Descriptions | 2 |
| **2** | **Speaking** | |
| 2.1 | Self-Introduction | 1 |
| 2.2 | Summarizing of Documentaries& Picture Narration | 1 |
| 2.3 | Small Talk; Mini Presentations | 1 |
| 2.4 | Group Discussions, Debates & Role Plays. | 1 |
| 2.5 | Group Discussions | 2 |
| 3 | **Reading** | |
| 3.1 | Loud Reading Vs Silent Reading, Skimming & Scanning of Passages | 1 |
| 3.2 | Reading Social Media Messages Relevant to Technical Contexts | 1 |
| 3.3 | Reading Newspaper Reports and Travel & Technical Blogs | 1 |
| 3.4 | Reading Advertisements, Gadget Reviews and User Manuals | 1 |
| 3.5 | Reading Newspaper Articles and Journal Reports | 2 |
| **4** | **Writing** | |
| 4.1 | Writing Letters – Informal and Formal | 1 |
| 4.2 | Paragraph Texting | 1 |
| 4.3 | Definitions and Instructions | 1 |
| 4.4 | Note-Making / Note-Taking | 1 |
| 4.5 | Essay Texting | 2 |
| 5 | **Verbal Ability** | |
| 5.1 | Reading Comprehension (MCQS) and Cloze Test | 1 |
| 5.2 | Sequencing of Sentences | 1 |
| 5.3 | Paraphrasing and Summarizing | 1 |
| 5.4 | Error Detection and Spelling Test | 1 |
| 5.5 | Prepositions | 2 |

**Course Designer(s)**

1. Dr.A.Palaniappan - palaniappan@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**

**(An Autonomous Institution affiliated to Anna University)**

B.E. / B.Tech. Degree Programme

**SCHEME OF EXAMINATIONS**

(For the candidates admitted in 2024-2025)

**THIRD SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1. | 60 MA 009 | Linear Algebra and Numerical Methods | 2 | 40 | 60 | 100 | 45 | 100 |
| 2. | 60 CS 002 | Data Structures and Algorithms | 2 | 40 | 60 | 100 | 45 | 100 |
| 3. | 60 EC 301 | Electronic Circuits | 2 | 40 | 60 | 100 | 45 | 100 |
| 4. | 60 EC 303 | Digital System Design | 2 | 40 | 60 | 100 | 45 | 100 |
| 5. | 60 MY 002 | Universal Human Values | 2 | 100 | - | 100 | - | 100 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 6. | 61 EC 302 | Circuit Analysis | 2 | 50 | 50 | 100 | 45 | 100 |
| **PRACTICAL** | | | | | | | | |
| 7. | 60 EC 3P1 | Analog and Digital Electronics Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 8. | 61 CS 0P2 | Data Structures and Algorithms Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 9. | 60 CG 0P2 | Career Skill Development – II | 2 | 100 | 00 | 100 | 00 | 100 |
| 10. | 60 CG 0P6 | Internship | - | 100 | - | 100 | - | 100 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 MA 009 | Linear Algebra and Numerical Methods | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | BS | 3 | 1 | 0 | 4 |

## Objectives

- To acquire knowledge about vector spaces.
- To get exposed to the basic concepts of linear transformation
- To know the concepts of interpolation and numerical integration.
- To learn the basics concepts of initial value problems.
- To acquire knowledge of various methods to solve partial differential equations with
- boundary conditions

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Apply the concept of vector spaces. | Apply |
| CO2 | Interpret the concepts of linear transformation | Apply |
| CO3 | Apply different techniques to find the intermediate values and to evaluate single definite integrals. | Apply |
| CO4 | Compute the solution for initial value problems using single and multi-step methods. | Apply |
| CO5 | Apply various methods to solve partial differential equations with boundary conditions. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO3 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO4 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO5 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 20 |
| Apply | 40 | 40 | 70 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to ECE & EE**

**60 MA 009 - Linear Algebra and Numerical Methods**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 1 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Vector Space***<br>Vector Space – Subspace – Null Space – Row and Column Space - Linear Combinations – Linear Independence and Linear Dependence – Basis and Dimension.<br>**Hands - on:** Find a basis and dimension for the vector subspace. | [9] |
| **Linear Transformation and Inner Product Spaces***<br>Linear Transformation - Matrix Representation of a Linear Transformation - Inner Product - Norm – Gram-Schmidt Orthogonalization Process.<br>**Hands - on:** Matrix representation of a linear transformation | [9] |
| **Interpolation and Numerical Integration****<br>Lagrange's and Newton's Divided Difference Interpolation (Unequal Intervals) - Newton's Forward and Backward Interpolation (Equal Intervals) - Two Point and Three Point Gaussian Quadrature – Trapezoidal, Simpson's 1/3 and 3/8 Rule (Single Integral).<br>**Hands - on:** Simpson 1/3 method for definite integral | [9] |
| **Numerical Solution of Ordinary Differential Equations****<br>Single Step Methods: Taylor's Series Method - Euler's Method - Modified Euler's Method- Fourth Order Runge-Kutta , Method for Solving First Order Equations - Multi Step Methods: Milne's Predictor and Corrector Method - Adam's Predictor and Corrector Method.<br>**Hands - on:** Runge – Kutta method for solving first order equations. | [9] |
| **Numerical Solution of Partial Differential Equations*****<br>Classifications of Partial Differential Equations of Second Order - Finite Difference Method - Laplace's Equations - Liebmann's Process - Poisson's Equation - Hyperbolic Equation.<br>**Hands - on:** Solution of one dimensional wave equation | [9] |
| **Total Hours: (Lecture - 45; Hands - on - 05; Tutorial - 10)** | **60** |

**Text Book(s):**

| | |
|---|---|
| 1. | David C. Lay, "Linear Algebra and its Applications", 6th Edition, Pearson Education, 2022. |
| 2. | Grewal B.S and Grewal J.S., "Numerical Methods in Engineering and Science", 10th Edition, Khanna Publishers, New Delhi, 2015. |

**Reference(s):**

| | |
|---|---|
| 1. | Howard Anton and Chris Rorres, "Elementary Linear Algebra", 11th Edition, John Wiley & Sons, 2014. |
| 2. | Gilbert Strang, "Linear Algebra and Its Applications", 4th Edition, Brooks/Cole/Cengage, 2006. |
| 3. | Gerald C.F and Wheatley P.O, "Applied Numerical Analysis", 7th Edition, Pearson Education (Asia), 2007. |
| 4. | Kandasamy P, Thilagavathy K and Gunavathi K, "Numerical Methods", 3rd Edition, S.Chand & Company Ltd, 2013. |

*SDG 4 - Quality Education
**SDG 9 - Industry, Innovation, and Infrastructure
***SDG 7- Affordable and Clean Energy

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1.0** | **Vector Spaces** | |
| 1.1 | Vector Space | 2 |
| 1.2 | Subspace | 1 |
| 1.3 | Null Space, Row and Column Space | 1 |
| 1.4 | Linear Combinations | 2 |
| 1.5 | Linear Independence | 1 |
| 1.6 | Linear Dependence | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 1.7 | Basis And Dimension. | 1 |
| 1.8 | Tutorial | 2 |
| 1.9 | Hands on | 1 |
| **2.0** | **Linear Transformation and Inner Product Spaces** | |
| 2.1 | Linear Transformation | 2 |
| 2.2 | Matrix Representation of A Linear Transformation | 1 |
| 2.3 | Inner Product | 1 |
| 2.4 | Problems | 1 |
| 2.5 | Gram-Schmidt Orthogonalization Process | 2 |
| 2.6 | Problems | 2 |
| 2.7 | Tutorial | 2 |
| 2.8 | Hands on | 1 |
| **3.0** | **Interpolation and Numerical Integration** | |
| 3.1 | Lagrange's Interpolation | 1 |
| 3.2 | Newton's Divided Difference Methods | 1 |
| 3.3 | Newton's Forward and Backward Difference Methods. | 2 |
| 3.4 | Two Point and Three Point Gaussian Quadratures | 2 |
| 3.5 | Trapezoidal Rule | 1 |
| 3.6 | Simpson's1/3 And 3/8 Rules | 2 |
| 3.7 | Tutorial | 2 |
| 3.8 | Hands on | 1 |
| **4.0** | **Numerical Solution of Ordinary Differential Equations** | |
| 4.1 | Taylor Series Method | 1 |
| 4.2 | Euler And Modified Euler Methods | 1 |
| 4.3 | Fourth Order Runge – Kutta Method | 2 |
| 4.4 | Milne's Predictor and Corrector Methods. | 2 |
| 4.5 | Problems | 1 |
| 4.6 | Adam's Predictor and Corrector Methods. | 1 |
| 4.7 | Problems | 1 |
| 4.8 | Tutorial | 2 |
| 4.9 | Hands on | 1 |
| **5.0** | **Numerical Solution of Partial Differential Equations** | |
| 5.1 | Classifications Of Partial Differential Equations of Second Order | 1 |
| 5.2 | Finite Difference Method | 1 |
| 5.3 | Laplace's Equations | 2 |
| 5.4 | Liebmann's Process | 1 |
| 5.5 | Poisson's Equation | 2 |
| 5.6 | Hyperbolic Equation. | 1 |
| 5.7 | Problems | 1 |
| 5.8 | Tutorial | 2 |
| 5.9 | Hands on | 1 |

**Course Designer(s)**


1. Mr. D.Senthil Raja -senthilrajad@ksrct.ac.in
2. Mrs. D.Padmavathi -padmavathi@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CS 002 | Data Structures and Algorithms | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ES | 3 | 0 | 0 | 3 |

## Objectives

- To study the asymptotic performance of algorithms and choose the appropriate data structure for a specified application
- To design and implement abstract data types such as linked list, stack, queue and trees
- To learn and implement the hashing techniques
- To design a priority queue ADT and its applications
- To demonstrate various sorting, searching and graph algorithms

## Pre-requisites

- Nil

## Course Outcomes

On the Successful Completion of the Course, Students will be Able to

| | | |
|---|---|---|
| CO1 | Analyse the asymptotic performance of algorithms and apply linear data structures to solve real time applications | Analyse |
| CO2 | Experiment with trees with its operations | Apply |
| CO3 | Apply algorithm for solving problems like sorting, searching | Apply |
| CO4 | Implement priority queue with its operations and hashing techniques | Apply |
| CO5 | Analyse shortest path algorithms, minimum spanning tree algorithms, biconnectivity and algorithmic design paradigms | Analyze |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | - | - | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 2 | - | - | 2 | 3 | - | - | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 2 | - | 2 | 3 | 2 | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 2 | - | - | 3 | 2 | 2 | - | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | - | 2 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 10 | 10 | 20 |
| Apply | 30 | 40 | 40 |
| Analyse | 10 | - | 20 |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to ECE & EE**

**60 CS 002 – Data Structures and Algorithms**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Lists, Stacks and Queues**<br>Abstraction - Abstract Data Types - Data Representation - Elementary Data Types - Mathematical Preliminaries: Big-Oh Notation - Efficiency of Algorithms - Notion of Time and Space Complexity - Performance Measures for Data Structures - **The List ADT – The Stack ADT – The Queue ADT***. | [9] |
| **Trees**<br>Preliminaries – Binary Trees – The Search Tree ADT – Binary Search Trees – AVL Trees – Tree Traversals – B–Trees – B+ Trees. | [9] |
| **Sorting and Searching**<br>Preliminaries – Insertion Sort – Shell Sort – Heap Sort – Merge Sort – Quick Sort – External Sorting – Searching: Sequential Search - Binary Search – Hashed List Searches | [9] |
| **Hashing and Priority Queues (Heaps)**<br>**Hashing – Hash Function – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing*** – Priority Queues (Heaps) – Model – Simple Implementations – Binary Heap – Applications of Priority Queues – D-Heaps. | [9] |
| **Graphs**<br>Definitions – **Topological Sort – Shortest-Path Algorithms – Unweighted Shortest Paths – Dijkstra's Algorithm – Minimum Spanning Tree – Prim's Algorithm, Kruskal's Algorithm – Applications of Depth-First Search*** – Undirected Graphs – Bi-connectivity.<br>Algorithm Design Paradigms - Greedy, Divide and Conquer, Dynamic Programming, Backtracking | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Weiss M.A, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education Asia, 2008. |
| 2. | Langsam Y, Augenstein M.J and Tenenbaum A.M, "Data Structures Using C", Pearson Education Asia, 2009. |
| **Reference(s):** | |
| 1. | Rajesh K.Sukla, "Data Structure Using C & C++", Wiley India, 2012. |
| 2. | Tannenbaum A, "Data Structure Using C", Pearson Education, 2003. |
| 3. | Goodrich and Tamassia, "Data Structures and Algorithms in C++", 2nd Edition, John Wiley and Sons, 2011. |
| 4. | Reema Thareja, "Data Structures Using C", 2nd Edition, Oxford Higher Education, 2014. |

*SDG4 - Quality Education

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Lists, Stacks and Queues** | |
| 1.1 | Abstract Data Type (ADT), Mathematical preliminaries: big-Oh notation | 1 |
| 1.2 | Efficiency of algorithms, Notion of time and space complexity - performance measures for data structures | 1 |
| 1.3 | List ADT | 4 |
| 1.4 | Stack ADT | 3 |
| 1.5 | Queue ADT | 3 |
| **2** | **Trees** | |
| 2.1 | Preliminaries | 1 |
| 2.2 | Binary Trees | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 2.3 | The Search Tree ADT | 1 |
| 2.4 | Binary Search Trees | 1 |
| 2.5 | AVL Trees | 1 |
| 2.6 | Tree Traversals | 1 |
| 2.7 | B-Trees | 2 |
| 2.8 | B+ Trees | 1 |
| **3** | **Sorting and Searching** | |
| 3.1 | Preliminaries, Insertion Sort | 1 |
| 3.2 | Shell Sort, Heap sort | 1 |
| 3.3 | Merge Sort, Quick sort | 1 |
| 3.4 | External Sorting | 1 |
| 3.5 | Sequential Searching | 1 |
| 3.6 | Binary Searching | 1 |
| 3.7 | Hashed List Searches | 1 |
| **4** | **Hashing and Priority Queues (Heaps)** | |
| 4.1 | Hashing, Hash Function | 1 |
| 4.2 | Separate Chaining, Open Addressing | 1 |
| 4.3 | Rehashing, Extendible Hashing | 1 |
| 4.4 | Priority Queues (Heaps) | 1 |
| 4.5 | Simple Implementations, Binary Heap | 1 |
| 4.6 | Applications of Priority Queues | 1 |
| 4.7 | d –Heaps | 1 |
| **5** | **Graphs** | |
| 5.1 | Graph Definitions - Topological Sort | 1 |
| 5.2 | Shortest-Path Algorithms - Unweighted Shortest Paths | 1 |
| 5.3 | Dijkstra's Algorithm | 1 |
| 5.4 | Minimum Spanning Tree | 1 |
| 5.5 | Prim's Algorithm | 1 |
| 5.6 | Kruskal's Algorithm | 1 |
| 5.7 | Applications of Depth-First Search | 1 |
| 5.8 | Undirected Graphs | 1 |
| 5.9 | Biconnectivity | 1 |
| 5.10 | Algorithm Design Paradigms | 1 |

**Course Designer(s)**

1. Ms.K.Poongodi - poongodik@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 301 | Electronic Circuits (Common to ECE & EE) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objectives

- To understand the operation of different transistor amplifiers
- To design and analyse the feedback amplifiers and oscillators
- To understand the operation of power amplifiers and differential amplifier
- To acquire the basic knowledge of operational amplifier
- To implement application circuits using op-amp.

## Pre-requisites

- Electronic Devices

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the operation of different transistor amplifier circuits | Understand |
| CO2 | Describe and analyse the characteristics of negative feedback amplifiers and oscillators | Apply |
| CO3 | Describe the concepts and characteristics of power amplifiers and design differential amplifier | Apply |
| CO4 | Understand the basic concepts of op-amp | Understand |
| CO5 | Design and analyse the various application of op-amp | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | - | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | - | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |

3 - Strong; 2 - Medium; 1 – Some

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 35 | 40 | 60 |
| Apply | 15 | 10 | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to ECE & EE**

**60 EC 301 - Electronic Circuits**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Transistor Amplifiers*** Biasing Schemes for BJT and FET - Overview of Single Stage BJT Amplifiers: Common Emitter, Common Base, Common Collector - Hybrid-pi Model - Miller Effect - Frequency Response of Single Stage MOSFET amplifier - Cascade and Cascode Amplifiers. | [9] |
| **Feedback Amplifiers and Oscillators *** Different Topologies: Voltage Series, Voltage Shunt, Current Series and Current Shunt, Effect on Gain and Frequency Response, Stability Considerations and Frequency Compensation - Basic Concept of Oscillators, RC and LC Sinusoidal Oscillators | [9] |
| **Power Amplifier & Differential Amplifier*** Different Modes of Operation of Amplifiers and their Power Efficiency: Class A, Class B, Class AB and Class C, **Push-Pull Amplifiers and Applications**.** Differential Amplifier: Basic Structure and Principle of Operation – Calculation of Differential Gain, Common Mode Gain, CMRR and ICMR, Design of Differential Amplifier for a Given Specification. | [9] |
| **Basics of Operational Amplifiers*** Ideal Op-amp Characteristics, General Operational Amplifier Stages and Internal Circuit Diagrams of IC 741, DC Characteristics, AC Characteristics, Frequency Response of Op-amp, Slew rate. | [9] |
| **Applications of Operational Amplifiers*** Basic Applications of Op-amp – Inverting and Non-inverting Amplifiers, Voltage Follower, Scale changer, Summer, Subtractor, Basic Comparator, **Precision Rectifier, Clipper and Clamper, Peak Detector, V/I & I/V Converters, Switched Capacitor circuits**: Basic Concept, Practical Configurations**, Application in Amplifier****. | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**

| | |
|---|---|
| 1. | David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University press, 2018. |
| 2. | Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and circuit theory", 11th Edition, Pearson Education, 2017. |
| 3. | RoyChoudry D , Shail Jain , 'Linear integrated Circuits', 5th Edition, New Age International Pvt Ltd, 2018. |

**Reference(s):**

| | |
|---|---|
| 1. | Anil K. Maini, VarshaAgrawal, "Electronics Devices and Circuits", 2nd Edition, Wiley India Pvt.Ltd, 2019. |
| 2. | Salivahanan S, Sureshkumar N, "Electronic Devices and circuits", 4th Edition, McGraw-Hill, 2017. |
| 3. | Ramakant A., Gayakwad, "Op – Amps and Linear Integrated Circuits", 4th Edition, Prentice Hall, 2017. |

*SDG 4 - Quality Education

**SDG 9 - Industry innovation and infrastructure

Assignment 1 – Covers Module 1 and 2

1. Simulation of biasing circuits, common emitter amplifier for the given specifications.
2. Simulation of feedback amplifiers with and without feedback and compare the measured gain.
3. Problems in RC and LC oscillators.

Assignment 2 – Covers Module 3 and 4

1. Problems in differential amplifier.
2. Comparison of op-amp 741 with another op-amp to analyze the features.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

Assignment 3 – Covers Module 5

1. Simulation of inverting amplifier, non-inverting amplifier, voltage follower, level shifter and comparator circuit using op-amp.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Transistor Biasing** | |
| 1.1 | Introduction To Biasing Schemes for BJT | 1 |
| 1.2 | FET | 1 |
| 1.3 | Overview of Single Stage BJT Amplifiers | 1 |
| 1.4 | Common Emitter Amplifier | 1 |
| 1.5 | Common Base, Common Collector | 1 |
| 1.6 | Hybrid-Pi Model, Miller Effect | 1 |
| 1.7 | Frequency Response of Single Stage MOSFET Amplifier | 1 |
| 1.8 | Cascade Amplifier | 1 |
| 1.9 | Cascode Amplifier | 1 |
| **2.0** | **Feedback Amplifiers and Oscillators** | |
| 2.1 | Different Topologies: Voltage Series | 1 |
| 2.2 | Voltage Shunt | 1 |
| 2.3 | Current Series | 1 |
| 2.4 | Current Shunt | 1 |
| 2.5 | Effect on Gain and Frequency Response, Stability Considerations and Frequency Compensation | 1 |
| 2.6 | Basic Concept of Oscillators | 1 |
| 2.7 | RC Oscillators | 1 |
| 2.8 | LC Sinusoidal Oscillators | 2 |
| **3.0** | **Power Amplifier & Differential Amplifier** | |
| 3.1 | Different Modes of Operation of Amplifiers | 1 |
| 3.2 | Their Power Efficiency: Class A, Class B, | 1 |
| 3.3 | Class AB And Class C | 1 |
| 3.4 | Push-Pull Amplifiers and Applications | 1 |
| 3.5 | Differential Amplifier: Basic Structure and Principle of Operation | 1 |
| 3.6 | Calculation Of Differential Gain, Common Mode Gain, CMRR And ICMR. | 1 |
| 3.7 | Design Of Differential Amplifier for A Given Specification | 1 |
| **4.0** | **Basics of Operational Amplifiers** | |
| 4.1 | Ideal Op-Amp Characteristics | 2 |
| 4.2 | General Operational Amplifier Stages | |
| 4.3 | Internal Circuit Diagrams of IC 741 | 1 |
| 4.4 | DC Characteristics | 1 |
| 4.5 | AC Characteristics | 2 |
| 4.6 | Frequency Response of Op-Amp | 1 |
| 4.7 | Slew Rate | 1 |
| **5.0** | **Applications of Operational Amplifiers** | |
| 5.1 | Basic Applications of Op-Amp – Inverting and Non-Inverting Amplifiers | 1 |
| 5.2 | Voltage Follower, Scale Changer | 1 |
| 5.3 | Summer, Subtractor | 1 |
| 5.4 | Basic Comparator, Precision Rectifier | |
| 5.5 | Clipper And Clamper | 1 |
| 5.6 | Peak Detector | 1 |
| 5.7 | V/I & I/V Converters | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.8 | Switched Capacitor Circuits: Basic Concept, Practical Configurations | 1 |
| 5.9 | Application In Amplifier | 1 |

**Course Designer(s)**


1. Dr.K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 61 EC 302 | Circuit Analysis (Common to ECE & EE) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 2 | 1 | 2 | 4 |

## Objectives

- To learn the basic concepts and behaviour of DC circuits
- To understand the various network theorems and two port network parameters
- To learn the basic concepts and behaviour of AC circuits
- To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations
- To learn the concept of coupling in circuits and the frequency response of resonant circuits

## Pre-requisite:

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Apply the basic laws to analyses the electric circuits using circuit analysis techniques. | Understand |
| CO2 | Apply network theorems and analyse the two-port network behaviour | Apply |
| CO3 | Analyse the steady state response of AC circuits with phasor diagram | Understand |
| CO4 | Apply Laplace Transform for steady state and transient analysis of RC, RL, and RLC networks | Apply |
| CO5 | Analyse the frequency response of electric circuits under resonance and coupled circuits | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | 3 | - | - | - | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | - | - | 2 | - | - | - | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | - | 3 | 2 | - | - | - | 3 | 3 | - | 2 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 10 | - | 10 | - | - | 15 | - |
| Understand | 10 | 40 | 10 | 40 | 40 | 25 | 40 |
| Apply | 40 | 60 | 40 | 60 | 60 | 60 | 60 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to ECE & EE**

**61 EC 302 - Circuit Analysis**

| Semester | Hours / Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| III | 2 | 1 | 2 | 75 | 4 | 50 | 50 | 100 |

| | |
|---|---|
| **DC Circuit Analysis*** <br> Laws: Ohms Law, Kirchhoff's Current Law, Kirchhoff's Voltage Law, Connections: Sources, Resistors, Inductors and Capacitors in Series and Parallel, Star and Delta Transformations, Voltage, Current Source Conversions. Voltage and Current Division Rules, Nodal Analysis and Mesh Analysis in DC Circuits. | [6] |
| **Network Theorems and Two Port Network*** <br> Theorems: Superposition, Thevenin's, Norton's, and Maximum Power Transfer Theorems, Reciprocity Theorem. Network Parameters - Impedance, Admittance, Transmission and Conversion Formulae. | [6] |
| **Sinusoidal Steady State Analysis *** <br> Sinusoidal Steady – State Analysis, Characteristics of Sinusoids, The Phasor, Phasor Relationship For R, L, And C, Impedance and Admittance, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, Apparent Power and Power Factor, Complex Power, Star and Delta Connections. | [6] |
| **Transients*** <br> Transient Analysis of RC, RL, And RLC Networks with and without Initial Conditions with Laplace Transforms Evaluation of Initial Conditions for DC & AC Inputs, State Equations for Networks. | [6] |
| **Resonance and Coupled Circuits*** <br> Behaviour of Series and Parallel Resonant Circuits, Frequency Response, Quality Factor and Bandwidth. Magnetically Coupled Circuits, Mutual Inductance, Coefficient of Coupling, Dot Rule- Analysis of Coupled Circuits. | [6] |
| **Practical:** <br> 1. Measurements of Current and Power of a Specific Branch in a Circuit <br> 2. Measurements of Voltage and Power of a Specific Note in a Circuit <br> 3. Verification of Mesh Analysis <br> 4. Verification of Nodal Analysis <br> 5. AC Circuit Various Power Calculation <br> 6. Verification of Theorems – Thevenin, Theorem <br> 7. Verification of Theorems – Nortons, Theorem <br> 8. Verification of Theorems – Superposition Theorem <br> 9. Verification of Theorems – Reciprocity Theorem <br> 10. Check the Transient Response of RL Circuits <br> 11. Check the Transient Response of RC Circuits <br> 12. Check the Transient Response of RLC Circuits | [30] |
| **Total Hours: (Lecture - 30; Practical - 30; Tutorial - 15)** | **75** |

**Text Book(s):**

| | |
|---|---|
| 1. | Sudhakar A and Shyam Mohan S, "Circuits & Network Analysis and Synthesis", 4th Edition, McGraw Hill, 2021. |
| 2. | Singh R.R, "Network Analysis and Synthesis", 2nd Edition, McGraw Hill Education Pvt Limited, 2021. |

**Reference(s):**

| | |
|---|---|
| 1. | Mahmood Nahvi and Joseph Edminister, "Electric Circuits", 6th Edition, Schaum's Outline series, Tata McGraw-Hill, 2014. |
| 2. | William H Hayt& Jack E Kemmerly, "Engineering Circuit Analysis", 8th Edition, McGraw Hill Education, 2013. |
| 3. | Franklin F. Kuo, "Network Analysis and Synthesis", 5th Edition, Wiley International, 2012. |
| 4. | John D Ryder, "Networks, Lines and Fields", 2nd Edition, Pearson Education, 2015. |

*SDG 4 – Quality Education

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **DC Circuit Analysis** | |
| 1.1 | Basic Components of Electric Circuits: Charge, Current, Voltage and Power | 1 |
| 1.2 | Voltage and Current Sources. Laws: Ohms Law, Kirchhoff's Current Law, Kirchhoff's Voltage Law, | 1 |
| 1.3 | Voltage and Current Division Rule, Connections: Series and Parallel Connected Sources, Resistors, Inductors and Capacitors | 1 |
| 1.4 | Star and Delta Transformation, Voltage, Current Sources Conversion. | 1 |
| 1.5 | Nodal Analysis | 1 |
| 1.6 | Mesh Analysis | 1 |
| 1.7 | Tutorial | 3 |
| **2** | **Network Theorems and Two Port Network** | |
| 2.1 | Superposition Theorem | 1 |
| 2.2 | Thevenin's Theorem, Nortons Theorem | 1 |
| 2.3 | Maximum Power Transfer Theorems, Reciprocity Theorem. | 1 |
| 2.4 | Impedance Parameter, Admittance Parameter | 1 |
| 2.5 | Transmission Parameter, Hybrid Parameter | 1 |
| 2.6 | Conversion Formula Between Two Port Parameters | 1 |
| 2.7 | Tutorial | 3 |
| **3** | **Sinusoidal Steady State Analysis** | |
| 3.1 | Sinusoidal Steady – State Analysis, Characteristics of Sinusoids | 1 |
| 3.2 | The Phasor Relationship For R, L and C | 1 |
| 3.3 | Impedance and Admittance Diagram, Phasor Diagrams | 1 |
| 3.4 | Ac Circuit Power Analysis, Instantaneous Power, Average Power, Apparent Power and Power, Factor, Complex Power | 1 |
| 3.5 | Problems on Various Power | 1 |
| 3.6 | Star and Delta Connection | 1 |
| 3.7 | Tutorial | 3 |
| **4** | **Transients** | |
| 4.1 | Transient Analysis of RC Without Initial Conditions | 1 |
| 4.2 | Transient Analysis of RC With Initial Conditions | 1 |
| 4.3 | Transient Analysis of RL Without / With Initial Conditions | 1 |
| 4.4 | Transient Analysis of RLC Networks Without Initial Conditions | 1 |
| 4.5 | Transient Analysis of RLC Networks with Initial Conditions | 1 |
| 4.6 | State Equations for Networks. | 1 |
| 4.7 | Tutorial | 3 |
| **5** | **Resonance and Coupled Circuits** | |
| 5.1 | Behaviour of Series Resonant Circuits, Frequency Response, Quality Factor and Bandwidth of Series Resonance | 1 |
| 5.2 | Behaviour of Parallel Resonant Circuits, Frequency Response, Quality Factor and Bandwidth of Parallel Resonance Circuit | 1 |
| 5.3 | Magnetically Coupled Circuits, Mutual Inductance, Coefficient Of Coupling, Dot Rule- Analysis of Coupled Circuits. | 1 |
| 5.4 | Introduction to Filters, Classification | 1 |
| 5.5 | T' Filter Network and Its Equation | 1 |
| 5.6 | 'Π' Filter Network and Its Equation | 1 |
| 5.7 | Tutorial | 3 |
| **Practical:** | | |
| 1. | Measurements of Current and Power of a Specific Branch in a Circuit | 3 |
| 2. | Measurements of Voltage and Power of a Specific Note in a Circuit | 3 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 3. | Verification of Mesh Analysis | 3 |
| 4. | Verification of Nodal Analysis | 3 |
| 5. | AC Circuit Various Power Calculation | 2 |
| 6. | Verification of Theorems – Thevenin, Theorem | 2 |
| 7. | Verification of Theorems – Nortons, Theorem | 2 |
| 8. | Verification of Theorems – Superposition Theorem | 2 |
| 9. | Verification of Theorems – Reciprocity Theorem | 2 |
| 10. | Check the Transient Response of RL Circuits | 3 |
| 11. | Check the Transient Response of RC Circuits | 3 |
| 12. | Check the Transient Response of RLC Circuits | 2 |

**Course Designer(s)**

1. Mr S.Jayamani - jayamani@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 303 | Digital System Design | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 2 | 1 | 0 | 3 |

## Objectives

- To introduce number systems and codes, basic postulates of Boolean algebra and show the correlation between Boolean expressions.
- To design and analyse combinational circuits
- To study the concept of sequential circuits.
- To introduce the concept of HDL
- Reinforce theory and techniques taught in the classroom through experiments and projects in laboratory

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the fundamentals of numbering system and apply Boolean algebra to design digital systems | Understand |
| CO2 | Design and analyze combinational circuits and semiconductor memories | Apply |
| CO3 | Design and analyze synchronous sequential logic circuits | Apply |
| CO4 | Analyse the asynchronous sequential circuits. | Understand |
| CO5 | Design and verify the digital circuits using HDL. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | - | 3 | 3 | - | - | - | - | - | - | - | 3 | 2 | - |
| CO5 | 2 | 2 | - | - | 3 | - | - | - | - | - | - | - | 3 | 2 | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 20 | 20 | 20 |
| Apply | 30 | 30 | 60 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to ECE & EE**

**60 EC 303 - Digital System Design**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| III | 2 | 1 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Digital Fundamentals*** Review of Number Systems – Representation-Conversions – Boolean Postulates and Laws – De-Morgan's Theorem – Logic Gates – Minimization of Boolean Expressions – Sum of Products (SoP) – Product of Sums (PoS) – Canonical Forms – Karnaugh Map Minimization – Implementation of Boolean Expressions Using Universal Gates. | [6] |
| **Combinational Circuits*** Combinational Logic Circuits – Adders, Subtractors, Decoders, Encoders, Multiplexers, Demultiplexers, Code Convertor, Realization of Boolean Expressions – Using Multiplexers. Memories – ROM Types, RAM Types, PLDs. **Hands - on:** Simulation of Combinational Circuits. | [6] |
| **Sequential Circuits*** Flip Flops SR, JK, T, D And Master Slave – Characteristic Table and Equation – Flip Flop Conversion, Application Table – Edge Triggering – Level Triggering – Ripple Counters – Synchronous Counters – Modulo – N Counter – **Design of Synchronous FSM – Analysis of Clocked Sequential Circuits*****: State Equation – State Table – State Diagram – State Reduction & Assignment – Register: Shift Registers – Universal Shift Register– Shift Counters **Hands - on:** Simulation of sequential circuits. | [6] |
| **Asynchronous Sequential Circuits** Analysis Procedure – Transition Table – Flow Table – Race Conditions – Design of Fundamental Mode Circuits – Primitive Flow Table – Reduction of State and Flow Table – Race Free State Assignment – Hazards – Overview and Comparison of Logic Families. | [6] |
| **Introduction to HDL**** **Design Flow of VLSI, Different Modelling Styles in Verilog HDL, Structural, Dataflow and Behavioural Modelling of Combinational and Sequential Logic Circuits.**** | [6] |
| **Total Hours: (Lecture - 30; Tutorial - 15)** | **45** |

**Text Book(s):**


1. Morris Mano M, Michael D. Ciletti, "Digital Design", 5th Edition, Pearson Education, New Delhi, 2016.
2. Samir Palnitkar, "Verilog HDL – A Guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, 2016.


**Reference(s):**


1. Anand Kumar, "Fundamentals of Digital Circuits", 4th Edition, Prentice Hall, 2016.
2. Donald P.Leach and Albert Paul Malvino, GoutamSaha, "Digital Principles and Applications", 8th Edition, Tata McGraw-Hill, New Delhi, 2016.
3. Salivahanan S and Arivazhagan S, "Digital Circuits and Design",5th Edition, Oxford University press, 2018.
4. John F.Wakerly, "Digital Design: principles and practices", 5th Edition, Pearson Education, 2018.


*SDG 4 - Quality Education

**SDG 8 - Decent work and economic growth

***SDG 9 - Industry, innovation and infrastructure

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Digital Fundamentals** | |
| 1.1 | Review of Number Systems, Conversions, Boolean postulates and laws | 1 |
| 1.2 | Boolean postulates and laws, De-Morgan's Theorem, Logic Gates | 1 |
| 1.3 | Minimization of Boolean expressions | 1 |
| 1.4 | Sum of Products (SOP) – Product of Sums (POS) | 1 |
| 1.5 | Canonical forms- Karnaugh map Minimization | 1 |
| 1.6 | Implementation of Boolean expressions using universal gates. | 1 |
| 1.7 | Tutorial | 3 |
| **2.0** | **Combinational Circuits** | |
| 2.1 | Combinational Logic Circuits, Adders, Subtractors, | 1 |
| 2.2 | Decoders, Encoders | 1 |
| 2.3 | Multiplexers, Demultiplexers | 1 |
| 2.4 | Code Convertor | 1 |
| 2.5 | Realization of Boolean Expressions-Using Multiplexers | 1 |
| 2.6 | Memories –ROM types, RAM types, PLDs | 1 |
| 2.7 | Tutorial | 3 |
| **3.0** | **Sequential Circuits** | |
| 3.1 | Flip flops SR, JK, T, D and Master slave, Characteristic Table and Equation | 1 |
| 3.2 | Flip flop conversion, Application table, Edge triggering – Level Triggering | 1 |
| 3.3 | Ripple counters – Synchronous counters, Modulo – N counter- Design of Synchronous FSM | 1 |
| 3.4 | Analysis of clocked sequential circuits: state equation – State table – State diagram | 1 |
| 3.5 | State reduction & assignment | 1 |
| 3.6 | Register: Shift Registers – Universal Shift Register– Shift counters | 1 |
| 3.7 | Tutorial | 3 |
| **4.0** | **Asynchronous Sequential Circuits** | |
| 4.1 | Analysis Procedure, Transition Table – Flow Table, Race Conditions | 1 |
| 4.2 | Design of Fundamental Mode Circuits, Primitive Flow Table | 1 |
| 4.3 | Reduction of State and Flow Table, Race Free State Assignment | 2 |
| 4.4 | Hazards | 1 |
| 4.5 | Overview and Comparison of Logic Families | 1 |
| 4.6 | Tutorial | 3 |
| **5.0** | **Introduction to HDL** | |
| 5.1 | Design Flow of VLSI | 1 |
| 5.2 | Different Modelling Styles in Verilog HDL, | 2 |
| 5.3 | Structural, Dataflow and Behavioural Modelling of Combinational and Sequential Logic Circuit | 3 |
| 5.4 | Tutorial | 3 |

**Course Designer(s)**

1. Dr.S.Malarkhodi – malarkhodi@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 MY 002 | Universal Human Values | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | MC | 3 | 0 | 0 | 3 |

## Objectives

- To identify the essential complementarily between 'values' and 'skills'
- To ensure core aspirations of all human beings.
- To acquire ethical human conduct, trustful and mutually fulfilling human behaviour
- To enrich interaction with Nature
- To achieve holistic perspective towards life and profession

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the significance of value inputs in formal education and start applying them in their life and profession | Understand |
| CO2 | Evaluate coexistence of the “I” with the body | Analyze |
| CO3 | Identify and evaluate the role of harmony in family, society and universal order | Analyze |
| CO4 | Classify and associate the holistic perception of harmony at all levels of existence and Nature | Analyze |
| CO5 | Develop appropriate human conduct and management patterns to create harmony in professional and personal lives. | Create |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | - | - | - | - | - | - | - | 3 | 2 | - | 2 | 3 | 3 | 1 | 1 |
| CO2 | - | - | - | - | - | 3 | - | 3 | 3 | - | - | 3 | 3 | 1 | 1 |
| CO3 | - | - | - | - | - | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 1 | 2 |
| CO4 | - | - | - | - | - | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 1 | 2 |
| CO5 | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 1 | 2 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom’s Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | No End Semester Examination |
| Understand | 10 | 10 | |
| Apply | 20 | 20 | |
| Analyse | 20 | 20 | |
| Evaluate | - | - | |
| Create | - | - | |
| Total | 60 | 60 | |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Common to All Branches** | | | | | | | | |
| **60 MY 002 – Universal Human Values** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 100 | - | 100 |

| | |
|---|---|
| **Introduction to value Education*** Understanding Value Education - Self Exploration as the Process for Value Education- Continuous Happiness and Prosperity - the Basic Human Aspirations - Right Understanding - Relationship and Physical Facility - Happiness and Prosperity - Current Scenario - **Method to Fulfill the Basic Human Aspirations**** | [9] |
| **Harmony in the Human Being*** Understanding Human Being as the Co-Existence of the Self and the Body - Distinguishing Between the Needs of the Self and the Body - **the Body as an Instrument of the Self-Understanding Harmony in the Self-Harmony of the Self with the Body**** - Programme to Ensure Self-Regulation and Health | [9] |
| **Harmony in the Family and Society*** Harmony In the Family - The Basic Unit of Human Interaction - Values in Human- to - Human Relationship - 'Trust' The Foundation Value in Relationship - 'Respect' - as the Right Evaluation - Understanding Harmony in the Society - Vision for the Universal Human Order. | [9] |
| **Harmony in the Nature/Existence*** Understanding Harmony in the Nature - Interconnectedness, Self-Regulation and Mutual Fulfillment among the Four Orders of Nature - Realizing Existence as Co-Existence at All Levels - The Holistic Perception of Harmony in Existence. | [9] |
| **Implications of the Holistic Understanding*** Natural Acceptance of Human Values - Definitiveness of Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models -Typical Case Studies - Strategies for Transition Towards Value Base Life and Profession. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Gaur R.R, Asthana R, Bagaria G.P, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1. |
| 2. | Gaur R.R, Asthana R, Bagaria G.P Teachers, "Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2. |
| **Reference(s):** | |
| 1. | EkParichaya, Nagaraj A, Jeevan Vidya Prakashan, Amarkantak, "Jeevan Vidya", 1999. |
| 2. | Tripathi A.N, "Human Values", New Age International. Publishers, New Delhi, 2004. |

*SDG 3 – Good Health and Well-Being

**SDG 5 – Quality Education

Passed in BoS Meeting held on 13/05/2023

Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Introduction to Value Education** | |
| 1.1 | Discussion on Present Education System and Skill Based Education | 1 |
| 1.2 | Understanding Value Education | 1 |
| 1.3 | Self-Exploration as the Process for Value Education | 1 |
| 1.4 | Basic Human Aspirations - Continuous Happiness and Prosperity | 1 |
| 1.5 | Basic Requirements to Fulfill Human Aspirations - Right Understanding, Relationship and Physical Facility | 1 |
| 1.6 | Transformation From Animal Consciousness to Human Consciousness | 1 |
| 1.7 | Sources of Happiness and Prosperity – Harmony and Disharmony | 1 |
| 1.8 | Current Scenario and Role of Education | 1 |
| 1.9 | Outcome of Human Education and Method to Fulfill the Basic Human Aspirations | 1 |
| **2.0** | **Harmony In the Human Being** | |
| 2.1 | Understanding Human Being - As Co-Existence of The Self and The Body – The Needs of The Self and The Body | 1 |
| 2.2 | Understanding Human Being - As Co-Existence of The Self and The Body - The Activities and Response of The Self and The Body | 2 |
| 2.3 | The Body as An Instrument of The Self | 1 |
| 2.4 | Understanding Harmony in The Self | 1 |
| 2.5 | Harmony of the Self with The Body | 2 |
| 2.6 | Programme To Ensure Self-Regulation and Health | 1 |
| 2.7 | My Participation (Value) Regarding Self and My Body - Correct Appraisal of Our Physical Needs | 1 |
| **3.0** | **Harmony in The Family and Society** | |
| 3.1 | Harmony in the Family - Understanding Values in Human Relationships | 1 |
| 3.2 | Family as the Basic Unit of Human Interaction | 1 |
| 3.3 | Values In Human Relationships | 1 |
| 3.4 | Trust - The Foundation Value in Relationship | 1 |
| 3.5 | Respect as the Right Evaluation, The Basis for Respect, Assumed Bases for Respect Today | 1 |
| 3.6 | Harmony From Family to World Family: Undivided Society | 1 |
| 3.7 | Extending Relationship from Family to Society, Identification of The Comprehensive Human Goal | 1 |
| 3.8 | Programs Needed to Achieve the Comprehensive Human Goal: The Five Dimensions of Human Endeavour | 1 |
| 3.9 | Harmony From Family Order to World Family Order – Universal Human Order | 1 |
| **4.0** | **Harmony in The Nature / Existence** | |
| 4.1 | The Four Orders in Nature | 1 |
| 4.2 | Participation of Human Being in Entire Nature | 1 |
| 4.3 | Natural Characteristics - Tendency of Human Living with Animal Consciousness / The Holistic Perception of Harmony in Existence | 1 |
| 4.4 | Present Day Problems | 1 |
| 4.5 | Recyclability And Self-Regulation in Nature | 1 |
| 4.6 | Relationship of Mutual Fulfillment | 1 |
| 4.7 | An Introduction to Space, Co-Existence of Units in Space | 1 |
| 4.8 | Harmony In Existence – Understanding Existence as Co- Existence | 1 |
| 4.9 | Natural Characteristic of Human Living with Human Consciousness | 1 |
| **5.0** | **Implications of the Holistic Understanding** | |
| 5.1 | Natural Acceptance of Human Values | 1 |
| 5.2 | Definitiveness of Ethical Human Conduct - Development of Human | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| | Consciousness | |
| 5.3 | Identification of Comprehensive Human Goal | 1 |
| 5.4 | Basis For Humanistic Education and Humanistic Constitution | 1 |
| 5.5 | Ensuring Competence in Professional Ethics | 1 |
| 5.6 | Issues In Professional Ethics-The Current Scenario | 1 |
| 5.7 | Holistic Technologies and Production Systems and Management Models - Typical Case Studies | 2 |
| 5.8 | Strategies For Transition Towards Value-Based Life and Profession | 1 |

**Course Designer(s)**

1. Dr.G.Vennila - vennila@ksrct.ac.in
2. Dr.K.Raja - rajak@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 3P1 | Analog and Digital Electronics Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 4 | 2 |

## Objectives

- To illustrate the working of transistor biasing circuits
- To understand and analyse the operation of single stage and multistage amplifiers
- To understand and analyse the applications of op-amp
- To design and implement combinational and sequential circuits for practical applications
- To simulate combinational and sequential circuits using HDL

## Pre-requisites

- Electronic Devices Laboratory

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Design and construct different biasing circuits for BJT & MOSFET | Apply |
| CO2 | Design, implement and obtain the frequency response of single stage CE amplifier and feedback amplifiers. | Apply |
| CO3 | Design and implement an application circuit using power amplifier | Apply |
| CO4 | Design and implement application circuit using combinational and sequential logic circuits | Apply |
| CO5 | Design and simulate combinational and sequential logic circuits using HDL | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | - | 2 | - | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | - | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 2 | 2 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom''s Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|
| | Lab | Activity | | | |
| Remember | - | - | - | - | - |
| Understand | 25 | - | 50 | | 50 |
| Apply | 25 | 25 | 50 | | 50 |
| Analyse | - | - | - | - | - |
| Evaluate | - | - | - | - | - |
| Create | - | - | - | - | - |
| Total | 50 | 25 | 100 | - | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Common to ECE & EE | | | | | | | | |
| 60 EC 3P1 – Analog and Digital Electronics Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| III | 0 | 0 | 4 | 60 | 2 | 60 | 40 | 100 |

**List of Experiments*:**

Students have to design application circuits using analog electronic components / MOKU GO Kit / multisim software

**Analog experiments***

1. Design and simulation of BJT & MOSFET biasing circuits
2. Design and implementation of MOS amplifier circuits**
3. Analysis of frequency response of feedback amplifiers/ multistage amplifier
4. Design and implementation of application circuits using op-amp**

**Digital experiments***

5. Design and implementation of combinational circuits using logic gates**
6. Design and implementation of synchronous sequential circuits**
7. Design and implementation of asynchronous sequential circuits**
8. Design and implementation of FSM (Finite State Machine)**
9. Design and simulation of combinational / synchronous & asynchronous sequential circuits using HDL**

**Lab Manual**

| | |
|---|---|
| 1. | "Analog and Digital Electronics Laboratory", Department of Electronics Engineering (VLSI Design and Technology), KSRCT. |

*SDG 4 – Quality Education

**SDG 9 – Industry innovation and Infrastructure

**Course Designer(s)**


1. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in
2. Dr.S.Malarkhodi - malarkhodi@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023

Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 61 CS 0P2 | Data Structures and Algorithms Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ES | 0 | 0 | 4 | 2 |

## Objectives

- To design and implement simple linear and nonlinear data structures
- To strengthen the ability to identify and apply the suitable data structure for the given real-world problem
- To program for storing data as tree structure and implementation of various traversal techniques
- To implement sorting and searching techniques
- To gain knowledge of hashing techniques and graph applications

## Pre-requisites

- Programming knowledge in C language

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Demonstrate the implementation of linear data structures and its applications | Apply |
| CO2 | Investigate balanced parenthesis and postfix expressions with the help of stack ADT | Apply |
| CO3 | Implement non-linear data structure | Apply |
| CO4 | Implement sorting and searching techniques | Apply |
| CO5 | Implement Hashing Techniques, Shortest Path and Minimum Spanning Tree Algorithm | Analyse |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | - | - | - | - | - | 2 | - | - | 2 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 3 | - | - | - | - | 3 | - | - | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 2 | - | - | 3 | 2 | - | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 2 | - | - | 3 | 2 | 2 | - | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | - | 2 | 2 | 2 | 3 | 3 | 2 | - | 2 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|
| | Lab | Activity | | | |
| Remember | - | - | - | - | - |
| Understand | - | - | - | - | - |
| Apply | 40 | 15 | 80 | - | 80 |
| Analyse | 10 | 10 | 20 | - | 20 |
| Evaluate | - | - | - | - | - |
| Create | - | - | - | - | - |
| Total | 50 | 25 | 100 | - | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Common to ECE & EE | | | | | | | | |
| 61 CS 0P2 - Data Structures and Algorithms Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| III | 0 | 0 | 4 | 60 | 2 | 60 | 40 | 100 |

**List of Experiments*:**

1. Implementation of List Abstract Data Type (ADT)*
2. Implementation of Stack ADT*
3. Implementation of Queue ADT*
4. Implementation of stack applications: *
   (a) Program for ‘Balanced Parenthesis’
   (b) Program for ‘Evaluating Postfix Expressions’
5. Implementation Search Tree ADT*
6. Implementation of Sorting Algorithms *
7. Develop a program for various Searching Techniques *
8. Implementation of Hashing Techniques *
9. Implementation of Shortest Path Algorithm*
10. Implementation of Minimum Spanning Tree Algorithm*

*SDG 4 - Quality Education

**Course Designer(s)**

1. Dr.K.Poongodi - poongodik@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CG 0P2 | Career Skill Development - II | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 2 | 1 |

## Objectives

- To help learners improve their vocabulary and enable them to use words appropriately in different academic and professional contexts.
- To help learners develop strategies that could be adopted while reading texts.
- To help learners acquire the ability to speak and write effectively in english in real life and career related situations.
- To improve listening, observational skills, and problem-solving capabilities
- To develop message generating and delivery skills

## Pre-requisites

- Basic knowledge of reading and writing in English.

## Course Outcomes

On the Successful Completion of the Course, Students will be Able to

| | | |
|---|---|---|
| CO1 | Compare and contrast products and ideas in technical texts | Analyze |
| CO2 | Identify cause and effects in events, industrial processes through technical texts | Analyze |
| CO3 | Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format. | Analyze |
| CO4 | Report events and the processes of technical and industrial nature. | Apply |
| CO5 | Articulate their opinions in a planned and logical manner, and draft effective résumés in context of job search. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | - | - |
| CO2 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | - | - |
| CO3 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to All Branches**

**60 CG 0P2 - Career Skill Development - II**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| III | 0 | 0 | 2 | 30 | 1 | 100 | 00 | 100 |

| | |
|---|---|
| **Listening*** Evaluative Listening: Advertisements, Product Descriptions, - Audio / Video; Filling A Graphic Organiser (Choosing A Product or Service by Comparison) - Listening to Longer Technical Talks and Completing - Gap Filling Exercises. Listening Technical Information from Podcasts - Listening to Process/Event Descriptions to Identify Cause & Effects, Documentaries Depicting a Technical Problem and Suggesting Solutions - Listening to TED Talks | [6] |
| **Speaking*** Marketing a Product, Persuasive Speech Techniques - Describing and Discussing the Reasons of Accidents or Disasters Based on News Reports, Group Discussion (Based on Case Studies), Presenting Oral Reports, Mini Presentations on Select Topics with Visual Aids, Participating in Role Plays, Virtual Interviews | [6] |
| **Reading*** Reading Advertisements, User Manuals and Brochures - Longer Technical Texts - Cause and Effect Essays, and Letters / Emails of Complaint - Case Studies, Excerpts from Literary Texts, News Reports etc. - Company Profiles, Statement of Purpose (SoPs) | [6] |
| **Writing*** Professional Emails, Email Etiquette - Compare and Contrast Essay - Writing Responses to Complaints Precis Writing, Summarizing and Plagiarism- Job / Internship Application - Cover Letter & Resume | [6] |
| **Verbal Ability II*** Reading Comprehension (Inferential fillups) - Spotting Errors - Verbal Analogies - Theme Detection - Change of Voice - Change of Speech - One word substitution | [6] |
| **Total Hours:** | **30** |

**Reference(s):**


| | |
|---|---|
| 1. | "English for Engineers & Technologists", Orient Blackswan Private Ltd. Department of English, Anna University, 2020 |
| 2. | Norman Lewis, "Word Power Made Easy - The Complete Handbook for Building a Superior Vocabulary Book", Penguin Random House India, 2020 |
| 3. | Raman. Meenakshi, Sharma. Sangeeta, "Professional English". Oxford University Press. New Delhi. 2019 |
| 4. | Arthur Brookes and Peter Grundy, "Beginning to Write: Writing Activities for Elementary and Intermediate Learners", Cambridge University Press, New York, 2003 |


*SDG 4 - Quality Education

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Listening** | |
| 1.1 | Evaluative Listening: Advertisements, Product Descriptions | 1 |
| 1.2 | Listening to Longer Technical Talks and Completing – Gap Filling Exercises. | 1 |
| 1.3 | Listening Technical Information from Podcasts | 1 |
| 1.4 | Listening to Process/Event Descriptions to Identify Cause & Effects and Documentaries Depicting a Technical Problem and Suggesting Solutions | 1 |
| 1.5 | Listening to TED Talks | 2 |
| **2.0** | **Speaking** | |
| 2.1 | Marketing a Product, Persuasive Speech Techniques | 1 |
| 2.2 | Describing and Discussing the Reasons of Accidents or Disasters Based on News Reports | 1 |
| 2.3 | Group Discussion (Based on Case Studies) | 1 |
| 2.4 | Presenting Oral Reports, Mini Presentations on Select Topics with Visual Aids | 1 |
| 2.5 | Participating in Role Plays and Virtual Interviews | 2 |
| **3.0** | **Reading** | |
| 3.1 | Reading Advertisements, User Manuals and Brochures | 1 |
| 3.2 | Reading - Longer Technical Texts – Cause and Effect Essays, and Letters / Emails of Complaint | 1 |
| 3.3 | Case Studies, Excerpts from Literary Texts, News Reports Etc. | 1 |
| 3.4 | Company Profiles | 1 |
| 3.5 | Statement of Purpose (SoPs) | 2 |
| **4.0** | **Writing** | |
| 4.1 | Professional Emails, Email Etiquette | 1 |
| 4.2 | Compare and Contrast Essay | 1 |
| 4.3 | Writing Responses to Complaints | 1 |
| 4.4 | Precis Writing, Summarizing and Plagiarism | 1 |
| 4.5 | Job / Internship Application – Cover Letter & Résumé | 2 |
| **5.0** | **Verbal Ability II** | |
| 5.1 | Reading Comprehension (Inferential Fillups) And Theme Detection | 1 |
| 5.2 | Spotting Errors | 1 |
| 5.3 | Verbal Analogies | 1 |
| 5.4 | Change of Voice and Change of Speech | 1 |
| 5.5 | One Word Substitution | 2 |

**Course Designer(s)**

1. Dr.A.Palaniappan - palaniappan@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**

**(An Autonomous Institution affiliated to Anna University)**

B.E. / B.Tech. Degree Programme

**SCHEME OF EXAMINATIONS**

(For the candidates admitted in 2024-2025)

**FOURTH SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1. | 60 MA 016 | Probability and Inferential Statistics | 2 | 40 | 60 | 100 | 45 | 100 |
| 2. | 60 EC 401 | Signals and Systems | 2 | 40 | 60 | 100 | 45 | 100 |
| 3. | 60 EC 402 | Linear Integrated Circuits | 2 | 40 | 60 | 100 | 45 | 100 |
| 4. | 60 EC 403 | Electromagnetic Waves | 2 | 40 | 60 | 100 | 45 | 100 |
| 5. | 60 OE L1* | Open Elective I | 2 | 40 | 60 | 100 | 45 | 100 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 6. | 61 EC 404 | Analog Communication | 2 | 50 | 50 | 100 | 45 | 100 |
| **PRACTICAL** | | | | | | | | |
| 7. | 60 EC 4P1 | Linear Integrated Circuits and Electromagnetics Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 8. | 60 EC 4P2 | Electronic Design Project Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 9. | 60 CG 0P3 | Career Skill Development – III | 2 | 100 | 00 | 100 | 00 | 100 |
| 10. | 60 CG 0P6 | Internship | - | 100 | - | 100 | - | 100 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 MA 016 | Probability and Inferential Statistics | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | BS | 3 | 1 | 0 | 4 |

## Objectives

- To learn the basic concepts of probability
- To get exposed to some standard distributions
- To familiarize the concepts of correlation and regression
- To familiarize various methods in hypothesis testing
- To get exposed to various statistical methods for time series

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Interpret the basics of probability. | Apply |
| CO2 | Interpret the concepts of standard distributions. | Apply |
| CO3 | Calculate coefficient of correlation and regression. | Apply |
| CO4 | Apply Student's t test, F test and Chi-square test for testing the statistical hypothesis. | Apply |
| CO5 | Apply suitable methods for measuring trend values. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO3 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO4 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO5 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - |

3 - Strong; 2 - Medium; 1 – Some

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 20 |
| Apply | 40 | 40 | 70 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R 2022**

**B.E - Electronics and Communication Engineering**

**60 MA 016 - Probability and Inferential Statistics**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| IV | 3 | 1 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Probability and Random Variables*** <br> Axioms of Probability – Conditional Probability – Baye's Theorem – Random Variable – Expectation – Probability Mass Function – Probability Density Function – Moment Generating Function. <br> **Hands – on:** <br> Calculate the mean and variance for discrete distributions. | [9] |
| **Standard Distributions** <br> Discrete Distributions: Binomial, Poisson*** and Geometric Distributions – Continuous Distributions: Uniform, Exponential and Normal Distributions – Properties. <br> **Hands - on:** <br> Fit the Normal distribution. | [9] |
| **Two Dimensional Random Variables*** <br> Joint Distributions – Marginal and Conditional Distributions – Covariance – Correlation and Regression – Rank Correlation. <br> **Hands - on:** <br> Calculate the correlation coefficient and lines of regression | [9] |
| **Testing of Hypothesis**** <br> Type I and Type II Errors – Test of Significance of Small Samples: Student's 'T' Test – Single Mean – Difference of Means – F- Test – Chi-Square Test – Goodness of Fit – Independence of Attributes. <br> **Hands - on:** <br> Applied Chi-square test to real data set. | [9] |
| **Time Series*** <br> Components of a Time Series – Method of Least Square – Parabolic Trend – Exponential Trend – Method of Seasonal Variations – Ratio to Trend Method – Link Relative Method. <br> **Hands - on:** <br> Fit a curve to the given data using method of least squares. | [9] |
| **Total Hours: (Lecture - 45; Hands - on - 05; Tutorial - 10)** | **60** |

**Text Book(s):**

| | |
|---|---|
| 1. | Richard A Johnson, "Miller & Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education Limited, New Delhi, 2018. |
| 2. | P N Arora and S Arora, "Statistics for Management", 5th Edition, Sultan Chand & Sons, New Delhi, 2015. |

**Reference(s):**

| | |
|---|---|
| 1. | Sheldon Ross, "A first course in Probability", 10th Edition, Pearson Education, New Delhi, 2019. |
| 2. | Veerarajan T, ''Probability, Statistics and Random process'',4th Edition, Tata McGraw-Hill Education, 2015. |
| 3. | Gupta S.P, "Statistical Methods", 45th Edition, Sultan Chand & sons, New Delhi, 2017. |
| 4. | Montgomery D.C, Cheryl L.Jennings and Murat Kulahci "Introduction to Time Series Analysis and Forecasting", 2nd Edition, John Wiley and Sons, 2015. |

*SDG 4 – Quality Education
**SDG 9 – Industry, Innovation, and Infrastructure
***SDG 2 – Zero Hunger

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S.No | Topic | No. of Hours |
|---|---|---|
| **1** | **Probability and Random Variables** | |
| 1.1 | Axioms of Probability | 1 |
| 1.2 | Conditional Probability | 1 |
| 1.3 | Baye's Theorem | 2 |
| 1.4 | Random Variable, Expectation | 2 |
| 1.5 | Probability Mass Function | 1 |
| 1.6 | Probability Density Function | 1 |
| 1.7 | Moments Generating Function. | 1 |
| 1.8 | Tutorial | 2 |
| 1.9 | Hands on | 1 |
| **2** | **Standard Distributions** | |
| 2.1 | Discrete Distributions- Binomial Distribution | 2 |
| 2.2 | Poisson Distribution | 1 |
| 2.3 | Geometric Distribution | 1 |
| 2.4 | Continuous Distributions - Uniform Distribution | 2 |
| 2.5 | Exponential Distribution | 1 |
| 2.6 | Normal Distribution | 1 |
| 2.7 | Properties | 1 |
| 2.8 | Tutorial | 2 |
| 2.9 | Hands on | 1 |
| **3** | **Two Dimensional Random Variables** | |
| 3.1 | Joint Distributions | 1 |
| 3.2 | Marginal Distribution | 1 |
| 3.3 | Conditional Distribution | 1 |
| 3.4 | Covariance | 1 |
| 3.5 | Correlation | 2 |
| 3.6 | Regression | 1 |
| 3.7 | Rank Correlation | 2 |
| 3.8 | Tutorial | 2 |
| 3.9 | Hands on | 1 |
| **4** | **Testing of Hypothesis** | |
| 4.1 | Type I and Type II Errors | 1 |
| 4.2 | Test of Significance of Small Samples -Student's 'T' Test | 1 |
| 4.3 | Single Mean | 1 |
| 4.4 | Difference of Means. | 2 |
| 4.5 | F- Test | 2 |
| 4.6 | Chi-Square Test – Goodness of Fit | 1 |
| 4.7 | Independence of Attributes. | 1 |
| 4.8 | Tutorial | 2 |
| 4.9 | Hands on | 1 |
| **5** | **Time Series** | |
| 5.1 | Components of a Time Series | 1 |
| 5.2 | Method of Least Square | 1 |
| 5.3 | Parabolic Trend | 2 |
| 5.4 | Exponential Trend | 1 |
| 5.5 | Method of Seasonal Variations | 2 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.6 | Ratio to Trend Method | 1 |
| 5.7 | Link Relative Method | 1 |
| 5.8 | Tutorial | 2 |
| 5.9 | Hands on | 1 |

**Course Designer(s)**


1 Mrs. D.Padmavathi - padmavathi@ksrct.ac.in
2 Mr. D.Senthil Raja - senthilrajad@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 401 | Signals and Systems (Common to ECE & EE) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 2 | 1 | 0 | 3 |

## Objectives

- To understand the basic properties of signals & systems and analysis of LTI systems
- To understand the sampling and reconstruction of CT signals.
- To analyse continuous time and discrete time signals and systems in the Fourier series and Fourier transform.
- To analyse discrete time signals and systems using z-transform.
- To study DFT and FFT algorithms

## Pre-requisites

- Integrals, Partial Differential Equations and Laplace transform.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the classification of signals and systems with their properties and analyse LTI systems. | Apply |
| CO2 | Analyse the concepts of sampling and reconstruction of CT signals. | Apply |
| CO3 | Analyse continuous-time and discrete-time signals and systems using Fourier series and Fourier transform | Apply |
| CO4 | Analyse discrete-time signals and systems using z-transform | Apply |
| CO5 | Computation of DFT and FFT algorithms | Apply |

## Mapping with Programme Outcomes

| Cos | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | 2 | 2 | - | - | 3 | 3 | - | - | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | - | 2 | 2 | - | - | 3 | 3 | - | - | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | - | 2 | 2 | - | - | 3 | 3 | - | - | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | - | 2 | 2 | - | - | 3 | 3 | - | - | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | 3 | 3 | - | - | 3 | 3 | 2 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 30 |
| Apply | 40 | 40 | 60 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R 2022**

**Common to ECE and EE**

**60 EC 401 - Signals and Systems**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| IV | 2 | 1 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Introduction to Signals and Systems*** <br> Basic Continuous – Time (CT) & Discrete – Time (DT) Signals – Classification of CT & DT Signals – Basic CT and DT Signals – Signal Operations – Classification – Properties of CT & DT Systems – Analysis of LTI Systems: Convolution Sum – Convolution Integral – Properties. <br> **Hands - on:** Signal generation & operations and verification of system properties | [6] |
| **Sampling*** <br> Representation of CT Signals by Samples – Sampling Theorem – Impulse Train Sampling – Effects of Under Sampling – Reconstruction of CT Signal from Samples Using Interpolation. <br> **Hands - on:** Sampling and Reconstruction. | [6] |
| **Fourier Analysis of Continuous Time and Discrete Time Signals and Systems*** <br> Representation of Periodic Signals by Continuous Time Fourier Series (CTFS) and Discrete Time Fourier Series (DTFS) – Representation of CT Aperiodic and Periodic Signals by Continuous Time Fourier Transform – Representation of DT Aperiodic and Periodic Signals by Discrete Time Fourier Transform – Properties – Frequency Response of Systems Characterized by Differential Equations and Difference Equations. <br> **Hands - on:** Analysis and Synthesis of CT and DT signals and systems using Fourier Transform | [6] |
| **Z Transform Analysis of Discrete Time Signals and Systems*** <br> Z Transform – Two Sided and One-Sided Z Transform – Properties of Z Transform – Properties of ROC – Inverse Z Transform, Analysis of LTI Systems Using Z Transform – Stability and Causality in Z-Domain – Solution of Difference Equations – Frequency Response and Impulse Response. <br> **Hands - on:** Analysis of DT systems using z-transform. | [6] |
| **DFT and FFT Algorithms*** <br> Introduction – Frequency Domain Sampling: Discrete Fourier Transform (DFT) - Properties of DFT – Efficient Computation of the DFT: FFT Algorithms – Radix 2 FFT Algorithms: Decimation in Time and Decimation in Frequency <br> **Hands - on:** Verification of properties of DFT | [6] |
| **Total Hours: (Lecture - 30; Tutorial - 15):** | 45 |

**Text Book(s):**


1. Alan V.Oppenheim, Alan S.Willsky with S.Hamid Nawab, ‘‘Signals & Systems”, 2nd Edition, Pearson Education, 2013.
2. Lathi B.P, ‘‘Signal processing and Linear systems”, Oxford University Press, 2010.


**Reference(s):**


1. John G.Proakis and Dimitris G.Manolakis, ‘‘Digital Signal Processing, Principles, Algorithms and Applications”, 4th Edition, Prentice Hall, 2013.
2. Roberts M.J, ‘‘Signals and Systems Analysis using Transform method and MATLAB”, 3rd Edition, Tata McGraw-Hill, 2018.
3. Simon Haykin and Barry Van Veen, ‘‘Signals and Systems”, 2nd Edition, John Wiley & Sons, 2012.


* SDG 4 – Quality Education

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S.No | Topic | No. of Hours |
|---|---|---|
| **1** | **Introduction to signals and systems** | |
| 1.1 | Basic Continuous-Time (CT) & Discrete-Time (DT) Signals | 1 |
| 1.2 | Classification of CT Signals | 1 |
| 1.3 | Classification of DT Signals | 1 |
| 1.4 | Basic CT and DT Signals -Signal Operations, Classification | 1 |
| 1.5 | Properties of CT Systems, Properties of DT Systems | 1 |
| 1.6 | Analysis of LTI Systems: Convolution Sum, Convolution Integral, Properties | 1 |
| 1.7 | Tutorial and Hands on | 3 |
| **2** | **Sampling** | |
| 2.1 | Representation of CT Signals by Samples- Sampling Theorem | 1 |
| 2.2 | Sampling theorem Problems | 1 |
| 2.3 | Impulse Train Sampling | 1 |
| 2.4 | Effects of Under Sampling | 1 |
| 2.5 | Effects of Under Sampling Problems | 1 |
| 2.6 | Reconstruction of CT Signal from Samples Using Interpolation | 1 |
| 2.7 | Tutorial and Hands on | 3 |
| **3** | **Fourier Analysis of Continuous Time and Discrete Time Signals and Systems** | |
| 3.1 | Representation of Periodic Signals by Continuous Time Fourier Series (CTFS) | 1 |
| 3.2 | Representation of Periodic Signals by Discrete Time Fourier Series (DTFS) | 1 |
| 3.3 | Representation of CT Aperiodic and Periodic Signals by Continuous Time Fourier Transform | 1 |
| 3.4 | Representation of DT Aperiodic and Periodic Signals by Discrete Time Fourier Transform, Properties | 1 |
| 3.5 | Frequency Response of Systems Characterized by Differential Equations | 1 |
| 3.6 | Frequency Response of Systems Characterized by Difference Equations | 1 |
| 3.7 | Tutorial and Hands on | 3 |
| **4** | **Z Transform Analysis of Discrete Time Signals and Systems** | |
| 4.1 | Z Transform - Two Sided and One-Sided Z Transform | 1 |
| 4.2 | Properties of Z Transform and Properties of ROC | 1 |
| 4.3 | Inverse Z Transform | 1 |
| 4.4 | Analysis of LTI Systems Using Z Transform | 1 |
| 4.5 | Stability and Causality In Z-Domain | 1 |
| 4.6 | Solution of Difference Equations-Frequency Response and Impulse Response | 1 |
| 4.7 | Tutorial and Hands on | 3 |
| **5** | **DFT And FFT Algorithms** | |
| 5.1 | Frequency Domain Sampling | 1 |
| 5.2 | Discrete Fourier Transform (DFT) | 1 |
| 5.3 | Properties of DFT | 1 |
| 5.4 | Efficient Computation of the DFT | 1 |
| 5.5 | FFT Algorithms - Radix 2 FFT Algorithms: Decimation in Time (DIT) | 1 |
| 5.6 | Decimation in Frequency (DIF) | 1 |
| 5.7 | Tutorial and Hands on | 3 |

**Course Designer(s)**


1. Dr.P.Babu - pbabu@ksrct.ac.in
2. Ms.C.Saraswathy - saraswathy@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 402 | Linear Integrated Circuits | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objectives

- To study the circuit configuration of linear integrated circuits.
- To introduce practical applications of linear integrated circuits.
- To introduce the concept of analog multiplier and Phase Locked Loop with applications.
- To study the application of ADC and DAC in real time systems.
- To introduce special function ICs and its construction.

## Pre-requisites

- Electronic Circuits

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the circuit configuration of linear integrated circuits. | Understand |
| CO2 | Design linear and non-linear circuits using op-amps | Apply |
| CO3 | Explain the operation and applications of analog multiplier and PLL | Understand |
| CO4 | Design ADC and DAC circuits using op-amps | Apply |
| CO5 | Explain the working principle of special function ICs | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 3 | - |
| CO2 | 2 | 2 | 3 | - | 3 | - | - | - | - | - | - | 3 | 3 | 3 | - |
| CO3 | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | - | - | 3 | - | - | - | - | - | - | 3 | 3 | 3 | - |

3 - Strong; 2 - Medium; 1 – Some

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 25 | 25 | 40 |
| Apply | 25 | 25 | 40 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R 2022**

**B.E - Electronics and Communication Engineering**

**60 EC 402 - Linear Integrated Circuits**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| IV | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Circuit Configuration for Linear ICs*** <br> Current Sources, Analysis of Differential Amplifiers with Active Loads, Supply and Temperature Independent Biasing, Band Gap References, Monolithic IC Operational Amplifiers, Specifications, Frequency Compensation, Slew Rate and Methods of Improving Slew Rate. Interpretation of TL082 Datasheet. <br> **Hands - on:** <br> 1. Design and Simulation of Differential amplifier | [9] |
| **Linear and Non-Linear Applications of Op-Amp*** <br> Linear and Nonlinear Circuits Using Operational Amplifiers and their Analysis, Differentiator, Integrator, Instrumentation Amplifier, Sine Wave Oscillators, Low Pass, High Pass and Band Pass Filters, Multivibrator and Schmitt Trigger, Triangle Wave Generator, Log and Antilog Amplifiers. <br> **Hands - on:** <br> 1. Design and Simulation of Differentiator | [9] |
| **Analog Multiplier and PLL*** <br> Analysis of Four Quadrants and Variable Transconductance Multipliers, Analog Multiplier MPY634 Features, Voltage Controlled Oscillator, Closed Loop Analysis of PLL, AM, PM and FSK Modulators and Demodulators. | [9] |
| **Analog to Digital and digital to Analog Convertors *** <br> Sample and Hold Circuit -Digital to Analog Converters – Binary Weighted and R-2R Ladder Types – Analog to Digital Converters – Flash - Counter Ramp, Successive Approximation, Single, Dual Slope – DAC/ADC Performance Characteristics and Comparison. <br> **Hands - on:** <br> 1. AD/DA converters | [9] |
| **Special Function ICs** <br> **555 Timers, Voltage Regulators - Linear and Switched Mode Types, Switched Capacitor Filter, SMPS, Frequency to Voltage Converters, Power Amplifiers and Isolation Amplifiers, sources for Noises, Op-Amp Noise Analysis and Low noise Op-Amps. **** | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**

| | |
|---|---|
| 1. | RoyChoudry D, Shail Jain , ‘‘Linear integrated Circuits”, 5th Edition, New Age International Pvt Ltd, 2018. |
| 2. | Ramakant A., Gayakwad, ‘‘Op – Amps and Linear Integrated Circuits”, 4th Edition, Prentice Hall, 2017. |

**Reference(s):**

| | |
|---|---|
| 1. | Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Mc Graw Hill Education, 2014. |
| 2. | Sergio Franco., ‘‘Design with Operational Amplifiers and Analog Integrated Circuits”, 4th Edition, Tata McGraw-Hill, 2014. |
| 3. | Salivahanan S & KanchanaBhaskaran V.S, ‘‘Linear Integrated Circuits”, 3rd Edition, TMH, 2018. |
| 4. | Gray and Meyer, ‘‘Analysis and Design of Analog Integrated Circuits”, 5th Edition, Wiley International, 2010. |

*SDG 4 – Quality Education

**SDG 9 – Industry, Innovation and Infrastructure

**Assignment activity:**

Assignment 1- Covers module 1 & 2: Questions Related to Hands-on and Case Study & presentation on different types of op amps

1. Design RC Phase shift oscillator, Clipper & clamper using Opamp 741.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

2. Discuss and analyse the following parameters of ALM2403-Q1 IC & Compare with LM741,
   i) Features, ii) Applications.

Assignment 2 - Covers module 3 & 4: Questions related to Hands-on and Case study & presentation on different types of ADC/DAC:

1. Design 8-bit SAR Analog to digital converter.
2. Discuss and analyse the following parameters of ADC0804 8-Bit Analog to Digital A/D Converter IC DIP-20 Package IC i) Features, ii) Specifications

Assignment 3 - Covers module 5: Questions related to Hands-on

1. Design monostable multivibrator using 555 timer

**Course Contents and Lecture Schedule**

| S.No | Topic | No. of Hours |
|---|---|---|
| **1** | **Circuit Configuration for Linear ICs** | |
| 1.1 | Current Sources | 2 |
| 1.2 | Analysis of Differential Amplifiers with Active Loads | 2 |
| 1.3 | Supply and Temperature Independent Biasing | 1 |
| 1.4 | Monolithic IC Operational Amplifiers, Specifications | 1 |
| 1.5 | Frequency Compensation | 1 |
| 1.6 | Slew Rate and Methods of Improving Slew Rate. | 1 |
| 1.7 | Interpretation of TL082 Datasheet | 1 |
| **2** | **Application of Operational Amplifiers** | |
| 2.1 | Differentiator, Integrator | 1 |
| 2.2 | Instrumentation Amplifier | 1 |
| 2.3 | Sine Wave Oscillators | 2 |
| 2.4 | Low Pass, High Pass And | 1 |
| 2.5 | Band Pass Filters | |
| 2.6 | Schmitt Trigger | 1 |
| 2.7 | Multivibrator, Triangle Wave Generator | 1 |
| 2.8 | Log and Antilog Amplifiers. | 1 |
| **3** | **Analog Multiplier And PLL** | |
| 3.1 | Analysis of Four Quadrants and Variable Transconductance Multipliers | 2 |
| 3.2 | Analog Multiplier MPY634 Features | 1 |
| 3.3 | Voltage Controlled Oscillator | 1 |
| 3.4 | Closed Loop Analysis Of PLL | 2 |
| 3.5 | AM, PM Modulators and Demodulators | 2 |
| 3.6 | FSK Modulators and Demodulators | 1 |
| **4** | **Analog To Digital and Digital to Analog Convertors** | |
| 4.1 | Digital to Analog Converters - Binary Weighted | 1 |
| 4.2 | Digital to Analog Converters - R-2R Ladder Types | 1 |
| 4.3 | Sample and Hold Circuit | 2 |
| 4.4 | Continuous - Counter Ramp Type ADC | 1 |
| 4.5 | Successive Approximation | 1 |
| 4.6 | Single, Dual Slope | 2 |
| 4.7 | DAC/ADC Performance Characteristics and Comparison. | 1 |
| **5** | **Special Function ICs** | |
| 5.1 | 555 Timers | 2 |
| 5.2 | Voltage Regulators - Linear and Switched Mode Types | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.3 | Voltage Regulators -Switched Capacitor Filter | 1 |
| 5.4 | SMPS | 1 |
| 5.5 | Frequency to Voltage Converters | 1 |
| 5.6 | Power Amplifiers and Isolation Amplifiers | 1 |
| 5.7 | Op-Amp Noise Analysis | 1 |
| 5.8 | Low Noise Op-Amps | 1 |

**Course Designer(s)**


1. Dr.K.B.Jayanthi – jayanthikb@ksrct.ac.in
2. Mr.D.Poornakumar - poornakumard@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 403 | Electromagnetic Waves | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 1 | 0 | 4 |

## Objectives

- To introduce the concept of vector analysis
- To develop an understanding of electromagnetic laws and its application in boundaries
- To study Maxwell's equation, plane wave propagation in free space
- To introduce the concept of signal propagation through transmission lines and high frequency lines
- To illustrate the propagation of TE, TM and TEM rectangular, circular waveguides and cavity resonators

## Pre-requisites

- Circuit Analysis

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the vector quantities and apply vector integration and differentiation in different coordinate systems | Apply |
| CO2 | Apply the laws of electromagnetics to evaluate the boundary conditions for electric and magnetic fields and describe the propagation of plane electromagnetic waves | Apply |
| CO3 | Apply Faraday's law to find the electromotive force and calculate displacement current using Maxwell's equation for time varying magnetic field | Apply |
| CO4 | Evaluate the characteristics and wave propagation in high frequency transmission lines | Apply |
| CO5 | Describe rectangular and circular waveguides and understand the propagation of electromagnetic waves | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 2 | - |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | 3 | - |
| CO4 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 30 |
| Understand | 20 | 20 | 30 |
| Apply | 30 | 30 | 40 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E- Electronics and Communication Engineering**

**60 EC 403 - Electromagnetic Waves**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| IV | 3 | 1 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Vector Analysis *** Vectors Analysis: Vector Algebra, Vector Calculus – Divergence, Gradient, Curl, Laplacian; Coordinate Systems – Cartesian, Cylindrical and Spherical **Hands - on:** 1. Generate electromagnetic wave 2. Find the electrostatic potential in an air-filled annular quadrilateral frame | [9] |
| **Electromagnetics *** Coulomb's Law, Gauss's Law, Electric Scalar Potential, Laplace and Poisson's Equations, Conduction and Polarization, Boundary Conditions, Biot-Savart Law, Ampere's Law **Hands - on:** Solve a 2-D magnetostatic model for a ferromagnetic frame with an h–shaped cavity | [9] |
| **Electrodynamics*** Maxwell's Equations, Faraday's Induction, Displacement Current, Plane Wave Propagation in Free Space and in Materials; Poynting Vector, Reflection and Transmission of Plane Waves at Media Boundary | [9] |
| **Transmission Lines*** Transmission-Line General Solution – Loading. Impedance Transformation and Matching. Smith Chart, Quarter-Wave and Half-Wave Transformers. Single Stub Matching | [9] |
| **Waveguides*** Classification of Guided Wave Solutions – TE, TM and TEM Waves. Rectangular and Circular Waveguides. Excitation of Waveguides. Rectangular and Circular Cavity Resonators | [9] |
| **Total Hours: (Lecture - 45; Tutorial - 15)** | **60** |

**Text Book(s):**

| | |
|---|---|
| 1. | Matthew N.O.Sadiku , "Elements of Electromagnetics", 7th Edition , Oxford University Press , 2018. |
| 2. | E.C. Jordan & K.G. Balmain, "Electromagnetic waves & Radiating Systems", 2nd Edition, Prentice Hall, 2013. |

**Reference(s):**

| | |
|---|---|
| 1. | William H.Hayt, John A.Buck , "Engineering Electromagnetics", 8th Edition, McGraw Hill Education, 2017. |
| 2. | John. D. Ryder, "Network Lines and Fields", 2nd Edition, Pearson Education India, 2015. |
| 3. | David K.Cheng, "Field and Wave Electromagnetics", 2nd Edition, Pearson Education, 2015. |
| 4. | Umesh Sinha, "Transmission Lines and Networks", Satya Prakashan Publishing Company, New Delhi, 2010. |

*****SDG 4 - Quality Education

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Vector Analysis** | |
| 1.1 | Electromagnetic Waves – Introduction | 1 |
| 1.2 | Vectors, Position & Distance Vector, Component of Vectors | 1 |
| 1.3 | Cartesian and Cylindrical Coordinate Systems | 1 |
| 1.4 | Spherical Coordinates-Constant Coordinate Surface | 1 |
| 1.5 | Vector Calculus-Differential Length, Area, Volume | 1 |
| 1.6 | Line, Surface & Volume Integrals – Del Operator | 1 |
| 1.7 | Gradient of Scalar-Divergence of a Vector | 1 |
| 1.8 | Divergence Theorem-Curl of a Vector | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 1.9 | Stokes Theorem- Laplacian of Scalar and Vector Field | 1 |
| 1.10 | Tutorial | 3 |
| **2.0** | **Electromagnetics** | |
| 2.1 | Coulomb's Law | 1 |
| 2.2 | Gauss's Law | 1 |
| 2.3 | Electric Scalar Potential | 1 |
| 2.4 | Laplace and Poisson's Equations | 1 |
| 2.5 | Conduction and Polarization | 2 |
| 2.6 | Boundary Conditions | 1 |
| 2.7 | Biot-Savart Law | 1 |
| 2.8 | Ampere's Law | 1 |
| 2.9 | Tutorial | 3 |
| **3.0** | **Electrodynamics** | |
| 3.1 | Maxwell's Equations | 2 |
| 3.2 | Faraday's Induction | 1 |
| 3.3 | Displacement Current | 1 |
| 3.4 | Plane Wave Propagation in Free Space and In Materials | 2 |
| 3.5 | Poynting Vector | 1 |
| 3.6 | Reflection of Plane Waves at Media Boundary | 1 |
| 3.7 | Transmission of Plane Waves at Media Boundary | 1 |
| 3.8 | Tutorial | 3 |
| **4.0** | **Transmission Lines** | |
| 4.1 | Transmission Line – V & I Equation of Transmission Line | 2 |
| 4.2 | Propagation Constant & Characteristic Impedance | 1 |
| 4.3 | Reflection Coefficient & VSWR | 1 |
| 4.4 | Impedance Transformation and Matching | 1 |
| 4.5 | Smith Chart | 1 |
| 4.6 | Admittance Smith Chart, Applications of Smith Chart | 1 |
| 4.7 | Quarter-Wave and Half-Wave Transformers | 1 |
| 4.8 | Single Stub Matching | 1 |
| 4.9 | Tutorial | 3 |
| **5.0** | **Waveguides** | |
| 5.1 | Classification of Waveguides | 1 |
| 5.2 | TM Waves in Rectangular Waveguides | 1 |
| 5.3 | TE Waves in Rectangular Waveguides | 1 |
| 5.4 | Characteristics of TE, TM Waves | 1 |
| 5.5 | Cut-Off Wavelength, Phase Velocity and Impossibility of TEM Waves | 1 |
| 5.6 | TM and TE Waves in Circular Waveguides | 1 |
| 5.7 | Excitation of Waveguides | 1 |
| 5.8 | Rectangular Cavity Resonators | 1 |
| 5.9 | Circular Cavity Resonators | 1 |
| 5.10 | Tutorial | 3 |

**Course Designer(s)**

1. Mr Saravanan S - saravanan.s@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 61 EC 404 | Analog Communication | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 2 | 0 | 2 | 3 |

## Objectives

- To understand the mathematical basis of random process in communication
- To impart the fundamentals of basic communication system and describe the amplitude modulation techniques
- To introduce the different angle modulation techniques
- To describe different types of noise and predict its effect on analog communication systems.
- To study the function of various radio receivers

## Prerequisite

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the mathematical basis of random process in communication | Understand |
| CO2 | Illustrate the generation of different amplitude modulation waveforms | Apply |
| CO3 | Describe the generation of different angle modulation waveforms | Apply |
| CO4 | Analyze the noise in continuous wave modulation systems | Apply |
| CO5 | Discuss the parameters involved in various radio transmitters and receivers | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | 3 | - | - | - | - | - | - | - | 3 | 2 | - |
| CO2 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | - | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | - | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 10 | - | 10 | - | - | 20 | - |
| Understand | 40 | 30 | 40 | 30 | 30 | 60 | 30 |
| Apply | 10 | 70 | 10 | 70 | 70 | 20 | 70 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**61 EC 404 - Analog Communication**

| Semester | Hours / Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| IV | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Random Process**<br>Mathematical Definition of Random Process – Stationary Process – Mean, Correlation and Covariance Function, Ergodic Process, Transmission of Random Processes Through an LTI Filter, **Power Spectral Density***, Gaussian Process. | [6] |
| **Amplitude Modulation Techniques***<br>Elements of a Communication System, Need for Modulation – Theory of Amplitude Modulation Techniques, Generation of AM Signal, DSBSC Signal, SSB Signal, VSB Signal. | [6] |
| **Angle Modulation Techniques***<br>Theory of Angle Modulation Techniques – Frequency Modulation, Phase Modulation, Practical Issues in Frequency Modulation, Generation of FM – FM Methods, Direct Methods, Indirect Method. | [6] |
| **Noise ***<br>External Noise, Internal Noise, Noise Calculations, Noise Figure, Noise Temperature, Noisy Receiver Model, **Noise in AM And FM Receivers*.** | [6] |
| **Radio Transmitter and Receivers***<br>Radio Communication, **Radio Transmitters**** – **AM Transmitters****, SSB Transmitters, FM Transmitters, Receiver – TRF Receiver, **Superheterodyne Receiver****, **AM Receivers**, FM Receivers**.** | [6] |
| **Practical:**<br>1. Probability Density Function Estimation for a poisson distribution<br>2. Generation of AM wave<br>3. Generation of SSB Modulation<br>4. DSB-SC Modulator & Detector<br>5. Generation and Detection of FM wave<br>6. Spectrum analyzer and analysis of AM and FM signals<br>7. Frequency Division Multiplexing & De multiplexing<br>8. Noise Spectrum Analysis using Simulation Tool<br>9. Pulse Amplitude Modulation & Demodulation<br>10. Pre-emphasis & de-emphasis<br>11. PLL as FM Demodulator | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |

| | |
|---|---|
| **Text Book(s):** | |
| 1. | George Kennedy, Bernard Davis, Prasanna S R M, “Electronic Communication Systems”, 5th Edition, McGraw-Hill, 2012. |
| 2. | Simon Haykin, “Communication Systems”, 5th Edition, John Wiley & sons, 2010. |
| **Reference(s):** | |
| 1. | Lathi B.P, “Communication Systems”, BS publications, 2013. |
| 2. | Joy Laskar, Babak Matinpour, Sudipto Chakraborty, “Modern Receiver Front- Ends Systems, Circuits, and Integration”, Wiley- Interscience, 2007 |
| 3. | Bruce Carlson A and Paul Crilly, “Communication System”, 5th Edition, McGraw-Hill, 2013. |
| 4. | Taub, Donald Schilling, Gowtham Saha, “Principles of Communication Systems”, 4th Edition, McGraw-Hill, 2013. |

*SDG 4 - Quality education
**SDG 9 - Industry, Innovation and Infrastructure

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Random Process** | |
| 1.1 | Mathematical Definition of Random Process | 1 |
| 1.2 | Stationary Process | 1 |
| 1.3 | Mean, Correlation and Covariance Function | 1 |
| 1.4 | Ergodic Process | 1 |
| 1.5 | Transmission of Random Processes Through an LTI Filter, Power Spectral Density | 1 |
| 1.6 | Gaussian Process | 1 |
| **2** | **Amplitude Modulation Techniques** | |
| 2.1 | Elements of a Communication System | 1 |
| 2.2 | Need for Modulation | 1 |
| 2.3 | Theory of Amplitude Modulation Techniques | 1 |
| 2.4 | Generation of AM Signal | 1 |
| 2.5 | DSBSC Signal, SSB Signal | 1 |
| 2.6 | VSB Signal | 1 |
| **3** | **Angle Modulation Techniques** | |
| 3.1 | Theory of Angle Modulation Techniques | 1 |
| 3.2 | Frequency Modulation | 1 |
| 3.3 | Phase Modulation | 1 |
| 3.4 | Practical Issues in Frequency Modulation | 1 |
| 3.5 | Generation of FM - FM Methods | 1 |
| 3.6 | Direct Methods, Indirect Method | 1 |
| **4** | **Noise** | |
| 4.1 | External Noise | 1 |
| 4.2 | Internal Noise | 1 |
| 4.3 | Noise Calculations, Noise Figure, Noise Temperature | 1 |
| 4.4 | Noisy Receiver Model | 1 |
| 4.5 | Noise in AM Receivers | 1 |
| 4.6 | Noise in FM Receivers | 1 |
| **5** | **Radio Transmitter and Receivers** | |
| 5.1 | Radio communication | 1 |
| 5.2 | Radio Transmitters, AM Transmitters | 1 |
| 5.3 | SSB Transmitters, FM Transmitters, | 1 |
| 5.4 | Receiver - TRF Receiver, Superheterodyne Receiver | 1 |
| 5.5 | AM Receivers | 1 |
| 5.6 | FM Receivers | 1 |
| **Practical:** | | |
| 1. | Probability Density Function Estimation for a poisson distribution | 2 |
| 2. | Generation of AM wave | 2 |
| 3. | Generation of SSB Modulation | 2 |
| 4. | DSB-SC Modulator & Detector | 2 |
| 5. | Generation and Detection of FM wave | 4 |
| 6. | Spectrum analyzer and analysis of AM and FM signals | 2 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 7. | Frequency Division Multiplexing & De multiplexing | 4 |
| 8. | Noise Spectrum Analysis using Simulation Tool | 2 |
| 9. | Pulse Amplitude Modulation & Demodulation | 4 |
| 10. | Pre-emphasis & de-emphasis | 2 |
| 11. | PLL as FM Demodulator | 4 |

**Course Designer(s)**

1. Mrs.S.S.Thamilselvi - sstamilselvi@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 4P1 | Linear Integrated Circuits and Electromagnetics Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 4 | 2 |

## Objectives

- To design and test the various circuits using Op-amp
- To design and test the various circuits using 555 timers
- To construct and test the phase locked loop
- To construct and test different data convertor circuits
- To demonstrate the field configurations in different geometries and waveguides

## Pre-requisites

- Electronic Circuits

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Design and test the various applications of op-amp | Apply |
| CO2 | Design and test the various applications of 555 timer | Apply |
| CO3 | Design and test the various applications of PLL | Apply |
| CO4 | Design and test the different data convertors | Apply |
| CO5 | Simulate the field configurations in different geometries and waveguides | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | 3 | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | 3 | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | 3 | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | 2 | - | - | 3 | 3 | - | - | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | - | - | - | - |
| Understand | - | - | 20 | 20 |
| Apply | 50 | 25 | 80 | 80 |
| Analyse | - | - | - | - |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |
| Total | 50 | 25 | 100 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 4P1- Linear Integrated Circuits and Electromagnetics Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| IV | 0 | 0 | 4 | 60 | 2 | 60 | 40 | 100 |

**List of Experiments:**

1. Application circuits using Op-Amp*
2. Application circuits using 555 timer*
3. Application circuits using PLL*
4. Application circuits using data convertors*
5. Simulation of the variation of electric field in point charge geometry and parallel plate capacitor geometry*
6. Simulation of Transverse electric modes in rectangular waveguide*

*SDG 4 – Quality Education

**Course Designer(s)**


1. Mr D.Poornakumar - poornakumard@ksrct.ac.in
2. Mr.S.Saravanan - saravanan.s@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 4P2 | Electronic Design Project Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 4 | 2 |

## Objectives

- To illustrate the design, application and limitations of electronic circuits through laboratory experience
- To introduce the analysis, testing and prototyping of electronic circuits
- To design various power supply blocks needed for electronic circuits
- To design various modules needed for a signal transmitter
- To stimulate student interests and help solve circuit problems using basic concepts

## Pre-requisites

- Analog and Digital Electronics Laboratory

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Design & build electronic circuits/systems using discrete components, FET transistors, Operational amplifiers, IC 555 timer and other Linear ICs to meet the desired specifications | Apply |
| CO2 | Design and develop digital circuits for the given specifications | Apply |
| CO3 | Exhibit creativity in the design of systems, circuits or processes and implement them | Apply |
| CO4 | Design regulated power supplies | Apply |
| CO5 | Switch to design mode of thinking for signal transmitter design with increased competence and success in circuit Implementation | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | - | - | - | - |
| Understand | - | - | - | - |
| Apply | 50 | 25 | 50 | 50 |
| Analyse | - | - | 50 | 50 |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |
| Total | 50 | 25 | 100 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 4P2 - Electronic Design Project Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| IV | 0 | 0 | 4 | 60 | 2 | 60 | 40 | 100 |

Students have to design application circuits/systems using analog and digital electronic components. Circuits can be chosen from the given list but need not be confined to it.

1. Design of low-noise, high-performance analog circuits*
2. Digital circuit design*
3. Electronic circuit prototyping, circuit debugging, and testing*
4. Design of power supply**
5. Design of signal transmitter**

*SDG 4 – Quality Education
**SDG 9 – Industry, innovation and Infrastructure

**Course Designer(s)**

1. Dr.C.Rajasekaran - rajasekaran@ksrct.ac.in
2. Dr.K.B.Jayanthi – jayanthikb@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CG 0P3 | Career Skill Development - III | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 2 | 1 |

## Objectives

- To help learners improve their logical reasoning skills at different academic and professional contexts.
- To help learners relate basic quantitative problems and solve them.
- To help learners Infer critically the statements with optimal conclusions and assumptions.
- To solve the quantitative problems pertaining to calculations of averages, ratio and proportions, and profit and loss effectively
- To compute quantitative problems related to time and work, speed and distance, and simple and compound interest

## Pre-requisites

- Basic knowledge of Arithmetic and Logical Reasoning

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Deduce the topics in logical reasoning at the preliminary and intermediate level. | Analyze |
| CO2 | Relate basic quantitative problems and solve them effectively at the preliminary level | Apply |
| CO3 | Infer critically the statements with optimal conclusions and assumptions with the data and information given. | Analyze |
| CO4 | Solve the quantitative problems pertaining to calculations of averages, ratio and proportions, and profit and loss effectively at the pre-intermediate level. | Apply |
| CO5 | Compute quantitative problems related to time and work, speed and distance, and simple and compound interest at intermediate level. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 2 | 2 | 2 | 3 | - | 3 | - | - | - | 2 | 3 | 3 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | - | 2 | - | - | - | 2 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 2 | 2 | 2 | 2 | - | 3 | - | - | - | 2 | 3 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | - | 2 | - | - | - | 2 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | - | 2 | - | - | - | 2 | 3 | 3 | 2 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to All Branches**

**60 CG 0P3 - Career Skill Development - III**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| IV | 0 | 0 | 2 | 30 | 1 | 100 | 00 | 100 |

| | |
|---|---|
| **Logical Reasoning*** Analogies - Alpha and Numeric Series - Number Series - Coding and Decoding - Blood Relations - Coded Relations - Order and Ranking – Odd Man Out - Direction and Distance | [6] |
| **Quantitative Aptitude – Part 1*** Number System - Squares & Cubes - Divisibility - Unit Digits - Remainder Theorem - HCF & LCM - Geometric and Arithmetic Progression - Surds & Indices | [6] |
| **Critical Reasoning*** Syllogism - Statements and Conclusions, Cause and Effect, Statements and Assumptions - Identifying Strong Arguments and Weak Arguments – Cause and Action -Data Sufficiency | [6] |
| **Quantitative Aptitude – Part 2*** Average - Ratio and Proportion – Ages – Partnership– Percentage - Profit & Loss – Discount - Mixture and Allegation | [6] |
| **Quantitative Aptitude – Part 3*** Time & Work - Pipes and Cistern – Time, Speed & Distance - Trains - Boats and Streams - Simple Interest and Compound Interest | [6] |
| **Total Hours:** | **30** |

**Reference(s):**


| | |
|---|---|
| 1. | Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi. |
| 2. | Abhijit Guha, “Quantitative Aptitude”, 6th Edition, McGraw Hill Education, 2016. |
| 3. | Dinesh Khattar, “Quantitative Aptitude for Competitive Examinations”, Pearson Education 2020. |
| 4. | Anne Thomson, “Critical Reasoning: A Practical Introduction”, 3rd Edition, Lexicon Books, 2022. |


*SDG 4 – Quality Education
*SDG 8 – Decent work and Economic growth
*SDG 9 – Industry, innovation and Infrastructure

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Logical Reasoning** | |
| 1.1 | Analogies - Alpha and Numeric Series | 1 |
| 1.2 | Number Series - Coding and Decoding | 1 |
| 1.3 | Blood Relations - Coded Relations | 1 |
| 1.4 | Order and Ranking – Odd Man Out | 1 |
| 1.5 | Direction and Distance | 2 |
| **2.0** | **Quantitative Aptitude – Part 1** | |
| 2.1 | Number System | 1 |
| 2.2 | Squares & Cubes - Divisibility | 1 |
| 2.3 | Unit Digits - Remainder Theorem | 1 |
| 2.4 | HCF & LCM- Geometric and Arithmetic Progression | 1 |
| 2.5 | Surds & Indices | 2 |
| **3.0** | **Critical Reasoning** | |
| 3.1 | Syllogism | 1 |
| 3.2 | Statements and Conclusions, Cause and Effect | 1 |
| 3.3 | Statements and Assumptions | 1 |
| 3.4 | Identifying Strong Arguments and Weak Arguments | 1 |
| 3.5 | Cause and Action - Data Sufficiency | 2 |
| **4.0** | **Quantitative Aptitude – Part 2** | |
| 4.1 | Average - Ratio and Proportion | 1 |
| 4.2 | Ages – Partnership | 1 |
| 4.3 | Percentage | 1 |
| 4.4 | Profit & Loss | 1 |
| 4.5 | Discount - Mixture and Allegation | 2 |
| **5.0** | **Quantitative Aptitude – Part 3** | |
| 5.1 | Time & Work | 1 |
| 5.2 | Pipes and Cistern | 1 |
| 5.3 | Time, Speed & Distance - Trains | 1 |
| 5.4 | Boats and Streams | 1 |
| 5.5 | Simple interest and Compound interest | 2 |

**Course Designer(s)**

1. R. Poovarasan - poovarasan@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC L01 | Internet of Things | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | OE | 1 | 0 | 4 | 3 |

**Objectives**

- To understand basics of an IoT System,
- To understand and Evaluate sensors available for IoT applications
- To analysis best IoT hardware and communication protocols for specified applications
- To understand and realize data storage, data analysis for IoT applications
- To design and develop real time IoT enabled applications

**Pre-requisites**

- Microprocessors and Microcontrollers, Basics of C Programming

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe basic premise of an IOT System | Understand |
| CO2 | Compare types of sensors available based on IoT applications | Analyse |
| CO3 | Demonstrate the communication protocols for IoT | Apply |
| CO4 | Implement cloud storage, data analysis and management | Analyse |
| CO5 | Analysis the potential business model and viable market for IoT products | Analyse |

**Mapping with Programme Outcomes**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | - | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | - | 3 |
| CO2 | 3 | 2 | 3 | 2 | - | - | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

**Assessment Pattern**

| Assessment 1 (Presentation) | | Assessment 2 (CA Test) | Assessment 3 (Model – Presentation) | |
|---|---|---|---|---|
| **Assessment Parameters** | **Marks** | **Marks** | **Assessment Parameters** | **Marks** |
| Problem Identification | 10 | Questions from CO1 to CO4 As per CA Test Pattern | Innovation | 30 |
| Innovation | 30 | | Clarity in Presentation | 10 |
| Solution for problem | 10 | | Demo | 30 |
| Clarity in Presentation | 05 | | Completion of Report | 20 |
| Viva | 05 | | Viva | 10 |
| **Total** | **60** | **60** | **Total** | **100** |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Open Elective** | | | | | | | | |
| **60 EC L01 - Internet of Things** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| | 1 | 0 | 4 | 75 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Internet of Things*** Functional Blocks of an IoT System (Sensors, Data Aggregation, Communication, Analysis, Decision Making, Actuation) IoT Architecture Layers, IoT Enabled Domains, M2M, Difference Between IoT, Embedded Systems and M2M, Industry 4.0 Concepts. | [3+12] |
| **IoT Sensors and Hardware*** Passive and Active Sensors, Types of Sensors (Temperature, Humidity, Pressure, Obstacle, Water Flow, Accelerometer, Colour, Gyro, Load Cell, Finger Print-Touch, Motion, Ultrasonic Distance, Magnetic Vibration, Eye Blink, Hear Beat, PPG, Glucose, Body Position, Blood Pressure), IoT Front End Hardware - Microcontrollers, Programming ESP32, Interfacing of Sensors. | [3+12] |
| **IoT Protocols*** Infrastructure (6LoWPAN, IPv4/IPv6, RPL), Identification (EPC, uCode, IPv6, URIs), Communication/ Transport (Wi-Fi, Bluetooth, Zigbee, LPWAN-LoRA), Data Protocols (MQTT, CoAP, AMQP, WebSocket, Node, LoRaWAN), Programming MQTT. | [3+12] |
| **IoT Cloud and Data Analytics*** Collecting Data from Sensors, Data Ingress, Cloud Storage, IoT Cloud Platforms (Amazon AWS, Microsoft Azure, Google APIs), Data Analytics for IoT, Software and Management Tool for IoT, Dashboard Design. | [3+12] |
| **IoT and Entrepreneurship*** Business Models for IoT Product, Lean Canvas, Market Analysis, Startup Policy and Fundings, Idea Pitching, Entity Formation, Legal and IPR. | [3+12] |
| **Total Hours: (Lecture - 15; Practical - 60)** | **75** |
| **Text Book(s):** | |

| | |
|---|---|
| 1. | Arshdeep Bahga, Vijay Madisetti, “Internet – of- Things – A Hands on Approach”, Universities Press, 2015. |
| 2. | Raj kamal, “Internet of Things, Architecture and Design Principles”, McGraw-Hill, 2017. |
| **Reference(s):** | |
| 1. | Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014. |
| 2. | Adrian McEwen & Hakim Cassimally, “Designing the Internet of Things”, Wiley, Nov 2013. |

*SDG 9 – Industry Innovation and Infrastructure

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Internet of Things** | |
| 1.1 | Functional Blocks of an IoT System | 1 |
| 1.2 | IoT Architecture Layers | 1 |
| 1.3 | Industry 4.0 Concepts | 1 |
| **2** | **IoT Sensors and Hardware** | |
| 2.1 | Passive and Active Sensors | 1 |
| 2.2 | IoT Front End Hardware | 1 |
| 2.3 | Interfacing of Sensors | 1 |
| **3** | **IoT Protocols** | |
| 3.1 | Infrastructure | 1 |
| 3.2 | Data Protocols | 1 |
| 3.3 | Programming MQTT | 1 |
| **4** | **IoT Cloud and Data Analytics** | |
| 4.1 | Collecting Data from Sensors | 1 |
| 4.2 | IoT Cloud Platforms | 1 |
| 4.3 | Software and Management Tool for IoT | 1 |
| **5** | **IoT and Entrepreneurship** | |
| 5.1 | Business Models for IoT Product | 1 |
| 5.2 | Startup Policy and Fundings | 1 |
| 5.3 | Legal and IPR | 1 |
| **6** | **Project** | |
| 6.1 | Problem Identification | 10 |
| 6.2 | Solution for Problem | 15 |
| 6.3 | Implementation | 20 |
| 6.4 | Presentation | 5 |
| 6.5 | Report | 5 |
| 6.6 | Demo | 5 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC L02 | Wearable Devices | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | OE | 3 | 0 | 0 | 3 |

## Objectives

- To learn the field of wearable devices and applications
- To study the various components and technologies used in wearable devices
- To discuss the product development and design factors in wearable device
- To understand the security issues, privacy concerns
- To learn about the psychological effects, and social impact, health issues related to wearable devices

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the history, current devices used as wearables and their applications | Understand |
| CO2 | Describe the key functions and basic principles of various components and technologies used in wearable devices | Understand |
| CO3 | Illustrate the development process and design considerations in wearable products | Understand |
| CO4 | Review security and privacy issues in wearable technology | Understand |
| CO5 | Explore the psychological and social impact, health concerns related to wearable devices | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | 2 | 2 | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | 2 | 2 | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | 2 | 2 | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 15 | 15 | 20 |
| Understand | 45 | 45 | 80 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Open Elective** | | | | | | | |
| **60 EC L02 - Wearable Devices** | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | |
| | L | T | P | | C | CA | ES | Total |
| | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Evolution of Wearables**<br>Evolution of Wearable Technology - Role of Wearables - Applications of Wearable Technology in Industry Sectors' Overview - Wearables: Challenges and Opportunities, Future and Research - Wearable Biomedical Devices and Its Applications Case Study: Google glass, Health monitoring. | [9] |
| **Components and Technologies****<br>Wearable Components and Technologies: Microcontrollers and Microprocessors, Operating Systems, Sensors, Wireless Connectivity Unit, Battery Technology, User Interface Elements - Artificial intelligence - Machine learning - IoT - Data mining - Virtual and Augmented Reality - Voice Recognition. | [9] |
| **Product Development and Design Considerations**<br>Product Development Process - Engineering Analysis, Prototyping, Testing and Validation, Production. Design considerations- Various Factors and Requirements – Operational, Power Packaging and Material, Maintenance. | [9] |
| **Security Issues and Privacy Concerns**<br>Security and Privacy Issues in Wearable Technology, Correlation between Product and Security Related Factors, Functionality vs. Perceived Security and Privacy, System Vulnerabilities and Potential Attack, Attack Categories - Potential Solutions - Product Case Examples. | [9] |
| **Psychological and Social Impact, Health Concern***<br>Psychological Effects of Wearables, Social Implications, Technology Acceptance Factors, Electromagnetic Radiation, Specific Absorption Rate, Thermal Effects, Cancer - Fertility, - Vision and Sleep Disorder - Pain and Discomfort - Electromagnetic Intolerance and Other Risks. | [9] |
| **Total Hours** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | HaiderRaad, "The Wearable Technology Handbook", United Scholars Publication, 2017. |
| 2. | Hang,Yuan-Ting, "Wearable Medical Sensors and Systems", Springer, 2013. |
| **Reference(s):** | |
| 1. | http://www.medgadget.com |
| 2. | https://www.wareable.com |
| 3. | Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability", Cambridge University Press, 2013. |
| 4. | Edward Sazonov, Michael R Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications", Elsevier, 2014. |

*SDG 3 - Good Health and Well Being
** SDG 9 - Sustainable industrialization and foster innovation

**Assignment Activity:**

**Assignment 1:**

1. Prepare a case study on wearable applications.
2. Poster Presentation components and technologies.

**Assignment 2:**

1. Group discussion in product development process.

**Assignment 3:**

1. Video presentation on security and privacy issues.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Evolution of Wearables** | |
| 1.1 | Evolution of wearable technology | 1 |
| 1.2 | Role of Wearables | 1 |
| 1.3 | Applications of wearable Technology in industry sectors' overview | 1 |
| 1.4 | Wearables: challenges and opportunities | 1 |
| 1.5 | Future and research | 1 |
| 1.6 | Wearable Biomedical Devices | 1 |
| 1.7 | Biomedical Devices Applications | 1 |
| 1.8 | Case Study: Google glass | 1 |
| 1.9 | Case Study: Health monitoring | 1 |
| **2** | **Components and Technologies** | |
| 2.1 | Wearable Components and Technologies | 1 |
| 2.2 | Microcontrollers and Microprocessors | 1 |
| 2.3 | Operating Systems, Sensors | 1 |
| 2.4 | Wireless Connectivity Unit, Battery technology | 1 |
| 2.5 | User Interface Elements | 1 |
| 2.6 | Artificial Intelligence, Machine Learning | 1 |
| 2.7 | IoT, Data Mining | 1 |
| 2.8 | Virtual and Augmented Reality | 1 |
| 2.9 | Voice Recognition | 1 |
| **3** | **Product Development and Design Considerations** | |
| 3.1 | Product Development Process | 1 |
| 3.2 | Engineering Analysis | 1 |
| 3.3 | Prototyping | 1 |
| 3.4 | Testing and Validation, Production | 1 |
| 3.5 | Design Considerations | 1 |
| 3.6 | Various Factors and Requirements | 1 |
| 3.7 | Operational | 1 |
| 3.8 | Power Packaging and Material | 1 |
| 3.9 | Maintenance | 1 |
| **4** | **Security Issues and Privacy Concerns** | |
| 4.1 | Security issues | 1 |
| 4.2 | Privacy issues in wearable technology | 1 |
| 4.3 | Correlation between Product and Security Related Factors | 1 |
| 4.4 | Functionality vs. Perceived Security and Privacy | 1 |
| 4.5 | System Vulnerabilities and Potential Attack | 1 |
| 4.6 | Attack Categories | 1 |
| 4.7 | Potential solutions | 1 |
| 4.8 | Product case examples | 2 |
| **5** | **Psychological and Social Impact, Health Concern** | |
| 5.1 | Psychological Effects of Wearables | 1 |
| 5.2 | Social Implications | 1 |
| 5.3 | Technology Acceptance Factors | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.4 | Electromagnetic Radiation, Specific Absorption Rate | 1 |
| 5.5 | Thermal Effects, Cancer | 1 |
| 5.6 | Fertility, Vision | 1 |
| 5.7 | Sleep Disorder | 1 |
| 5.8 | Pain and Discomfort | 1 |
| 5.9 | Electromagnetic Intolerance and Other Risks | 1 |

**Course Designer(s)**

1. Ms.R.Ramya - rramya@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC L03 | Next Generation Wireless Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | OE | 3 | 0 | 0 | 3 |

## Objectives

- To study about advanced wireless networks, 4G/5G
- To study about SDN basics and architecture
- To study about NFV basics and architecture
- To study about Network Slicing & Radio access network
- To understand the recent trends and various applications in Next generation wireless networks

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the principles of latest 4G/5G networks | Understand |
| CO2 | Explain the SDN basics and architecture | Understand. |
| CO3 | Describe the NFV basics and architecture | Understand. |
| CO4 | Discuss about the concepts of network slicing & radio access network | Understand. |
| CO5 | Illustrate the recent trends and various applications in Next generation wireless networks | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 40 |
| Understand | 40 | 40 | 60 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Open Elective** | | | | | | | | |
| **60 EC L03 – Next Generation Wireless Networks** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Wireless Networks**<br>3G, 4G(LTE) and 5G - Evolving LTE to 5G Capability - 5G NR and 5G Core Network (5GCN) - 5G Standardization - 5G Architecture - Spectrum for 5G - 5G Deployment - Options, Challenges and Applications.<br>**Hands - on:**<br>1. Implementation of Time Division Multiplexing.<br>2. Implementation of CDMA.<br>3. Modeling a 4G LTE System. | [9] |
| **Software-defined networking***<br>SDN Origins and Evolution, - Background on Implantation of SDN for 5G -Hybrid Architecture of SDN and SDR - SDN Based Network Configuration to Deliver Content Intelligently over LTE. | [9] |
| **Network functions virtualization***<br>Network Functions Virtualization - Features of NFV-NFV and SDN Relationship - NFV Architecture, Evolution & Background - NFV Layers and Architecture | [9] |
| **Network Slicing & Radio access network***<br>Network Slicing - Key Concepts – Architecture - Benefits of 5G infrastructure in Network Slicing - RAN Architecture - Advantages and Challenges of the Cloud (or Centralized) RAN (C-RAN) and the Virtualized RAN (V-RAN). | [9] |
| **Recent Trends and applications***<br>Massive IoT and Ultra - Low-Latency Applications, Narrow - Band IoT (NB-IoT) and Machine to Machine (M2M) Communications, 6G Applications - Unmanned Aerial Vehicles (UAV), Optical Wireless Communication (OWC). | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Saad Z. Asif, “5G Mobile Communications Concepts and Technologies”, 1st Edition, CRC Press, 2019. |
| 2. | Ulrich Trick, “An Introduction to the 5th Generation Mobile Networks”, Walter de Gruyter ,2021. |
| **Reference(s):** | |
| 1. | Afif osseiran, Jose F. Monserrat, Patrick marsch, “5G Mobile and wireless communications technology“, Cambridge university, 2016. |
| 2. | Ying Zhang, “Network Function Virtualization: Concepts and Applicability in 5G Networks”, John Wiley & Sons, 2018. |
| 3. | Guy Pujolle, “Software Networks: Virtualization, SDN, 5G and Security”, John Wiley & Sons, 2015. |
| 4. | Dr. William Stallings, “5G Wireless A Comprehensive Introduction”, Addison-wesley, 2021. |

*SDG 9 - Build resilient infrastructure and foster innovation

**Assignment activity:**

**Assignment 1:**

1. Chart work and presentation on Electromagnetic spectrum.

**Assignment 2:**

1. Implementation of SDN using simulator.

**Assignment 3:**

1. Mini project on M2M communication.

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Wireless Networks** | |
| 1.1 | 3G and 4G(LTE) | 1 |
| 1.2 | 5G | 1 |
| 1.3 | Evolving LTE to 5G Capability | 1 |
| 1.4 | 5G NR and 5G Core Network (5GCN) | 1 |
| 1.5 | 5G Standardization | 1 |
| 1.6 | 5G Architecture | 1 |
| 1.7 | Spectrum for 5G | 1 |
| 1.8 | 5G Deployment | 1 |
| 1.9 | Options, Challenges and Applications | 1 |
| **2.0** | **Software-defined networking** | |
| 2.1 | Introduction | 1 |
| 2.2 | SDN Origins | 1 |
| 2.3 | SDN Evolution | 1 |
| 2.4 | SDN Architecture | 1 |
| 2.5 | Background on Implantation of SDN for 5G | 1 |
| 2.6 | Hybrid Architecture of SDN and SDR | 1 |
| 2.7 | Hybrid Architecture of SDN and SDR | 1 |
| 2.8 | SDN Based Network Configuration to Deliver Content Intelligently over LTE. | 1 |
| 2.9 | SDN Based Network Configuration to Deliver Content Intelligently over LTE. | 1 |
| **3.0** | **Network functions virtualization** | |
| 3.1 | Introduction | 1 |
| 3.2 | Network Functions Virtualization | 1 |
| 3.3 | Features of NFV | 1 |
| 3.4 | NFV and SDN Relationship | 1 |
| 3.5 | NFV Architecture, | 1 |
| 3.6 | Evolution | 1 |
| 3.7 | NFV Layers | 1 |
| 3.8 | Background | 1 |
| 3.9 | Applications | 1 |
| **4.0** | **Network Slicing & Radio access network** | |
| 4.1 | Introduction to Network Slicing | 1 |
| 4.2 | Key Concepts | 1 |
| 4.3 | Network Slicing Architecture | 1 |
| 4.4 | Benefits of 5G infrastructure in Network Slicing | 1 |
| 4.5 | Architecture | 1 |
| 4.6 | Advantages and Challenges of the Cloud (or Centralized) RAN (C-RAN) | 1 |
| 4.7 | Advantages and Challenges of the Virtualized RAN (V-RAN). | 1 |
| 4.8 | C-RAN Architecture | 1 |
| 4.9 | V-RAN Architecture | 1 |
| **5.0** | **Recent Trends and applications** | |
| 5.1 | Massive IoT | 1 |
| 5.2 | Ultra-Low-Latency Applications | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.3 | Narrow-Band IoT (NB-IoT) | 1 |
| 5.4 | Machine To Machine (M2M) Communication | 1 |
| 5.5 | 6G Applications | 1 |
| 5.6 | Unmanned Aerial Vehicles (UAV) | 1 |
| 5.7 | Unmanned Aerial Vehicles (UAV)-Challenges | 1 |
| 5.8 | Optical Wireless Communication (OWC) | 1 |
| 5.9 | Optical Wireless Communication (OWC) -Challenges | 1 |

**Course Designer(s)**

1. Mr.R.Satheesh kumar - satheeshkumar@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC L04 | Microprocessor and Microcontroller | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | OE | 3 | 0 | 0 | 3 |

## Objectives

- To introduce the architecture and programming of 8085 microprocessor
- To introduce the architecture, programming and interfacing of 8051 micro controller
- To understand the special function registers of 8051 and to perform an assembly level programming.
- To introduce the AI boards
- To develop microcontroller-based Applications

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs | Understand |
| CO2 | Discuss the architecture and features of 8051 | Understand |
| CO3 | Discuss the functions of the special function registers | Understand |
| CO4 | Discuss the Edge AI development KIT | Understand |
| CO5 | Develop microcontroller-based system and interface various input and output peripherals. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 40 |
| Understand | 40 | 40 | 40 |
| Apply | - | - | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Open Elective** | | | | | | | |
| **60 EC L04 – Microprocessor and Microcontroller** | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | |
| | L | T | P | | C | CA | ES | Total |
| | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **8085** – **8 Bit Microprocessor*** <br> 8085 Architecture – Instruction Set – Addressing Modes – Interrupt Structure – Timing Diagrams – Memory Interfacing – Interfacing I/O Devices – Assembly Language Programming. | [9] |
| **8051** – **8 Bit Microcontroller*** <br> 8051 – Architecture, Clock and RESET Circuits, PSW, Stack and Stack Pointer, Program Counter, I/O Pins Ports and Circuits, Instruction Set, Addressing Modes. | [9] |
| **8051 Special Purpose Registers and Programming*** <br> Special Function Register – Interfacing of Memory Devices – Timer Programming, Serial Data Transfer – UART – I/O Ports and Port Expansion, Programing on Interrupts. Assembly Language Programs, C Language Programs using SFR** | [9] |
| **Peripheral Interfacing**** <br> Standard Interfaces – RS232, USB, SPI and I2C, Interfacing of Sensors, DAC, ADC, PWM, DC Motor, Stepper Motor and LCD Interfacing. | [9] |
| **AI Based Board*** <br> Basic Principles of OS – OS Architecture – Overview of an Edge AI Hardware, Basic Setup and OS Installation, Python and C Programming, Linux Library Installation, Executing AI Models in Edge AI Hardware**. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Ramesh S Gaonkar, “Microprocessor Architecture, Programming and application with 8085”, 6th Edition, Penram International Publishing, 2015. |
| 2. | Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin Mc Kinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2nd Edition, Pearson Education, 2011. |
| **Reference(s):** | |
| 1. | Krishna Kant, “Microprocessors and microcontrollers Architecture, Programming and System design 8085, 8086, 8051, 8096”, 3rd Reprint, Prentice Hall of India, 2014. |
| 2. | Ayala K.J, “8051 Microcontroller”, Delmar Cengage Learning, 3rd Edition, 2007. |
| 3. | NPTEL video lectures by M. Krishna Kumar, IISc. |

*SDG 4 - Quality Education
**SDG 9 - Industry Innovation and Infrastructure

**Assignment Activity:**

**Assignment 1** – Covers Module 1 & 2 Questions related to the problems and simulation / Hands on

1. Arithmetic operation for 8085 processor.

**Assignment 2 -** Covers Module 1 & 2 Questions related to the problems and simulation / Hands on

1. Embedded C program for configuring the Ports and Peripheral interface with 8051.

**Assignment 3** – Mini Project

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **8085 – 8 Bit Microprocessor** | |
| 1.1 | 8085 Architecture | 1 |
| 1.2 | Instruction set | 1 |
| 1.3 | Addressing modes | 1 |
| 1.4 | Interrupt structure | 1 |
| 1.5 | Timing diagrams | 1 |
| 1.6 | Interfacing basics | 1 |
| 1.7 | Memory interfacing | 1 |
| 1.8 | Interfacing I/O devices | 1 |
| 1.9 | Assembly language programming | 1 |
| **2.0** | **8051 – 8 Bit Microcontroller** | |
| 2.1 | 8051 – Architecture | 1 |
| 2.2 | Clock Circuits | 1 |
| 2.3 | RESET circuits PSW | 1 |
| 2.4 | Stack and Stack Pointer | 1 |
| 2.5 | Program Counter | 1 |
| 2.6 | I/O Pins Ports | 1 |
| 2.7 | I/O Pins Ports and Circuits | 1 |
| 2.8 | Instruction set | 1 |
| 2.9 | Addressing modes | 1 |
| **3.0** | **8051 Special Purpose Registers and Programming** | |
| 3.1 | Special Function register | 1 |
| 3.2 | Interfacing of memory devices | 1 |
| 3.3 | Timer programming | 1 |
| 3.4 | Serial data transfer – UART | 1 |
| 3.5 | I/O ports and port expansion | 1 |
| 3.6 | I/O ports expansion | 1 |
| 3.7 | Programing on Interrupts | 1 |
| 3.8 | Assembly language programs, | 1 |
| 3.9 | C language programs using SFR | 1 |
| **4.0** | **Peripheral Interfacing** | |
| 4.1 | Standard interfaces – RS232 | 1 |
| 4.2 | Standard interfaces – USB | 1 |
| 4.3 | I2C | 1 |
| 4.4 | Interfacing of sensors | 1 |
| 4.5 | DAC | 1 |
| 4.6 | ADC | 1 |
| 4.7 | PWM | 1 |
| 4.8 | DC motor, Stepper motor | 1 |
| 4.9 | LCD interfacing | 1 |
| **5.0** | **AI Based Board** | |
| 5.1 | Basic principles of OS | 1 |
| 5.2 | OS Architecture | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.3 | Edge AI Hardware, | 1 |
| 5.4 | OS Setup | 1 |
| 5.5 | OS installation | 1 |
| 5.6 | Python Programming | 1 |
| 5.7 | C Programming | 1 |
| 5.8 | Linux library installation | 1 |
| 5.9 | Executing AI models in Edge AI Hardware. | 1 |

**Course Designer(s)**


1. Dr. C. Rajasekaran – rajasekaran@ksrct.ac.in
2. Dr.T.Baranidharan - baranidharan@ksrct.ac.in


Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC L05 | 5G Communications and MIMO | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | OE | 3 | 0 | 0 | 3 |

## Objectives

- To equip the participants with fundamental understanding of the key requirements, key capabilities and usage scenarios of 5G and the key innovations behind it.
- To guide the participants to identify the various opportunities offered by 5G.
- To provide awareness about the issues and challenges for 5G deployment.
- Understand the massive MIMO for 5G.
- Learn the different 5G applications and its security.

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Recall the basic concepts of Wireless communication. | Understand |
| CO2 | Apply the cellular concepts of 5G mobile Communication. | Apply |
| CO3 | Contrast the concepts of different multiple access techniques and MIMO techniques. | Understand |
| CO4 | Illustrate the massive MIMO of 5G technology. | Understand |
| CO5 | Explain the concepts of 5G Application and Security. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 40 |
| Understand | 30 | 40 | 50 |
| Apply | 10 | - | 10 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Open Elective** | | | | | | | | |
| **60 EC L05 - 5G Communications and MIMO** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Communication Systems**<br>General Communication Systems, Main Classification of Signals, Frequency and Wavelength, Bandwidth, Half Duplex and Full Duplex, Transmission Lines, MODEM, Multiplexing, Electromagnetic Spectrum, Evaluation of Mobile Technologies 1G to 4G.<br>**Hands - on:**<br>**1.** Simulation of Time Division Multiple Access and Space Division Multiple Access<br>**2.** MIMO Wireless System Design for 5G using MATLAB<br>3. 5G Waveforms Generation using MATLAB | [9] |
| **Cellular concepts***<br>Frequency Reuse-System Architecture - Hand off - Interference & System Capacity - Reflection-Diffraction - Scattering-Fading - Coverage and Capacity Improvement: Cell Splitting-Sectoring – Repeaters - Microcell Zone Concepts. | [9] |
| **Multiple Access Techniques***<br>Multiple Access - Techniques: FDMA, TDMA, CDMA, SDMA, OFDM, Filter Banks, GFDM, OTFS, Packet Radio, Non-Orthogonal Multiple Accesses (NOMA). | [9] |
| **MIMO***<br>Point-to-Point MIMO, Virtual MIMO (relaying), Multiuse MIMO, Massive MIMO, Propagation Channel Model, Channel Estimation, Uplink and Downlink Data Transmission Capacity Bounds, Achievable Rate, Energy and Spectral Efficiency Trade-Off. | [9] |
| **5G Applications****<br>High Speed Mobile Network, Device-to-Device (D2D), Vehicle to Vehicle Communication (V2V), Vehicle to Infrastructure Communication (V2I), Smart Home, Smart Cities, Industrial IOT, Security and Surveillance, Indoor and Outdoor Positioning Accuracy Technologies, Enhanced Mobile Broadband (eMBB). | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock, "Millimeter Wave Wireless Communications", 1st Edition, Pearson,2014.. |
| 2. | Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, "5G Mobile Communications", Springer, 2017. |
| **Reference(s):** | |
| 1. | W.C.Y.Lee, "Mobile Communications Engineering: Theory and applications", 2nd Edition, McGraw-Hill International, 2009. |
| 2. | David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge university press, 2005. |
| 3. | Martin Sauter, "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell, 2016. |

*SDG 4 - Quality education

**SDG 9 - Industry, Innovation and Infrastructure

**Assignment activity:**

Questions related to the simulation / Hands on/chart preparation

**Assignment 1 – Covers Module 1 &2**

1. Electromagnetic Spectrum- Chart Preparation
2. Multiplexing- Simulation

**Assignment 2 - Covers Module 3 &4**

1. FDMA, TDMA, CDMA, SDMA, OFDM- Simulation

**Assignment 3:**

1. Case study - 5G Applications

Passed in BoS Meeting held on 13/05/2023

Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Communication Systems** | |
| 1.1 | General Communication Systems | 1 |
| 1.2 | Main Classification of Signals, Frequency and Wavelength | 1 |
| 1.3 | Bandwidth | 1 |
| 1.4 | Half Duplex and Full Duplex | 1 |
| 1.5 | Transmission Lines | 1 |
| 1.6 | MODEM | 1 |
| 1.7 | Multiplexing | 1 |
| 1.8 | Electromagnetic Spectrum | 1 |
| 1.9 | Evaluation of Mobile Technologies 1G to 4G | 1 |
| **2.0** | **Cellular concepts** | |
| 2.1 | Frequency Reuse-System Architecture | 1 |
| 2.2 | Hand Off | 1 |
| 2.3 | Interference & System Capacity | 1 |
| 2.4 | Reflection | 1 |
| 2.5 | Diffraction | 1 |
| 2.6 | Scattering | 1 |
| 2.7 | Fading | 1 |
| 2.8 | Coverage and Capacity Improvement: Cell Splitting | 1 |
| 2.9 | Sectoring, Repeaters, Microcell Zone Concepts | 1 |
| **3.0** | **Multiple Access Techniques** | |
| 3.1 | Multiple Access Techniques | 1 |
| 3.2 | FDMA, TDMA | 1 |
| 3.3 | CDMA, SDMA | 1 |
| 3.4 | OFDM | 1 |
| 3.5 | Filter Banks | 1 |
| 3.6 | GFDM | 1 |
| 3.7 | OTFS | 1 |
| 3.8 | Packet Radio | 1 |
| 3.9 | Non-Orthogonal Multiple Accesses (NOMA) | 1 |
| **4.0** | **MIMO** | |
| 4.1 | Point-to-Point MIMO | 1 |
| 4.2 | Virtual MIMO (relaying) | 1 |
| 4.3 | Multiuse MIMO | 1 |
| 4.4 | Massive MIMO | 1 |
| 4.5 | Propagation Channel Model | 1 |
| 4.6 | Channel Estimation | 1 |
| 4.7 | Uplink and Downlink Data Transmission Capacity Bounds | 1 |
| 4.8 | Achievable Rate | 1 |
| 4.9 | Energy and Spectral Efficiency Trade-Off | 1 |
| **5.0** | **5G Applications** | |
| 5.1 | High Speed Mobile Network | 1 |
| 5.2 | Device-to-Device (D2D) | 1 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.3 | Vehicle to Vehicle Communication (V2V) | 1 |
| 5.4 | Vehicle to Infrastructure Communication (V2I), Smart Home | 1 |
| 5.5 | Smart Cities | 1 |
| 5.6 | Industrial IOT | 1 |
| 5.7 | Security and Surveillance, | 1 |
| 5.8 | Indoor and Outdoor Positioning Accuracy Technologies | 1 |
| 5.9 | Enhanced Mobile Broadband (eMBB) | 1 |

**Course Designer(s)**

1. Mr.R.Satheesh Kumar - satheeshkumar@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC L06 | Mobile Robotics | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | OE | 3 | 0 | 0 | 3 |

## Objectives

- To broaden the importance of Robot Locomotion
- To learn the knowledge of mobile Robot kinematics and dynamics
- To broaden the importance of GPS and sensors
- To enhance the knowledge about Localization, Planning and Navigation
- To make the student design, fabricate, motion planning, and control of intelligent mobile robotic systems

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Summarize about the Robot Locomotion | Apply |
| CO2 | Explain the Kinematics and Dynamics of Mobile Robots | Apply |
| CO3 | Utilize the Sensors and GPS in Robots | Apply |
| CO4 | Solve the Localization and Planning problems in Mobile Robots | Apply |
| CO5 | Apply the knowledge of Navigation in Mobile Robots | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 2 | 2 | 2 | - | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 2 | 2 | 2 | - | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 2 | - | - | 2 | 2 | 2 | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 2 | 2 | 2 | - | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 2 | - | - | 2 | 2 | 2 | - | 2 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 34 |
| Understand | 20 | 20 | 33 |
| Apply | 20 | 20 | -30 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Open Elective** | | | | | | | | |
| **60 EC L06 - Mobile Robotics** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Robot Locomotion*** Types of Locomotion - Hopping Robots, Legged Robots, Wheeled Robots - Stability - Manoeuvrability - Controllability. | [9] |
| **Mobile Robot Kinematics and Dynamics*** Forward And Inverse Kinematics - Holonomic and Nonholonomic Constraints - Kinematic Models of Simple Car and Legged Robots - Dynamics Simulation of Mobile Robots. | [9] |
| **Perception*** Proprioceptive/Exteroceptive and Passive/Active Sensors - Performance Measures of Sensors - Sensors For Mobile Robots Like Global Positioning System (GPS) - Doppler Effect Based Sensors - Vision Based Sensors - Uncertainty In Sensing – Filtering. | [9] |
| **Localization*** Odometric Position Estimation - Belief Representation - Probabilistic Mapping - Markov Localization - Bayesian Localization - Kalman Localization - Positioning Beacon Systems. | [9] |
| **Planning and navigation*** Path Planning Algorithms Based on A-Star - Dijkstra, Voronoi Diagrams- Probabilistic Roadmaps (PRM), Rapidly Exploring Random Trees (RRT), Markov Decision Processes (MDP) - Stochastic Dynamic Programming (SDP). | [9] |
| **Total Hours:** | **45** |
| **Text Book(s):** | |

| | |
|---|---|
| 1. | Siegwart R, Nourbakhsh I.R, "Introduction to Autonomous Mobile Robots", The MIT Press, 2017. |
| 2. | Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms in MATLAB", Springer Tracts in Advanced Robotics, 2018. |
| **Reference(s):** | |
| 1. | La Valle S.M, "Planning Algorithms", Cambridge University Press, 2016. |
| 2. | Thrun S, Burgard W and Fox D, "Probabilistic Robotics", MIT Press, Cambridge MA, 2017. |
| 3. | Melgar E.R and Diez C.C, "Arduino and Kinect Projects: Design", Build Blow Their Minds, 2016. |

*SDG 9 – Industry Innovation and Infrastructure

**Assignment activity:**

**Assignment 1:**
Create the actual framework of your mobile robot with open source CAD software, which includes components like as wheels, motors, sensors, and any other required pieces.

**Assignment 2:**
Provide a simulation of a real-world application in which GPS and navigation are crucial to improving the autonomy and performance of mobile robotics. Examine the limits and potential future improvements in GPS-based navigation for mobile robotics.

**Assignment 3:**
Poster presentation

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Robot locomotion** | |
| 1.1 | Introduction to Robot Locomotion | 1 |
| 1.2 | Hopping Robots | 2 |
| 1.3 | Legged Robots | 2 |
| 1.4 | Wheeled Robots | 2 |
| 1.5 | Stability – Maneuverability - Controllability | 2 |
| **2.0** | **Mobile Robot Kinematics and Dynamics** | |
| 2.1 | Introduction Mobile Robot Kinematics and Dynamics | 1 |
| 2.2 | Forward and Inverse Kinematics | 2 |
| 2.3 | Holonomic and Nonholonomic Constraints | 2 |
| 2.4 | Kinematic Models of Simple Car and Legged Robots | 2 |
| 2.5 | Dynamics Simulation of Mobile Robots | 2 |
| **3.0** | **Perception** | |
| 3.1 | Perception | 1 |
| 3.2 | Proprioceptive/Exteroceptive and Passive/Active Sensors | 1 |
| 3.3 | Performance Measures of Sensors | 1 |
| 3.4 | Sensors for Mobile Robots | 1 |
| 3.5 | Global Positioning System (GPS) | 1 |
| 3.6 | Doppler Effect-Based Sensors | 1 |
| 3.7 | Vision-Based Sensors | 1 |
| 3.8 | Uncertainty in Sensing | 1 |
| 3.9 | Filtering | 1 |
| **4.0** | **Localization** | |
| 4.1 | Localization | 1 |
| 4.2 | Odometric Position Estimation | 1 |
| 4.3 | Belief Representation | 1 |
| 4.4 | Probabilistic Mapping | 1 |
| 4.5 | Markov Localization | 1 |
| 4.6 | Bayesian Localization | 2 |
| 4.7 | Kalman Localization | 1 |
| 4.8 | Positioning Beacon Systems | 1 |
| **5.0** | **Introduction to planning and navigation** | |
| 5.1 | Introduction to Planning and Navigation | 1 |
| 5.2 | Path Planning Algorithms Based On A-Star | 1 |
| 5.3 | Dijkstra | 1 |
| 5.4 | Voronoi Diagrams | 1 |
| 5.5 | Probabilistic Roadmaps (PRM) | 2 |
| 5.6 | Rapidly Exploring Random Trees (RRT) | 1 |
| 5.7 | Markov Decision Processes (MDP) | 1 |
| 5.8 | Stochastic Dynamic Programming (SDP) | 1 |

**Course Designer(s)**

1. Dr.D. Mugilan - mugilan@ksrct.ac.in

Passed in BoS Meeting held on 13/05/2023
Approved in Academic Council Meeting held on 03/06/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**
**(An Autonomous Institution affiliated to Anna University)**
B.E. / B.Tech. Degree Programme
**SCHEME OF EXAMINATIONS**
(For the candidates admitted in 2024-2025)
FIFTH SEMESTER

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1. | 60 EC 501 | Control Systems Engineering | 2 | 40 | 60 | 100 | 45 | 100 |
| 2. | 60 EC 502 | VLSI and Chip Design | 2 | 40 | 60 | 100 | 45 | 100 |
| 3. | 60 EC 503 | Digital Signal Processing | 2 | 40 | 60 | 100 | 45 | 100 |
| 4. | 60 EC 504 | Microprocessors and Microcontrollers | 2 | 40 | 60 | 100 | 45 | 100 |
| 5. | 60 OE L2* | Open Elective II | 2 | 40 | 60 | 100 | 45 | 100 |
| 6. | 60 MY 003 | Startups and Entrepreneurship | 2 | 100 | - | 100 | - | 100 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 7. | 60 EC E1* | Professional Elective I | 2 | 50 | 50 | 100 | 45 | 100 |
| **PRACTICAL** | | | | | | | | |
| 8. | 60 EC 5P1 | Microcontrollers Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 9. | 60 EC 5P2 | VLSI Laboratory | 2 | 60 | 40 | 100 | 45 | 100 |
| 10. | 60 EC 5P3 | Signal Processing Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 11. | 60 CG 0P4 | Career Skill Development – IV | 2 | 100 | 00 | 100 | 00 | 100 |
| 12. | 60 CG 0P6 | Internship | - | 100 | - | 100 | - | 100 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 501 | Control Systems Engineering | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 1 | 0 | 4 |

## Objectives

- To understand the concepts of mathematical models, transfer function, block diagram reduction techniques and signal flow graphs.
- To learn methods for improving system time response and frequency response and types of controllers.
- To learn the concepts of stability in time domain and frequency domain.
- To analyse the frequency domain response of the given systems.
- To analyse digital control system using the state space technique.

## Pre-requisites

- Integrals, Partial Differential Equations and Laplace Transform

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Derive the mathematical modelling of the physical systems and find out the transfer function using block diagram reduction techniques and signal flow graphs. | Apply |
| CO2 | Apply standard test signals to a second order control system to determine their characteristics in time and frequency domain. | Apply |
| CO3 | Analyse the control system behaviour using stability analysis technique. | Apply |
| CO4 | alyse the open loop control system using frequency response methods and various types of compensators to determine stability margins. | Apply |
| CO5 | Analyse the state variable model of a discrete time control systems. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 2 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 2 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 2 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 30 |
| Apply | 40 | 40 | 60 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC 501 - Control Systems Engineering**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| V | 3 | 1 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Systems Modeling*** <br> Open loop and Closed loop Systems - Modeling of Electrical and Mechanical Systems - Translational and Rotational Systems - Block Diagram Reduction - Signal Flow Graph - Mason's Gain Formula - Applications of Control Systems - Drone Control System Design****.** <br> **Hands - on:** Write a program to find the overall transfer function if the two system are connected to cascade system, parallel system and feedback system. | [9] |
| **Time and Frequency Domain Analysis*** <br> Standard test signals - Time response of Second Order Systems - Performance Specifications on System Time Response - Types of systems - Steady State Error - Introduction to PID Controllers - Performance Specifications on System Frequency Response. <br> **Hands - on:** Plot the time response and frequency response of the given system subjected to standard input | [9] |
| **Stability Analysis*** <br> Concepts of Stability - Routh Stability Criterion - Concepts of Root Locus Technique - Guidelines for Sketching Root Locus. <br> **Hands - on**: Sketch the root locus of the unity feedback systems governed by the open loop transfer function | [9] |
| **Frequency Response and System Analysis*** <br> Polar plot - Nyquist stability Criterion - Bode Plot - Compensator Design using Bode Plot - Cascade Lead Compensation, Cascade Lag Compensation. <br> **Hands - on:** Write a program to draw the polar plot and bode plot for various open loop transfer function and calculate gain margin and phase margin. | [9] |
| **State Space Analysis of Digital Control Systems*** <br> State Space Representation of Discrete time Systems - Solution of Discrete Time State Space Equation - State Transition Matrix - Decomposition Techniques - Controllability and Observability, <br> **Hands - on:** Write a program to determine the controllability and observability of the system governed by state model. | [9] |
| **Total Hours: (Lecture - 45; Tutorial - 15)** | **60** |

| | |
|---|---|
| **Text Book(s):** | |
| 1. | Gopal M, "Control Systems, Principles & Design", 4th Edition, Tata McGraw Hill, 2012. |
| 2. | Nagrath I.J & Gopal M, "Control Systems Engineering", 6th Edition, New Age International Publishers, 2018. |
| **Reference(s):** | |
| 1. | Norman S.Nise, "Control Systems Engineering", 8th Edition, Wiley, 2019. |
| 2. | Ogata K, "Modern Control Engineering", 5h Edition, Pearson Education India, 2015 |
| 3. | Ogata K, "Discrete Time Control Systems", 2nd Edition, Pearson Education India, 2012 |
| 4. | Benjamin.C. Kuo, Farid Golnaraghi, "Automatic Control Systems", 10th Edition, McGraw-Hill Education, 2017. |

*SDG 4 - Quality Education

**SDG 9 - Industry Innovation and Infrastructure

Passed in BoS Meeting held on 18/11/2023

Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Systems Modeling** | |
| 1.1 | Open Loop and Closed Loop Systems & Modeling of Electrical Systems | 1 |
| 1.2 | Modeling of Mechanical Systems | 1 |
| 1.3 | Translational Systems | 1 |
| 1.4 | Rotational Systems | 1 |
| 1.5 | Block Diagram Reduction - Rules | 1 |
| 1.6 | Block Diagram Reduction - Problems | 1 |
| 1.7 | Signal Flow Graph - Concept | 1 |
| 1.8 | Mason's Gain Formula - Problem | 1 |
| 1.9 | Applications of Control Systems - Drone Control System Design | 1 |
| 1.10 | Tutorial | 3 |
| **2.0** | **Time and Frequency Domain Analysis** | |
| 2.1 | Standard Test Signals | 1 |
| 2.2 | Time Response of Second Order Systems | 1 |
| 2.3 | Time Response of Second Order Systems- Problems | 1 |
| 2.4 | Performance Specifications on System Time Response- Concepts | 1 |
| 2.5 | Performance Specifications on System Time Response- Problems | 1 |
| 2.6 | Types of Systems & Steady State Error | 1 |
| 2.7 | Introduction to PID Controllers | 1 |
| 2.8 | Performance Specifications on System Frequency Response | 1 |
| 2.9 | Specifications on System Frequency Response - Problems | 1 |
| 2.10 | Tutorial | 3 |
| **3.0** | **Stability Analysis** | |
| 3.1 | Concepts of Stability | 1 |
| 3.2 | Routh Stability Criterion - Concepts | 1 |
| 3.3 | Routh Stability Criterion - Problems | 1 |
| 3.4 | Routh Stability Criterion - Problems | 1 |
| 3.5 | Concepts of Root Locus Technique | 1 |
| 3.6 | Guidelines for Sketching Root Locus | 1 |
| 3.7 | Sketching Root Locus | 1 |
| 3.8 | Sketch the Root Locus - Problems | 1 |
| 3.9 | Sketch the Root Locus - Problems | 1 |
| 3.10 | Tutorial | 3 |
| **4.0** | **Frequency Response and System Analysis** | |
| 4.1 | Polar Plot | 1 |
| 4.2 | Nyquist Stability Criterion | 1 |
| 4.3 | Bode Plot - Concepts | 1 |
| 4.4 | Bode Plot - Problems | 1 |
| 4.5 | Compensator Design Using Bode Plot - Concepts | 1 |
| 4.6 | Cascade Lead Compensation - Procedure | 1 |
| 4.7 | Cascade Lead Compensation - Problems | 1 |
| 4.8 | Cascade Lag Compensation - Procedure | 1 |
| 4.9 | Cascade Lag Compensation - Problems | 1 |
| 4.10 | Tutorial | 3 |
| **5.0** | **State Space Analysis of Digital Control Systems** | |
| 5.1 | State Space Representation of Discrete Time Systems | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.2 | Solution of Discrete Time State Space Equation - Concepts | 1 |
| 5.3 | Solution of Discrete Time State Space Equation - Problems | |
| 5.4 | State Transition Matrix - Concepts | 1 |
| 5.5 | State Transition Matrix - Problems | 1 |
| 5.6 | Decomposition Techniques | 1 |
| 5.7 | Decomposition Techniques - Problems | 1 |
| 5.8 | Controllability and Observability - Concepts | 1 |
| 5.9 | Controllability and Observability - Problems | 1 |
| 5.10 | Tutorial | 3 |

**Course Designer(s)**


1. Dr.P.Babu - pbabu@ksrct.ac.in
2. Ms.C.Saraswathy - saraswathy@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 502 | VLSI and Chip Design | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objectives

- To study the fundamentals of IC technology components and their characteristics.
- To understand the combinational logic circuits and design principles.
- To understand sequential logic circuits and clocking strategies.
- To discuss the arithmetic building blocks and memory architecture.
- To learn the concept of testability and ASIC Design of VLSI circuits.

## Pre-requisites

- Digital System Design

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the MOS technologies | Understand |
| CO2 | Describe combinational logic circuits and design principles | Understand |
| CO3 | Describe sequential logic circuits and clocking strategies | Understand |
| CO4 | Design arithmetic building blocks and memory architecture | Apply |
| CO5 | Illustrate the ASIC design process and testing | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | - | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | - | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | - | - | 3 | - | 3 | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 50 | 40 | 60 |
| Apply | - | 10 | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 502 - VLSI and Chip Design | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **MOS Transistor Principles**<br>Long Channel I-V Characteristics - VTC Parameters (DC Characteristics) - Second Order Effects - CMOS Logic - CMOS Fabrication: n-Well Processes - Layout Design Rules - Technology Scaling* - Advanced Technologies*: FinFET, GAA and RibbonFET. | [9] |
| **Combinational Logic Circuits**<br>Propagation Delays - Elmore's Constant - Power Dissipation - Low Power Design Principles - Static CMOS Design - Dynamic CMOS Design. | [9] |
| **Sequential Logic Circuits and Clocking Strategies**<br>Static Latches and Registers - Dynamic Latches and Registers - Pipelines - Non-Bistable Sequential Circuits - Timing Classification of Digital Systems - Synchronous Design - Self Timed Circuit Design. | [9] |
| **Arithmetic Building Blocks and Memory Architecture**<br>Adders – Multipliers - Shift Registers - Logic Implementation using Programmable Devices (ROM, PLA, FPGA) - Memory Architecture and Building Blocks - Memory Core and Memory Peripherals Circuitry*. | [9] |
| **ASIC Design and Design for Testability**<br>ASIC Design Flow - ASIC Types: Full Custom, Semi-Custom, FPGA - Issues in Design for Testability - Fault Model Types - Automatic Test Pattern Generation - IC Packaging Technology: Chiplet/Dis-Aggregated Technologies*. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Jan M Rabaey, Anantha Chandrakasan, "Digital Integrated Circuits: A Design Perspective", PHI, 2016. |
| 2. | Neil H E Weste, Kamran Eshranghian, "Principles of CMOS VLSI Design: A System Perspective", Addison Wesley, 2017. |
| **Reference(s):** | |
| 1. | Smith M.J , "Application Specific Integrated Circuits", Addison Wesley, 2002. |
| 2. | Samir Palnitkar, "Verilog HDL – A Guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, 2011. |
| 3. | Charles H Roth Jr, Lizy Kurian John and Byeong Kil Lee, "Digital Systems Design Using Verilog", 1st Edition, Cengage Learning, 2016. |
| 4. | Parag K.Lala, " Digital Circuit Testing and Testability", Academic Press, 1997. |

*SDG 9 - Industry Innovation and Infrastructure

**Assignment Activity:**

**Assignment 1:**

1. Simulation of various digital circuits with test bench code using EDA tools
2. Prepare case study report on advanced technologies
3. Poster presentation on low power design principles

**Assignment 2:**

1. Mini project using FPGA
2. Video presentation on memory core

**Assignment 3:**

1. Case Studies - ASIC Design

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **MOS Transistor Principles** | |
| 1.1 | Long channel I-V characteristics | 1 |
| 1.2 | VTC Parameters (DC characteristics) | 1 |
| 1.3 | Second Order Effects | 1 |
| 1.4 | CMOS Logic | 1 |
| 1.5 | CMOS Fabrication: n-Well Processes | 1 |
| 1.6 | Layout Design Rules | 1 |
| 1.7 | Technology Scaling | 1 |
| 1.8 | Advanced Technologies: Fin FET, GAA | 1 |
| 1.9 | Advanced Technologies: Ribbon FET | 1 |
| **2.0** | **Combinational Logic Circuits** | |
| 2.1 | Propagation Delays | 1 |
| 2.2 | Elmore's Constant | 1 |
| 2.3 | Power Dissipation | 1 |
| 2.4 | Low Power Design Principles | 1 |
| 2.5 | Static CMOS Design: Complementary CMOS | 1 |
| 2.6 | Static CMOS Design: Ratioed Logic | 1 |
| 2.7 | Static CMOS Design: Pass-Transistor Logic | 1 |
| 2.8 | Dynamic CMOS Design: Basic Principles, Speed and Power Dissipation of Dynamic Logic | 1 |
| 2.9 | Dynamic CMOS Design: Issues in Dynamic Design | 1 |
| **3.0** | **Sequential Logic Circuits and Clocking Strategies** | |
| 3.1 | Static Latches and Registers | 1 |
| 3.2 | Dynamic Latches and Registers | 1 |
| 3.3 | Pipelines | 1 |
| 3.4 | Non-Bistable Sequential Circuits: The Schmitt Trigger | 1 |
| 3.5 | Non-Bistable Sequential Circuits: Monostable Sequential Circuits | 1 |
| 3.6 | Non-Bistable Sequential Circuits: Astable Circuits | 1 |
| 3.7 | Timing Classification of Digital Systems | 1 |
| 3.8 | Synchronous Design | 1 |
| 3.9 | Self-Timed Circuit Design | 1 |
| **4.0** | **Arithmetic Building Blocks and Memory Architecture** | |
| 4.1 | Adders | 1 |
| 4.2 | Multipliers | 1 |
| 4.3 | Shift Registers | 1 |
| 4.4 | Logic Implementation using Programmable Devices (ROM, PLA) | 1 |
| 4.5 | Logic Implementation using Programmable Devices (FPGA) | 1 |
| 4.6 | Memory Architecture | 1 |
| 4.7 | Memory Building Blocks | 1 |
| 4.8 | Memory core | 1 |
| 4.9 | Memory peripherals circuitry | 1 |
| **5.0** | **ASIC Design and Design for Testability** | |
| 5.1 | ASIC Design Flow | 1 |
| 5.2 | ASIC Types: Full Custom, Semi-Custom | 1 |
| 5.3 | ASIC Types: FPGA | 1 |
| 5.4 | Issues in Design for Testability | 1 |
| 5.5 | Fault Model Types: Stuck-At-0 | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.6 | Fault Model Types: Stuck-At-1 | 1 |
| 5.7 | Automatic Test Pattern Generation | 1 |
| 5.8 | IC Packaging Technology: Chiplet Technologies | 1 |
| 5.9 | IC Packaging Technology: Dis-Aggregated Technologies | 1 |

**Course Designer(s)**


1. Mrs.C.Saranya - saranyac@ksrct.ac.in
2. Mr.S.Saravanan – saravanan@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 503 | Digital Signal Processing | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 1 | 0 | 4 |

## Objectives

- To analyse a DSP system and design FIR and IIR filters.
- To realise digital filters.
- To discuss multi rate signal processing.
- To understand finite word length effects.
- To study the architecture of digital signal processors.

## Pre-requisites

- Signals and Systems

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Design IIR filters using Impulse Invariant and Bilinear Transformation Techniques. | Apply |
| CO2 | Design linear phase FIR filters using Windowing Techniques and sampling method. | Apply |
| CO3 | Explain the concept of multi rate signal processing | Apply |
| CO4 | Analyse the effects of Finite word length on digital filters. | Analyse |
| CO5 | Describe the architecture of TMS320C6x DSP processor. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 3 | 3 | - | 2 | 3 | 3 | - |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 3 | 3 | - | 2 | 3 | 3 | - |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 3 | 3 | - | - | 3 | 3 | - |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 3 | 3 | - | - | 3 | 3 | - |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 3 | 3 | - | - | 3 | 3 | - |
| 3 – Strong; 2 – Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 20 | 20 | 30 |
| Apply | 30 | 20 | 40 |
| Analyse | - | 10 | 10 |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC 503 - Digital Signal Processing**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| V | 3 | 1 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Design of IIR Filters*** Design of IIR Filters from Analog Filters – Frequency Transformation – IIR Filters (Butterworth): Properties – Design: Impulse Invariant Technique – Bilinear Transformation – Realization of IIR filters. | [9] |
| **Design of FIR Filters*** Design of FIR Filters – Symmetric and Anti symmetric FIR Filters – Design of Linear Phase FIR Filters: Windowing Techniques (Rectangular, Hamming, Hanning) – Frequency Sampling – Realization of FIR Filters. | [9] |
| **Multirate Signal Processing*** Multirate Operations – Decimation and Interpolation – Fractional Sampling Rate Alteration – Interconnection of Building Blocks – The Noble Identities – The Poly Phase Representation – Efficient Structure of Decimation and Interpolation Filters. | [9] |
| **Finite Word Length Effects*** Representation of Numbers – Fixed Point and Floating Point Representation – Errors Resulting From Rounding and Truncation – Quantization Process and Error- Analysis of Coefficient Quantization Effects – A/D Conversion Noise Analysis – Quantization Noise Model – Signal to Quantization Noise Ratio – Round off Effects in Digital Filters – Limit Cycle Oscillations in Recursive Systems – Scaling to Prevent Overflow. | [9] |
| **Digital Signal Processors*** Programmable DSPs – TMS320C6X DSPs, Architectures Features – DSP Building Blocks– Memory Space Organization – External Bus Interfacing Signals – Memory Interface – Parallel I/O Interface– Programmed I/O – Interrupts and I/O – Direct Memory Access (DMA). | [9] |
| **Total Hours: (Lecture - 45; Tutorial - 15)** | **60** |

| **Text Book(s):** | |
|---|---|
| 1. | John G Proakis, Dimitris G Manolakis, "Digital Signal Processing Principles, Algorithms and Application", 4th Edition, Pearson Educations, 2014. |
| 2. | Venkataramani B & Bhaskar M, "Digital Signal Processor Architecture, Programming and Application", 2nd Edition, McGraw Hill, 2014. |
| **Reference(s):** | |
| 1. | Mitra S.K, "Digital Signal Processing: A Computer based approach", 4th Edition, McGraw Hill, 2013. |
| 2. | Alan V Oppenheim, Ronald W Schafer, John R Back, "Discrete Time Signal Processing", 3rd Edition, Pearson, 2013. |
| 3. | Monson H.Hayes, "Statistical Digital Signal Processing and Modelling", John Wiley & Sons, 2013. |
| 4. | Thad B. Welch, Cameron H.G. Wright, Michael G. Morrow, "Real-Time Digital Signal Processing from MATLAB to C with the TMS320C6x DSPs", CRC Press, 2016. |

*****SDG 9 – Industry Innovation and Infrastructure

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Design of IIR Filters** | |
| 1.1 | Design of IIR Filters From Analog Filters | 1 |
| 1.2 | Frequency Transformation (Low pass to high pass) | 1 |
| 1.3 | Frequency Transformation (Low pass to band pass) | 1 |
| 1.4 | IIR Filters (Butterworth): Properties | 1 |
| 1.5 | Impulse Invariant Technique | 1 |
| 1.6 | Bilinear Transformation | 1 |
| 1.7 | Design of Butterworth filter with Impulse Invariant Technique | 1 |
| 1.8 | Design of Butterworth filter with Bilinear Transformation | 1 |
| 1.9 | Realization of IIR Filters | 1 |
| 1.10 | Tutorial | 3 |
| **2.0** | **Design of FIR Filters** | |
| 2.1 | Design of FIR Filters | 1 |
| 2.2 | Symmetric | 1 |
| 2.3 | Anti symmetric FIR Filters | 1 |
| 2.4 | Design of Linear Phase FIR Filters | 1 |
| 2.5 | Windowing Techniques - Rectangular | 1 |
| 2.6 | Windowing Techniques - Hamming | 1 |
| 2.7 | Windowing Techniques - Hanning | 1 |
| 2.8 | Frequency Sampling | 1 |
| 2.9 | Realization of FIR Filters | 1 |
| 2.10 | Tutorial | 3 |
| **3.0** | **Multirate Signal Processing** | |
| 3.1 | Multirate Operations | 1 |
| 3.2 | Decimation | 1 |
| 3.3 | Interpolation | 1 |
| 3.4 | Fractional Sampling Rate Alteration | 1 |
| 3.5 | Interconnection of Building Blocks | 1 |
| 3.6 | The Noble Identities | 1 |
| 3.7 | The Poly Phase Representation | 1 |
| 3.8 | Efficient Structure of Decimation Filters | 1 |
| 3.9 | Efficient Structure of Interpolation Filters | 1 |
| 3.10 | Tutorial | 3 |
| **4.0** | **Finite Word Length Effects** | |
| 4.1 | Representation of Numbers – Fixed Point and Floating Point Representation | 1 |
| 4.2 | Errors Resulting from Rounding and Truncation | 1 |
| 4.3 | Quantization Process and Error | 1 |
| 4.4 | Analysis of Coefficient Quantization Effects | 1 |
| 4.5 | A/D Conversion Noise Analysis | 1 |
| 4.6 | Quantization Noise Model | 1 |
| 4.7 | Signal to Quantization Noise Ratio | 1 |
| 4.8 | Round off Effects in Digital Filters | 1 |
| 4.9 | Limit Cycle Oscillations in Recursive Systems – Scaling to Prevent Overflow | 1 |
| 4.10 | Tutorial | 3 |
| **5.0** | **Digital Signal Processors** | |
| 5.1 | Programmable DSPs – TMS320C6X DSPs | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.2 | Architectures Features | 1 |
| 5.3 | DSP Building Blocks | 1 |
| 5.4 | Memory Space Organization | 1 |
| 5.5 | External Bus Interfacing Signals | 1 |
| 5.6 | Memory Interface – Parallel I/O Interface | 1 |
| 5.7 | Programmed I/O | 1 |
| 5.8 | Interrupts and I/O | 1 |
| 5.9 | Direct Memory Access (DMA) | 1 |
| 5.10 | Tutorial | 3 |

**Course Designer(s)**


1. Dr. P. Babu - pbabu@ksrct.ac.in
2. Mrs.K.Gogila Devi- gogiladevi@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 504 | Microprocessors and Microcontrollers | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objectives

- To introduce the architecture and programming of 8085 microprocessor.
- To introduce the architecture, programming and interfacing of 8051 micro controller.
- To develop the simple simulation projects.
- To introduce the AI boards
- To develop microcontroller-based Applications.

## Pre-requisites

- Digital System Design

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the architecture and instruction set of the 8085 microprocessor and develop assembly language programs | Understand |
| CO2 | Explain the internal architecture and operation of the 8051 microcontroller | Understand |
| CO3 | Analyze the functionality of special function registers and create simple simulation projects | Apply |
| CO4 | Design and interface I/O peripherals | Apply |
| CO5 | Execute AI models on Edge AI hardware using Python and C. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 10 | 20 |
| Understand | 40 | 20 | 40 |
| Apply | - | 30 | 40 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K. S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 504 - Microprocessors and Microcontrollers | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **8085 – 8 Bit Microprocessor*** 8085 Architecture - Instruction set - Addressing Modes - Interrupt Structure - Timing Diagrams - Memory Interfacing - Interfacing I/O Devices - Assembly Language Programming. | [9] |
| **8051 – 8 Bit Microcontroller*** 8051 - Architecture - Clock and RESET Circuits - PSW - Stack and Stack Pointer - Program Counter - I/O Pins Ports and Circuits - Instruction Set, - Addressing Modes. | [9] |
| **8051 Special Purpose Registers and Programming*** Special Function Register - Interfacing of Memory Devices - Timer Programming - Serial Data Transfer - UART. I/O Ports and Port Expansion - Programing on Interrupts. Assembly Language Programs, C Language Programs Using SFR**. | [9] |
| **Peripheral Interfacing**** Standard Interfaces - RS232 - USB - SPI and I2C, Interfacing of Sensors - DAC - ADC - PWM - DC Motor - Stepper Motor and LCD Interfacing | [9] |
| **AI Based Board*** Principles of OS - OS Architecture - Overview of an Edge AI Hardware, - Setup and OS Installation. Python and C Programming, Linux library installation, Executing AI models in Edge AI Hardware**. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Ramesh S Gaonkar, "Microprocessor Architecture, Programming and Application with 8085", 6th Edition, Penram International Publishing, 2015. |
| 2. | Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin Mc Kinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson Education, 2011. |
| **Reference(s):** | |
| 1 | Krishna Kant, "Microprocessors and Microcontrollers Architecture, Programming and System Design 8085, 8086, 8051, 8096", 3rd Reprint, Prentice Hall of India, 2014. |
| 2 | Ayala K.J, "8051 Microcontroller", 3rd Edition, Delmar Cengage Learning, 2007. |
| 3 | NPTEL video lectures by M. Krishna Kumar, IISc. |

*SDG4 - Quality Education

**SDG9 - Industry Innovation and Infrastructure

**Assignment Activity:**

Assignment 1 - Covers Module 1 & 2 Questions related to the problems and simulation
Assignment 2 - Covers Module 3 & 4 Questions related to the problems and simulation
Assignment 3 - AI Boards hands on

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **8085 – 8 Bit Microprocessor** | |
| 1.1 | 8085 Architecture | 1 |
| 1.2 | Instruction set | 1 |
| 1.3 | Addressing Modes | 1 |
| 1.4 | Interrupt Structure | 1 |
| 1.5 | Timing Diagrams | 1 |
| 1.6 | Memory Interfacing | 1 |
| 1.7 | Interfacing I/O Devices | 1 |
| 1.8 | Assembly Language Programming. | 1 |
| 1.9 | Assembly Language Programming. | 1 |
| **2.0** | **8051 – 8 Bit Microcontroller** | |
| 2.1 | 8051 – Architecture | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 2.2 | Clock and RESET Circuits | 1 |
| 2.3 | PSW | 1 |
| 2.4 | PUSH and POP | 1 |
| 2.5 | Stack and Stack Pointer | 1 |
| 2.6 | Program Counter | 1 |
| 2.7 | I/O Pins Ports and Circuits, | 1 |
| 2.8 | Instruction Set | 1 |
| 2.9 | Addressing Modes | 1 |
| **3.0** | **8051 Special Purpose Registers and Programming*** | |
| 3.1 | Special Function Register- | 1 |
| 3.2 | Interfacing of Memory Devices | 1 |
| 3.3 | Timer Programming | 1 |
| 3.4 | Serial Data Transfer | 1 |
| 3.5 | UART | 1 |
| 3.6 | I/O Ports and Port Expansion | 1 |
| 3.7 | Programming on Interrupts | 1 |
| 3.8 | Assembly Language Programs | 1 |
| 3.9 | C Language Programs Using SFR | 1 |
| **4.0** | **Peripheral Interfacing**** | |
| 4.1 | Standard Interfaces - RS232, USB, SPI and I2C, | 1 |
| 4.2 | USB | 1 |
| 4.3 | SPI | 1 |
| 4.4 | I2C | 1 |
| 4.5 | Interfacing of Sensors | 1 |
| 4.6 | DAC | 1 |
| 4.7 | ADC | 1 |
| 4.8 | Motor Interface | 1 |
| 4.9 | LCD Interface | 1 |
| **5.0** | **AI Based Board** | |
| 5.1 | Principles of OS | 1 |
| 5.2 | OS Architecture | 1 |
| 5.3 | Overview of an Edge AI Hardware | 1 |
| 5.4 | Setup and OS Installation | 1 |
| 5.5 | Python Programming | 1 |
| 5.6 | C Programming | 1 |
| 5.7 | Linux Installation | 1 |
| 5.8 | Linux library installation | 1 |
| 5.9 | **Executing AI models in Edge AI Hardware** | 1 |

**Course Designer(s)**


1. Dr.C.Rajasekaran - rajasekaran@ksrct.ac.in
2. Mr.S.Jayamani - jayamani@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 MY 003 | Startups and Entrepreneurship | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | MC | 2 | 0 | 0 | 2 |

## Objectives

- To Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
- To provide practical proven tools for transforming an idea into a product or service that creates value for others.
- To Comprehend the process of opportunity identification through design thinking, identify market potential and customers while developing a compelling value proposition solution and prototypes
- To create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
- To Prepare and present an investible pitch deck of their practice venture to attract stakeholders

## Pre-requisites

- Basic knowledge of reading and writing in English

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Develop an entrepreneurial mindset and appreciate the concepts of design thinking, entrepreneurship and innovation | Understand |
| CO2 | Apply process of problem -opportunity identification and validation through human centred approach to design thinking in building solutions | Apply |
| CO3 | Understand market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product | Apply |
| CO4 | Create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture | Apply |
| CO5 | Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders | Create |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 1 | - | 2 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 3 | 3 | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 1 | 2 | - | - | - | 1 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | 1 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 3 | - | - | 2 | - | - | 3 | 2 | 2 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | Pitch Deck final submission & Viva voce |
|---|---|---|---|
| | Milestone 1 (25 Marks) | Milestone 2 & 3 (25 Marks) | |
| Remember | 10 | - | 50 |
| Understand | 05 | 10 | |
| Apply | 10 | 15 | |
| Analyse | - | - | |
| Evaluate | - | - | |
| Create | - | - | |
| Total | 25 | 25 | |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to ALL Branches**

**60 MY 003 – Startups and Entrepreneurship**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| V | 2 | 0 | 0 | 30 | 2 | 100 | - | 100 |

| | |
|---|---|
| **Introduction to Entrepreneurship & Entrepreneur**<br><br>Meaning and concept of Entrepreneurship, the history of Entrepreneurship development, Myths of Entrepreneurship, role of Entrepreneurship in Economic Development, Agencies in Entrepreneurship Management and Future of Entrepreneurship. The Entrepreneur: Meaning, the skills required to be an entrepreneur, the entrepreneurial decision process, Role models, Mentors and Support system.Innovation and Creativity, types of innovations, Innovations in current scenario | [6] |
| **Problem-Opportunity Identification, Customers Discovery and competitive advantage**<br><br>Understanding the Problem and opportunity, define problem using Design thinking principles and validate problem. Exploring market types and estimating the market size, knowing your customer and consumer, Customer segmentation and creating customer personas. Importance of Value Proposition, Value Proposition Canvas, Developing Problem-solution fit, Competition analysis, Blue ocean strategy, Competitive positioning and understanding unique selling points. | [6] |
| **Business model and build your MVP**<br><br>Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Prototyping, building a Minimum viable product, Hypothesis testing and MVP Validation, MVP Iteration-Importance of Build - Measure – Learn approach | [6] |
| **Business Plan, Financial feasibility and Managing growth**<br><br>Business planning: components of Business plan- Sales plan, People plan and financial plan, Preparing a business plan. Financial Planning: Types of costs, preparing the financial plan using financial template, understanding basics of Unit economics and analyzing Growth and the financial performance | [6] |
| **Go To Market Strategies and Funding**<br><br>Introduction to Go to market strategies, start-up branding and its elements, Selecting the Right Channel, creating digital presence, building customer acquisition strategy. Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity, Map the Start-up Lifecycle to Funding Options, Build an Investor ready pitch deck. | [6] |
| **Total Hours:** | **30** |

**Text Book(s):**

| | |
|---|---|
| 1. | Stephen Key, “One Simple Idea for Startups and Entrepreneurs: Live Your Dreams and Create Your Own Profitable Company”, 1st Edition, Tata Mc Grawhill Company, New Delhi, 2013. |
| 2. | Charles Bamford and Garry Bruton, “Entrepreneurship: The Art, Science, and Process for Success”, 2nd Edition, Tata Mc Grawhill Company, New Delhi, 2016. |

**Reference(s):**

| | |
|---|---|
| 1. | Philip Auerswald, “The Coming Prosperity: How Entrepreneurs Are Transforming the Global Economy”, Oxford University Press, 2012. |
| 2. | Janet Kiholm Smith; Richard L. Smith Richard T. Bliss, “Entrepreneurial Finance: Strategy, Valuation and Deal Structure, Stanford Economics and Finance”, 2011. |
| 3. | Edward D. Hess, “Growing an Entrepreneurial Business: Concepts and Cases”, Stanford Business Books, 2011. |
| 4. | Ignite program, wadhwani platform, Entrepreneurship, NPTEL online course By Prof. C Bhaktavatsala Rao \| IIT Madras |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Introduction to Entrepreneurship & Entrepreneur** | |
| 1.1 | Meaning and concept of Entrepreneurship and the history of Entrepreneurship development | 1 |
| 1.2 | The Entrepreneur: Meaning, the skills required to be an entrepreneur, the entrepreneurial decision process, | 1 |
| 1.3 | Myths of Entrepreneurship, How to Become a Successful Entrepreneur - Dr Romesh Wadhwani (Platform on boarding) | 1 |
| 1.4 | Role models, Mentors and Support system- Masterclass on My Story - Joshua Salins | 1 |
| 1.5 | Role of Entrepreneurship in Economic Development, Agencies in Entrepreneurship Management and Future of Entrepreneurship | 1 |
| 1.6 | Innovation and Creativity, types of innovations, Innovations in current scenario, Concepts of Entrepreneurial Thinking, General Enterprising tendency test | 1 |
| **2.0** | **Problem-Opportunity Identification, Customers Discovery and competitive advantage** | |
| 2.1 | Understanding the Problem and opportunity, define problem using Design thinking principles and validate problem. Case study and Fireside chat – Desi Hangover | 1 |
| 2.2 | Identifying a problem for practice venture and filling Problem statement canvas (Handout week 1 - class activity) | 1 |
| 2.3 | Customer and markets discovery , knowing your customer and consumer, Customer segmentation and Exploring market types and estimating the market size. Case study and Fireside chat – Verloop | 1 |
| 2.4 | Creating customer personas & Market estimation (Handout week 2 - class activity) | 1 |
| 2.5 | Importance of Value Proposition, Introduce Value Proposition Canvas, Developing Problem-solution fit. Case study and Fireside chat – Honey Twigs | 1 |
| 2.6 | Competition analysis, Blue ocean strategy, Competitive positioning and understanding unique selling points. Case study and Fireside chat on Inzpira Fill Value Proposition Canvas (Handout week 3 - class activity) and Competition analysis framework (Handout week 5 - class activity) **Briefing on Assignment 1 - Milestone 1** | 1 |
| **3.0** | **Business model and Build your MVP** | |
| 3.1 | Introduction to Business model and types. Case study and Fireside chat – NUOS | 1 |
| 3.2 | Lean approach, 9 block lean canvas model, riskiest assumptions to Business models | 1 |
| 3.3 | Class Activity- Fill Lean canvas for you idea and understand revenue model ( Handout week 6) | 1 |
| 3.4 | Prototyping, Meaning of MLP , Difference between MLP and MVP, How to build an MLP? Different types MLP that you can build. Case study and Fireside chat – KNORISH | 1 |
| 3.5 | Hypothesis testing and MVP Validation, MVP Iteration-Importance of Build - Measure – Learn approach | 1 |
| 3.6 | Class Activity- Fill MVP framework (Handout week 7) and learn validation | 1 |
| **4.0** | **Business Plan, Financial feasibility and Manging growth** | |
| 4.1 | Business planning: components of Business plan- Sales plan, People plan and financial plan, Preparing a business plan. Case study and Fireside chat – Bodh Gems | 1 |
| 4.2 | Financial Planning: Types of costs, preparing the financial plan using financial template (Handout week 9) | 1 |
| 4.3 | Class activity - starting up costs, COGS, Sales plan and people plan template. | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.4 | Class activity - One year P&L projection, Breakeven Analysis, Five year projection | 1 |
| 4.5 | Understanding basics of Unit economics and analyzing Growth and the financial performance | 1 |
| 4.6 | Class activity - Financial template - Unit economics (Handout week 12) | 1 |
| **5.0** | **Go To Market Strategies and Funding** | |
| 5.1 | Introduction to Go to market strategies, start-up branding and its elements, Selecting the Right Channel | 1 |
| 5.2 | Creating digital presence, building customer acquisition strategy. | 1 |
| 5.3 | Class activity: Handout week 10 - create your GTM strategy | 1 |
| 5.4 | Choosing a form of business organization specific to your venture | 1 |
| 5.5 | Identifying sources of funds: Debt & Equity, Map the Start-up Lifecycle to Funding Options | 1 |
| 5.6 | Class activity - Visit relevant GOI websites, other sites to help students explore funding opportunities and **briefing on final submission of the pitch deck** Build an Investor ready pitch deck, What Should You Cover in Your Pitch Deck? Art of pitching and storytelling | 1 |

**Course Designer(s)**

1. Dr.N.Tiruvenkadam - tiruvenkadam@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 5P1 | Microcontrollers Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 3 | 1.5 |

**Objectives**

- To familiarize the 8085,8051 processors architectures
- To give an exposure of assembling language programming and interfacing of various modules
- To use IDE for Programming and debugging
- To give an exposure of Embedded C programming for accessing the microcontroller internal registers and blocks.
- To understand the techniques to interface sensors and I/O circuits and to implement applications using these processors

**Pre-requisites**

- Microprocessors and Microcontrollers

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Perform arithmetic operations using 8085 and 8051 by developing assembly and C language | Understand |
| CO2 | Compile, debug and execute C program for the given target board | Apply |
| CO3 | Develop C code for accessing GPIO Port access and timers | Apply |
| CO4 | Develop C code for interfacing the input and output peripherals | Apply |
| CO5 | Design a system for temperature acquisition | Apply |

**Mapping with Programme Outcomes**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | - | - | - | - |
| Understand | - | - | 40 | 40 |
| Apply | 50 | 25 | 60 | 60 |
| Analyse | - | - | - | - |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |
| Total | 50 | 25 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 5P1 - Microcontrollers Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 0 | 0 | 3 | 45 | 1.5 | 60 | 40 | 100 |

**List of Experiments:**

1. Assembly Program for Arithmetic operation in 8085 & 8051*
2. Program for 8051 using KEIL IDE*
3. Developing C program for accessing GPIO and timers**
4. Developing a setup for a display unit, the data in LED, LCD and 7segment**
5. Develop a setup to receive an input and show the response with suitable peripherals**
6. Develop an analog data acquisition system for monitoring the outside temperature
7. Develop digital to analog conversion system using suitable 8-bit controllers.
8. Design a motor control application along with sensor**

**Lab Manual**

| | |
|---|---|
| 1. | "Microcontrollers Laboratory Manual", Department of Electronics and Communication Engineering, KSRCT. |

* SDG 4 – Quality Education

** SDG 9 – Industry Innovation

**Course Designer(s)**

1. Mr S.Jayamani – jayamani@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 5P2 | VLSI Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 2 | 1 |

## Objectives

- To learn Hardware Descriptive Language (HDL)
- To learn the fundamental principles of digital system design using HDL and FPGA
- To learn the fundamental principles of VLSI circuit design in analog and digital domain using EDA tools
- To understand the layouts of digital circuits using EDA tools
- To provide hands on design experience with EDA platforms

## Pre-requisites

- Digital System Design

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Develop HDL code for basic as well as advanced digital circuit | Apply |
| CO2 | Implement various logic modules into FPGA | Apply |
| CO3 | Synthesize place and route the digital IPs | Apply |
| CO4 | Design, simulate and extract the layouts of digital circuits using EDA tools | Apply |
| CO5 | Design various arithmetic building blocks using HDL | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |

3 - Strong; 2 - Medium; 1 - Some

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | - | - | - | - |
| Understand | 25 | 12 | 50 | 50 |
| Apply | 25 | 13 | 50 | 50 |
| Analyse | - | - | - | - |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |
| Total | 50 | 25 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 5P2 - VLSI Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 0 | 0 | 2 | 30 | 1 | 60 | 40 | 100 |

1. Design and verify basic combinational circuit with test bench code. Simulate it using the EDA tool and implement it using an FPGA.
2. Design and verify basic sequential circuit with test bench code. Simulate it using the EDA tool and implement it by FPGA.
3. Design and simulate DC transfer characteristics of CMOS inverter. Generate Layout.
4. Design and simulate a combinational circuit. Generate Layout.
5. Design and simulate a sequential circuit. Generate Layout.
6. Design carry save adder using arithmetic building blocks using HDL
7. Design multiplier using arithmetic building blocks using HDL.

- Mini project – ALU design / Finite State Machine /Memory design*

*SDG 9 - Industry Innovation and Infrastructure

**Course Designer(s)**

1. Mrs.C.Saranya – saranyac@ksrct.ac.in
2. Mr.S.Saravanan – saravanan@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 5P3 | Signal Processing Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 3 | 1.5 |

**Objectives**

- To implement FIR and IIR filters using simulation.
- To design a DSP system to demonstrate the multi-rate signal processing concepts.
- To analyse the effects of sampling and quantization errors in signals.
- To simulate waveforms and process of mathematical operations of Digital Signal Processing.
- To design and implement digital filters for given specifications and applications in DSP system.

**Pre-requisites**

- Signals and Systems

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Design of IIR and FIR filters and verify its performance using simulation | Apply |
| CO2 | Design of multirate filters and verify its performance using simulation | Apply |
| CO3 | Evaluate the effects of quantization errors in continuous time signals | Apply |
| CO4 | Generate standard waveform and compute arithmetic operation using Digital Signal Processor | Apply |
| CO5 | Design of IIR & FIR filters and verify its performance using Digital Signal Processor | Apply |

**Mapping with Programme Outcomes**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | - | - | - | - |
| Understand | 20 | 12 | 30 | 30 |
| Apply | 30 | 13 | 70 | 70 |
| Analyse | - | - | - | - |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |
| Total | 50 | 25 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 5P3 - Signal Processing Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 0 | 0 | 3 | 45 | 1.5 | 60 | 40 | 100 |

**List of Experiments*:**
**Using Simulation**

1. Design of IIR filters
2. Design of FIR filters
3. Design of Multirate filters
4. Analyse the effect of quantization on continuous time analog signals

**Using DSP Processor**

5. Generation of standard waveforms
6. Implementation of arithmetic operations
7. Design and implementation of FIR filter for real time applications
8. Design and implementation of IIR filter for real time applications

- Mini Project

| **Lab Manual** | |
|---|---|
| 1. | "Signal Processing Laboratory Manual", Department of Electronics and Communication Engineering, KSRCT. |

* SDG 4- Quality Education

**Course Designer(s)**


1. Dr.P.Babu - pbabu@ksrct.ac.in
2. Ms.C.Saraswathy - saraswathy@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CG 0P4 | Career Skill Development - IV | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 2 | 1 |

## Objectives

- To help learners improve their vocabulary and enable them to use words appropriately in different academic and professional contexts.
- To help learners develop strategies that could be adopted while reading texts.
- To help learners acquire the ability to speak and write effectively in english in real life and career related situations.
- Improve listening, observational skills, and problem-solving capabilities
- Develop message generating and delivery skills

## Pre-requisites

- Basic knowledge of Arithmetic and Logical Reasoning

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Compare and contrast products and ideas in technical texts. | Analyse |
| CO2 | Identify cause and effects in events, industrial processes through technical texts | Analyse |
| CO3 | Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format. | Analyse |
| CO4 | Report events and the processes of technical and industrial nature. | Apply |
| CO5 | Articulate their opinions in a planned and logical manner, and draft effective résumés in context of job search. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 2 | 2 | 2 | 3 | - | 3 | - | - | - | 2 | 3 | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | - | 2 | - | - | - | 2 | 3 | 3 | 3 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 2 | - | 3 | - | - | - | 2 | 3 | 3 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | - | 2 | - | - | - | 2 | 3 | 3 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | - | 2 | - | - | - | 2 | 3 | 3 | 3 | 2 | 2 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Common to All Branches** | | | | | | | | |
| **60 CG 0P4 - Career Skill Development - IV** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 0 | 0 | 2 | 30 | 1 | 100 | - | 100 |

| | |
|---|---|
| **Verbal & Analytical Reasoning*** Seating Arrangements – Analytical Reasoning (PUZZELS) – Machin Input and Output - Coded Inequality – Eligibility Test. | [6] |
| **Quantitative Aptitude - Part – 4*** Permutation and Combination - Probability - Quadratic Equation – Geometry – Clock – Calendar – Logarithmic. | [6] |
| **Non-Verbal Reasoning *** Series Completion of Figures – Classification – Courting of figure – Figure matrix – Embedded Figure – Complete Figure – Paper Cutting and Folding – Mirror images and Water Images. | [6] |
| **Quantitative Aptitude - Part – 5*** Mensuration of Area, Volume and Surface area in 2D and 3D Shapes – 2D Shapes – Square, Rectangle, Triangle, Circle, etc. – 3D Shapes – Cube, Cuboid, Sphere, Cone, etc. | [6] |
| **Data Interpretation and Analysis*** Data interpretation Based on text – Data interpretation Based on Tabulation, Pie chart, Bar graph and Line graph – Venn Diagram – Data sufficiency. | [6] |
| **Total Hours:** | **30** |

**Reference(s):**


| | |
|---|---|
| 1. | Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, S.Chand & Co Ltd., New Delhi, Reprint 2009. |
| 2. | Abhijit Guha, “Quantitative Aptitude”, 6th Edition, McGraw Hill Education, 2016. |
| 3. | Dinesh Khattar, “Quantitative Aptitude for Competitive Examinations”, Pearson Education, 2020. |
| 4. | Anne Thomson, “Critical Reasoning: A Practical Introduction” Lexicon Books, 3rd Edition, 2022. |


*SDG 4 – Quality Education
*SDG 8 – Decent work and Economic growth
*SDG 9 – Industry, innovation and Infrastructure

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Verbal & Analytical Reasoning** | |
| 1.1 | Seating Arrangements | 1 |
| 1.2 | Analytical Reasoning (Puzzels) | 1 |
| 1.3 | Machin Input and Output | 1 |
| 1.4 | Coded Inequality | 1 |
| 1.5 | Eligibility Test | 2 |
| **2.0** | **Quantitative Aptitude - Part – 4** | |
| 2.1 | Permutation And Combination | 1 |
| 2.2 | Probability | 1 |
| 2.3 | Quadratic Equation - Geometry | 1 |
| 2.4 | Clock – Calendar | 1 |
| 2.5 | Logarithmic | 2 |
| **3.0** | **Non-Verbal Reasoning** | |
| 3.1 | Series Completion of Figures – Classification | 1 |
| 3.2 | Courting of Figure – Figure Matrix | 1 |
| 3.3 | Embedded Figure – Complete Figure | 1 |
| 3.4 | Paper Cutting and Folding | 1 |
| 3.5 | Mirror Images and Water Images | 2 |
| **4.0** | **Quantitative Aptitude - Part – 5** | |
| 4.1 | Mensuration of Area, Volume | 1 |
| 4.2 | Mensuration of Volume | 1 |
| 4.3 | Surface Area In 2D And 3D Shapes | 1 |
| 4.4 | 2D Shapes – Square, Rectangle, Triangle, Circle, Etc. | 1 |
| 4.5 | 3D Shapes – Cube, Cuboid , Sphere , Cone , Etc. | 2 |
| **5.0** | **Data Interpretation and Analysis** | |
| 5.1 | Data Interpretation Based on Text | 1 |
| 5.2 | Data Interpretation Based on Tabulation, Pie Chart | 1 |
| 5.3 | Bar Graph and Line Graph | 1 |
| 5.4 | Venn Diagram | 1 |
| 5.5 | Data Sufficiency | 2 |

**Course Designer(s)**

1. R. Poovarasan - poovarasan@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**
**(An Autonomous Institution affiliated to Anna University)**
B.E. / B.Tech. Degree Programme
**SCHEME OF EXAMINATIONS**
(For the candidates admitted in 2024-2025)

SIXTH SEMESTER

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1. | 60 EC 601 | Embedded systems | 2 | 40 | 60 | 100 | 45 | 100 |
| 2. | 60 EC 602 | Digital Communication | 2 | 40 | 60 | 100 | 45 | 100 |
| 3. | 60 EC 603 | Mobile Communication and Networks | 2 | 40 | 60 | 100 | 45 | 100 |
| 4. | 60 EC E2* | Professional Elective II | 2 | 40 | 60 | 100 | 45 | 100 |
| 5. | 60 OE L3* | Open Elective III | 2 | 40 | 60 | 100 | 45 | 100 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 6. | 60 EC 604 | Machine Learning Techniques | 2 | 50 | 50 | 100 | 45 | 100 |
| **PRACTICAL** | | | | | | | | |
| 7. | 60 EC 6P1 | Innovation Engineering Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 8. | 60 EC 6P2 | Embedded systems Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 9. | 60 EC 6P3 | Digital Communication Laboratory | 2 | 60 | 40 | 100 | 45 | 100 |
| 10. | 60 CG 0P5 | Comprehension Test | 2 | 100 | 00 | 100 | 00 | 100 |
| 11. | 60 CG 0P6 | Internship | - | 100 | - | 100 | - | 100 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 601 | Embedded Systems | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objectives

- To impart the knowledge of the Embedded design
- To learn the architecture and features of ARM Cortex
- To learn the functionality and its features of ARM Cortex Peripherals
- To program the CORTEX M3
- To impart the working of Embedded operating system

## Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the overall landscape and characteristics of embedded systems | Understand |
| CO2 | Discuss the architecture and features of ARM CORTEX | Understand |
| CO3 | Analyse the functionalities of ARM CORTEX-M3/M4 peripherals and develop programs | Apply |
| CO4 | Develop programs to access the features of ARM CORTEX M3/M4 | Apply |
| CO5 | Discuss the architecture of the real time operating system and its operations | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 10 | 20 |
| Understand | 40 | 20 | 20 |
| Apply | - | 30 | 60 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 601 - Embedded Systems | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Structure of Embedded Systems *** Embedded Computing: Characteristics of Embedding Computing Applications, Embedded System Architecture: Instruction Set Architecture, CISC and RISC, Embedded C Data types and variables, Storage classes, Register data assignment, Bitwise operation, GPIO: Overview, Interfacing | [9] |
| **ARM CORTEX-M3 Architecture *** ARM Architecture – Versions, CORTEX-M3/M4 Microcontroller: Block diagram, Bus architecture, Reset value of a register, Register bit positions**,** UART: Protocol, Port accessing, Error management | [9] |
| **Peripherals in CORTEX M3** Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence, ADC: SAR ADC, HAL_ADC module, Conversion modes, Resolution, DAC: HAL_DAC module, Pin assignments, I2C Interfacing. | [9] |
| **CORTEX M3 Programming *** Development Flow, Volatile and effect of optimization, Interrupt handling, Timer Interrupt, SysTick Timer, Watchdog Timer, SPI Peripherals and testing, EEPROM Interface | [9] |
| **Real Time Operating Systems **** OS: Principles, Architecture, System calls, Threads, tasks and process, Kernel and its function, Scheduling: static, dynamic, priority, Interrupt APIs, Task Creation API, Low Power Management with RTOS, RTOS vs Embedded Linux | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Wayne Wolf, “Computers as Components - Principles of Embedded Computing System Design”, 2nd Edition, Elsevier, 2008. |
| 2. | Joseph Yiu, “The Definitive Guide to the ARM CORTEX M3/M4”, 2nd Edition, Elsevier,2010. |
| 3. | Carmine Noviello, “Mastering STM32”, 2018. |
| 4. | Shibu K.V.Tata, “Introduction to Embedded Systems”, Tata Mcgraw Hill Education (India) Private Limited, 2009. |
| **Reference(s):** | |
| 1. | Israel Gbati, “Embedded Systems Bare-Metal Programming Ground Up™ (STM32)”, BHM Engineering Academy, Udemy Course. |
| 2. | Kiran Navak, “Mastering RTOS: Hands on Free RTOS and STM32Fx with Debugging”, FastBit Embedded Brain Academy, Udemy Course. |

*SDG 9 – Industry Innovation and Infrastructure
**SDG 7 – Affordable and Clean Energy

**Assignment Activity:**

**Assignment 1**

Report on various real-life examples of embedded system

**Assignment 2**

Report on applications of ARM Cortex

**Assignment 3**

Case study - RTOS

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Structure of Embedded Systems** | |
| 1.1 | Embedded Computing: Characteristics of Embedding Computing Applications | 1 |
| 1.2 | Embedded System Architecture: Instruction Set Architecture, CISC and RISC | 1 |
| 1.3 | Embedded C Data types and variables | 1 |
| 1.4 | Storage classes | 1 |
| 1.5 | Register data assignment | 1 |
| 1.6 | Bitwise operation – AND, OR, NOT | 1 |
| 1.7 | Bitwise operation – Bit shifting | 1 |
| 1.8 | GPIO: Overview, | 1 |
| 1.9 | Interfacing | 1 |
| **2.0** | **ARM CORTEX-M3 Architecture** | |
| 2.1 | ARM Architecture – Versions | 1 |
| 2.2 | CORTEX-M3/M4 Microcontroller: Block diagram | 1 |
| 2.3 | Bus architecture | 1 |
| 2.4 | Reset value of a register, Register bit positions | 1 |
| 2.5 | UART: Protocol – Data frame | 1 |
| 2.6 | UART: Protocol – Handshaking | 1 |
| 2.7 | Port accessing – GPIO as Input / output | 1 |
| 2.8 | Port accessing – BSRR | 1 |
| 2.9 | Error management | 1 |
| **3.0** | **Peripherals in CORTEX M3** | |
| 3.1 | Operation Mode, Exceptions and Interrupts | 1 |
| 3.2 | Vector Tables | 1 |
| 3.3 | Stack Memory Operations | 1 |
| 3.4 | Reset Sequence | 1 |
| 3.5 | CORTEX M3 Instruction Sets: Assembly Basics | 1 |
| 3.6 | SAR ADC, HAL_ADC module | 1 |
| 3.7 | Conversion modes, Resolution | 1 |
| 3.8 | HAL_DAC module, Pin assignments | 1 |
| 3.9 | I2C Interfacing | 1 |
| **4.0** | **CORTEX M3 Programming** | |
| 4.1 | Development Flow, Volatile and effect of optimization | 1 |
| 4.2 | Interrupt handling | 1 |
| 4.3 | Timer Interrupt | 1 |
| 4.4 | SysTick Timer | 1 |
| 4.5 | Watchdog Timer | 1 |
| 4.6 | SPI Peripherals | 1 |
| 4.7 | SPI testing | 1 |
| 4.8 | EEPROM Interface – Write Data | 1 |
| 4.9 | EEPROM Interface – Read Data | 1 |
| **5.0** | **Real Time Operating Systems** | |
| 5.1 | OS: Basic principles, Architecture | 1 |
| 5.2 | System calls | 1 |
| 5.3 | Threads, tasks and process | 1 |
| 5.4 | Kernel and its function | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.5 | Scheduling: static, dynamic, priority | 1 |
| 5.6 | Interrupt APIs | 1 |
| 5.7 | Task Creation API | 1 |
| 5.8 | Low Power Management with RTOS | 1 |
| 5.9 | RTOS vs Embedded Linux | 1 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in



Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023


CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 602 | Digital Communication | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 1 | 0 | 4 |

## Objectives

- To study signal space representation of signals and discuss the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy charnels.
- To understand baseband signal transmission and reception techniques.
- To understand passband signal transmission and reception techniques.
- To discuss fundament concepts and limits in information theory in the context of digital communication systems.

## Pre-requisites

- Analog Communication

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the sampling process and various waveform coding techniques. | Understand |
| CO2 | Describe the different channel coding techniques used to provide reliable transmission of digital information over the channel. | Apply |
| CO3 | Examine the transmission of a signal at high modulation rate through a band-limited channel and discuss the baseband data transmission systems. | Apply |
| CO4 | Design of optimum receivers and explain the transmission of digital data over a band pass channel. | Analyze |
| CO5 | Discuss the fundamental concepts and limits of information theory in the context of a digital communication system. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 2 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO2 | 3 | 2 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO5 | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 20 | 10 | 10 |
| Apply | 30 | 20 | 60 |
| Analyse | - | 20 | 20 |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 602 – Digital Communication | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 1 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Pulse Digital Modulation Techniques*** Pulse Code Modulation - Sampling, Quantizing, Encoding - Quantization Noise - Robust Quantization - Differential Pulse Code Modulation - Adaptive Differential Pulse Code Modulation - Delta Modulation - Adaptive Delta Modulation. | [9] |
| **Error Control Coding*** Linear Block Codes - Encoding and Decoding - Cyclic Codes – Encoder - Syndrome Calculator - Convolutional Codes - Encoding - Viterbi Decoding. | [9] |
| **Baseband Pulse Transmission*** Line Codes - PSD's - ISI - Nyquist Criterion for Zero ISI - Optimum Transmit and Receive Filters - Correlative Coding - M - Array PAM. | [9] |
| **Baseband Modulation*** Matched Filter Receiver - BASK, BFSK, BPSK - Transmitter, Receiver, Signal Space Diagram, Error Probabilities - Coherent Quadrature Modulation Schemes: QPSK, MSK - Non Coherent Binary Modulation Schemes: BFSK - Comparison of Binary and Quaternary Modulation Schemes - M - Ary Modulation Schemes. | [9] |
| **Fundamentals of Information Theory*** Measure of Information - Entropy - Source Coding Theorem - Discrete Memoryless Channels - Lossless, Deterministic, Noiseless - BEC - BSC - Mutual Information - Channel Capacity - Shannon-Hartley Law - Shannon - Fano Coding - Huffman Coding - Run Length Coding - LZW Algorithm. | [9] |
| **Total Hours: (Lecture - 45; Tutorial -15)** | **60** |

**Text Book(s):**

| | |
|---|---|
| 1. | Simon Haykin, "Digital Communication", 6th Edition, Wiley Publishers, 2014. |
| 2. | John G. Proakis, "Digital Communication", 5th Edition, Tata McGraw Hill, 2014. |

**Reference(s):**

| | |
|---|---|
| 1. | B.P Lathi & Zhi Ding, "Modern Digital and Analog Communication Systems", 5th Edition, Oxford University Press, 2018. |
| 2. | Taub & Schilling, "Principles of Digital Communication", 4th Edition, Mc-Graw Hill, 2015. |
| 3. | Simon Haykin, "Communication Systems", 4th Edition, Wiley Publishers, 2013. |
| 4. | Bernaud Sklar & Ray, "Digital Communications- Fundamentals and Applications", 2nd Edition, Pearson Education, 2012. |

* SDG 4 – Quality Education

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Pulse Digital Modulation Techniques** | |
| 1.1 | Sampling, Quantizing | 1 |
| 1.2 | Encoding | 1 |
| 1.3 | Quantization Noise | 1 |
| 1.4 | robust Quantization | 1 |
| 1.5 | Differential Pulse Code Modulation | 1 |
| 1.6 | Adaptive Differential Pulse Code Modulation | 1 |
| 1.7 | Delta Modulation Concept | 1 |
| 1.8 | Delta Modulation Problems | 1 |
| 1.9 | Adaptive delta modulation | 1 |
| 1.10 | Tutorial | 3 |
| **2** | **Error Control Coding** | |
| 2.1 | Linear Block Codes - Encoding | 1 |
| 2.2 | Linear Block Codes - Decoding | 1 |
| 2.3 | Cyclic Codes | 1 |
| 2.4 | Cyclic Codes- Encoder | 1 |
| 2.5 | Syndrome Calculator | 1 |
| 2.6 | Convolutional Codes | 1 |
| 2.7 | Encoding | 1 |
| 2.8 | Different Structures | 1 |
| 2.9 | Viterbi Decoding | 1 |
| 2.10 | Tutorial | 3 |
| **3** | **Baseband Pulse Transmission** | |
| 3.1 | Line codes | 1 |
| 3.2 | PSD's- ISI | 1 |
| 3.3 | Nyquist criterion for zero ISI | 1 |
| 3.4 | optimum transmit and receive filters | 1 |
| 3.5 | Correlative Coding | 1 |
| 3.6 | Duo Binary Signalling | 1 |
| 3.7 | Modified Duo Binary | 1 |
| 3.8 | M-Array | 1 |
| 3.9 | Pulse Amplitude Modulation | 1 |
| 3.10 | Tutorial | 3 |
| **4** | **Baseband Modulation** | |
| 4.1 | Matched Filter Receiver | 1 |
| 4.2 | BASK – Transmitter, Receiver, Signal Space Diagram, Error Probabilities | 1 |
| 4.3 | BFSK - Transmitter, Receiver, Signal Space Diagram, Error Probabilities | 1 |
| 4.4 | BPSK- Transmitter, Receiver, Signal Space Diagram, Error Probabilities | 1 |
| 4.5 | Coherent Quadrature Modulation Schemes: QPSK | 1 |
| 4.6 | Coherent Quadrature Modulation Schemes: MSK | 1 |
| 4.7 | Non Coherent Binary Modulation Schemes: BFSK | 1 |
| 4.8 | Comparison of Binary and Quaternary Modulation Schemes | 1 |
| 4.9 | M-ary Modulation Schemes | 1 |
| 4.10 | Tutorial | 3 |
| **5** | **Fundamentals of Information Theory** | |
| 5.1 | Measure of Information - Entropy | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.2 | Source Coding Theorem | 1 |
| 5.3 | Discrete Memoryless Channels, Lossless, Deterministic, Noiseless, BEC, BSC | 1 |
| 5.4 | Mutual information -Channel Capacity | 1 |
| 5.5 | Shannon-Hartley Law | 1 |
| 5.6 | Shannon-Fano Coding | 1 |
| 5.7 | Huffman Coding | 1 |
| 5.8 | Run Length Coding | 1 |
| 5.9 | LZW Algorithm | 1 |
| 5.10 | Tutorial | 3 |

**Course Designer(s)**


1. Dr P Kumar - pkumar@ksrct.ac.in
2. Mr P Balamurugan - pbalamurugan@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 603 | Mobile Communication and Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objectives

- To describe the mobile radio communication principles and the recent trends adopted in cellular systems
- To investigate different radio propagation models
- To explore various modulation techniques and its performances
- To design the different wireless standards and networks
- To understand the basics of Next generation wireless networks

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the cellular system design and technical challenges | Understand |
| CO2 | Identify the different radio wave propagation models and fading effects | Apply |
| CO3 | Compare the performance of modulation and diversity techniques | Apply |
| CO4 | Discuss the principles and applications of wireless systems and standards | Understand |
| CO5 | Investigate the next generation wireless networks | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | 3 | - | - | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 12 | 12 | 20 |
| Understand | 28 | 28 | 40 |
| Apply | 20 | 20 | 40 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 603 - Mobile Communication and Networks | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Wireless Communication Systems**<br>Wireless Communication Systems - 2G/3G/4G Cellular Networks - Cellular Concept: Frequency Reuse - Channel Assignment Strategies - Hand Off - Interference & System Capacity - Coverage and Capacity Improvement. | [9] |
| **Mobile Radio Propagation**<br>Free Space Propagation Model - Reflection - Two-Ray Model - Diffraction - Knife-Edge Diffraction Model - Scattering - Log-Normal Shadowing - Okumara Model - Hata Model - Log-Distance Path Loss Model - Small-Scale Multipath Propagation - Parameters of Mobile Multipath Channels - Types of Small-Scale Fading. | [9] |
| **Modulation Techniques and Signal Processing**<br>Principles of Offset - QPSK - Π/4-DQPSK - GMSK - Error Performance in Fading Channels - Spread Spectrum Modulation - Multi Carrier System - OFDM - Diversity Reception Techniques - MIMO Systems – Spatial Multiplexing - System Model. | [9] |
| **Wireless Standards and Networks**<br>GSM System - GSM Network and System Architecture, GSM Channel Concepts, CDMA Architecture - Power Control, System Capacity, 60-Ghz Millimeter Wave Radios - Millimeter Wave Characteristics - Channel Performance At 60 GHz, Gigabit Wireless Communication, Standards - Wi-Gig, IEEE 802.11ad, IEEE 802.15.3c - Millimeter Wave Applications. | [9] |
| **5G and Beyond Networks****<br>Network Architecture Of 5G-And-Beyond Systems - Spectrum Management and Sharing - Small Cell Networks - Heterogeneous Networks - Network Densification - Cloud Radio Access Network (C-RAN) - Software Defined Network (SDN) - Network Function Virtualization (NFV) - Unmanned Aerial Vehicles (UAVs) - Unmanned Aerial Base Stations (UABSs) - Emerging Services and Applications. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | T.S.Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education/Prentice Hall of India, 2009. |
| 2. | Erik Dahlman, Stefan Parkvall and Johan Skold, "4G, LTE-Advanced Pro and The Road to 5G", 3rd Edition, Elsevier, 2016. |
| **Reference(s):** | |
| 1. | Lee W.C.Y, "Mobile Communications Engineering: Theory and applications", 2nd Edition, McGraw-Hill International, 2009. |
| 2. | Martin Sauter, "From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell, 2016. |
| 3. | Erik Dahlman, Stefan Parkvall and Johan Skold, "5G NR: The Next Generation Wireless Access Technology", 1st Edition, Elsevier, 2018. |
| 4. | Eldad Perahia and Robert Stacey, "Next Generation Wireless LANs: 802.11n and 802.11ac", 2nd Edition, Cambridge University Press, 2013. |
| 5. | Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", 1st Edition, CRC Press, 2019. |

**SDG 9 – Industry Innovation and Infrastructure

**Assignment Activity:**

**Assignment 1**

1. Implementation of Two-ray ground-reflection model using MATLAB.
2. Chart preparation of types of Fading.

**Assignment 2**

1. Implementation of MIMO/OFDM system using MATLAB.

**Assignment 3**

1. Report and presentation on 5G and Beyond Networks

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Wireless communication systems** | |
| 1.1 | Wireless Communication Systems - 2G/3G/4G | 1 |
| 1.2 | Wireless Communication Systems - 2G/3G/4G | 1 |
| 1.3 | Cellular Networks | 1 |
| 1.4 | Cellular Concept: Frequency Reuse | 1 |
| 1.5 | Channel Assignment | 1 |
| 1.6 | Hand Off | 1 |
| 1.7 | Interference | 1 |
| 1.8 | System Capacity | 1 |
| 1.9 | Coverage and Capacity Improvement | 1 |
| **2.0** | **Mobile Radio Propagation** | |
| 2.1 | Free space propagation model | 1 |
| 2.2 | Reflection | 1 |
| 2.3 | Two-Ray model, Diffraction, Knife-edge diffraction model | 1 |
| 2.4 | Scattering - Log-normal shadowing | 1 |
| 2.5 | Okumara model - Hata model | 1 |
| 2.6 | Log-distance path loss model | 1 |
| 2.7 | Small-scale multipath propagation | 1 |
| 2.8 | Parameters of mobile multipath channels | 1 |
| 2.9 | Types of small-scale fading | 1 |
| **3.0** | **Modulation Techniques and Signal Processing** | |
| 3.1 | Principles of Offset | 1 |
| 3.2 | QPSK | 1 |
| 3.3 | π/4-DQPSK | 1 |
| 3.4 | GMSK - Error performance in fading channels | 1 |
| 3.5 | Spread Spectrum Modulation | 1 |
| 3.6 | Multi carrier system-OFDM | 1 |
| 3.7 | Diversity reception techniques | 1 |
| 3.8 | MIMO systems | 1 |
| 3.9 | spatial multiplexing - System model. | 1 |
| **4.0** | **Wireless Standards and Networks** | |
| 4.1 | GSM system | 1 |
| 4.2 | GSM network | 1 |
| 4.3 | GSM system architecture & channel concepts | 1 |
| 4.4 | CDMA architecture –power control, system capacity | 1 |
| 4.5 | 60-GHz Millimeter wave radios | 1 |
| 4.6 | Millimeter wave characteristics - Channel performance at 60 GHz | 1 |
| 4.7 | Gigabit wireless communication | 1 |
| 4.8 | Standards - Wi-Gig, IEEE 802.11ad | 1 |
| 4.9 | IEEE 802.15.3c - Millimeter wave applications | 1 |
| **5.0** | **5G and Beyond Networks** | |
| 5.1 | Network architecture of 5G-and-beyond. systems | 1 |
| 5.2 | Spectrum management and sharing | 1 |
| 5.3 | Small cell networks - Heterogeneous Networks - Network densification | 1 |
| 5.5 | Cloud Radio Access Network (C-RAN) - Software Defined Network (SDN) | 1 |
| 5.6 | Network Function Virtualization (NFV) | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.7 | Unmanned Aerial Vehicles (UAVs) | 1 |
| 5.8 | Unmanned Aerial Base Stations (UABSs) | 1 |
| 5.9 | Emerging services and applications | 1 |

**Course Designer(s)**


1. Dr.P.Kumar - kumar@ksrct.ac.in
2. Mr.R.Satheeshkumar - satheeshkumar@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 604 | Machine Learning Techniques | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 2 | 4 |

## Objectives

- To understand different techniques related to machine learning.
- To understand machine learning techniques for linear models.
- To study various unsupervised learning techniques and dimensionality reduction techniques.
- To learn the theoretical aspects of graphical models.
- To explain the reinforcement learning techniques and its applications.

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the concepts of machine learning. | Understand |
| CO2 | Identify and apply the appropriate machine learning technique for classification, regression and decision making. | Apply |
| CO3 | Solve the clustering and dimensionality problems. | Apply |
| CO4 | Apply the inference and learning algorithms for the graphical model. | Apply |
| CO5 | Apply reinforcement learning techniques for real life problems. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO2 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | - | 10 | - | - | 30 | - |
| Understand | 30 | 10 | 30 | 10 | 10 | 60 | 10 |
| Apply | 10 | 90 | 20 | 90 | 90 | 10 | 90 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC 604 - Machine Learning Techniques**

| Semester | Hours / Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 2 | 75 | 4 | 50 | 50 | 100 |

| | |
|---|---|
| **Neural Networks*** <br> Neural Networks - Training a Perceptron - Learning Boolean Functions, Activation - ReLu, Hyper Parameter Tuning, Batch Normalization, Regularization, Multilayer Perceptrons - Back Propagation Algorithm - Training Procedures - Types of Machine Learning - Generalization Trade-off - Bias and Variance - Machine Learning Model Deployment Techniques. | [9] |
| **Linear Models** <br> Linear Regression - Ridge Regression - Lasso, Bayesian Regression - Regression with Basis Functions - Logistic Regression - Large Margin Classification - Kernel Methods - Support Vector Machines - Decision Tree. | [9] |
| **Unsupervised Learning and Dimensionality Reduction** <br> Nearest Neighbour Models - K Means - Clustering Around Medoids - Silhouettes - Hierarchical Clustering - Dimensionality Reduction - Principal Component Analysis - Factor Analysis - Independent Component Analysis. | [9] |
| **Graphical Model and Ensemble Methods** <br> Markov Chain Monte Carlo Methods - Sampling - Proposal Distribution - Bayesian Belief Networks - Markov Random Fields - Hidden Markov Models - Boosting - Bagging - Simple Methods - Stacking Technique. | [9] |
| **Reinforcement Learning**** <br> Passive Reinforcement Learning - Direct Utility Estimation - Adaptive Dynamic Programming - Temporal Difference Learning - Active Reinforcement Learning - Exploration - Generalization in Reinforcement Learning - Policy Search - Inverse and Transfer Learning Reinforcement - Applications in Health Care and Robot Control. | [9] |
| **Practical:** <br> 1. Simulate the data extraction from the database and various data pre-processing techniques for a given dataset. <br> 2. Simulate the ANN using back-propagation algorithm. <br> 3. Simulate a regression model for a given dataset. <br> 4. Simulate SVM classification for a dataset. <br> 5. Simulate a decision tree classification model for a given dataset. <br> 6. Simulate dimensionality reduction using PCA method on a given dataset. <br> 7. Simulate dimensionality reduction using ICA method on a given dataset. <br> 8. Simulate K Means clustering method. <br> 9. Simulate boosting ensemble method for any dataset. <br> 10. Simulate reinforcement learning algorithm for medical applications. <br><br> **Tools used: MATLAB / Open Source** | [30] |
| **Total Hours: (Lecture - 45; Practical - 30)** | **75** |

**Text Book(s):**

| | |
|---|---|
| 1. | Ethem Alpaydin, "Introduction to Machine Learning", 4th Edition, MIT Press, 2020. |
| 2. | Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2017. |

**Reference(s):**

| | |
|---|---|
| 1. | Peter Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012. |
| 2. | Murphy K.P, "Machine Learning: A probabilistic perspective", MIT Press, 2012. |
| 3. | Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2014. |
| 4. | Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, 2014. |

* SDG 3 – Good Health and Well Being
**SDG 9 - Sustainable industrialization and foster innovation

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Neural Networks** | |
| 1.1 | Neural Networks - Training a Perceptron | 1 |
| 1.2 | Learning Boolean Functions - ReLu, Hyper Parameter Tuning | 1 |
| 1.3 | Batch Normalization, Regularization, Dropout | 1 |
| 1.4 | Multilayer Perceptron's | 1 |
| 1.5 | Back Propagation Algorithm -Training Procedures | 1 |
| 1.6 | Types of Machine Learning - Supervised and Unsupervised Learning | 1 |
| 1.7 | Theory of Generalization, Generalization Bound - Approximation | 1 |
| 1.8 | Generalization Trade-off - Bias and Variance | 1 |
| 1.9 | Machine Learning Model Deployment Techniques | 1 |
| **2** | **Linear Models** | |
| 2.1 | Linear Regression | 1 |
| 2.2 | Ridge Regression | 1 |
| 2.3 | Lasso, Bayesian Regression | 1 |
| 2.4 | Regression with Basis Functions | 1 |
| 2.5 | Logistic Regression | 1 |
| 2.6 | Large Margin Classification- Kernel Methods | 1 |
| 2.7 | Support Vector Machines | 1 |
| 2.8 | Hard SVM, Soft SVM | 1 |
| 2.9 | Decision Tree | 1 |
| **3** | **Unsupervised Learning and Dimensionality Reduction** | |
| 3.1 | Nearest Neighbour Models | 1 |
| 3.2 | K Means | 1 |
| 3.3 | Clustering Around Medoids | 1 |
| 3.4 | Silhouettes | 1 |
| 3.5 | Hierarchical Clustering | 1 |
| 3.6 | Dimensionality Reduction | 1 |
| 3.7 | Principle Component Analysis | 1 |
| 3.8 | Factor Analysis | 1 |
| 3.9 | Independent Component Analysis | 1 |
| **4** | **Graphical Model and Ensemble Methods** | |
| 4.1 | Markov Chain Monte Carlo Methods | 1 |
| 4.2 | Sampling - Proposal Distribution | 1 |
| 4.3 | Bayesian Belief Networks | 1 |
| 4.4 | Markov Random Fields | 1 |
| 4.5 | Hidden Markov Models | 1 |
| 4.6 | Boosting - Gradient Boosting | 1 |
| 4.7 | Adaboost, | 1 |
| 4.8 | Bagging - Simple Methods | 1 |
| 4.9 | Stacking Technique | 1 |
| **5** | **Reinforcement Learning** | |
| 5.1 | Passive Reinforcement Learning – Direct Utility Estimation | 1 |
| 5.2 | Adaptive Dynamic Programming | 1 |
| 5.3 | Temporal Difference Learning | 1 |
| 5.4 | Active Reinforcement Learning – Exploration | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.5 | Learning an Action-Utility Function | 1 |
| 5.6 | Generalization in Reinforcement Learning | 1 |
| 5.7 | Policy Search –Inverse and Transfer Learning Reinforcement | 1 |
| 5.8 | Applications in Health Care | 1 |
| 5.9 | Applications in Robot Control | 1 |
| **Practical:** | | |
| 1. | Simulate the data extraction from the database and various data pre-processing techniques for a given dataset. | 2 |
| 2. | Simulate the ANN using back-propagation algorithm. | 2 |
| 3. | Simulate a regression model for a given dataset. | 2 |
| 4. | Simulate SVM classification for a dataset. | 2 |
| 5. | Simulate a decision tree classification model for a given dataset. | 2 |
| 6. | Simulate dimensionality reduction using PCA method on a given dataset. | 4 |
| 7. | Simulate dimensionality reduction using ICA method on a given dataset. | 4 |
| 8. | Simulate K Means clustering method. | 4 |
| 9. | Simulate boosting ensemble method for any dataset. | 4 |
| 10. | Simulate reinforcement learning algorithm for medical applications | 4 |

**Course Designer(s)**


1. Dr.K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Ms.R.Ramya - rramya@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 6P1 | Innovation Engineering Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 3 | 1.5 |

## Objectives

- To disassemble and reassemble circuits
- To diagnose faults in a circuit
- To deconstruct a product and extract design information
- To learn connections and power requirements
- To develop a prototype

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Sketch the design information of a product | Apply |
| CO2 | Execute efficient assembly and disassembly design in an electronic product | Apply |
| CO3 | Test and troubleshoot an electronic circuit | Analyse |
| CO4 | Design an electronic product efficiently | Analyse |
| CO5 | Develop prototype for a product already available in the market with enhanced features | Evaluate |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | - | - | - | - |
| Understand | - | - | - | - |
| Apply | 25 | - | 50 | 50 |
| Analyse | 25 | - | 50 | 50 |
| Evaluate | - | 25 | - | - |
| Create | - | - | - | - |
| Total | 50 | 25 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 6P1 - Innovation Engineering Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 0 | 0 | 3 | 45 | 1.5 | 60 | 40 | 100 |

1. Diagnose and troubleshoot the given PCB
2. Extract the circuit drawing from the given PCB
3. Tear down a product
    i. Find the design information
    ii. Draw the circuit
    iii. Find the connections and power requirements
    iv. Report on feature enhancement of the product in terms of design, power requirement, packaging or any other feature of interest
4. Design and develop a prototype for the product already available in the market

The product for experiment 3 can be chosen from the below list or the student can bring his/her own electronic product

- Pulse oximeter*
- Stabiliser**
- Audio amplifier**
- UPS board**

*SDG 3 – Good Health and Well Being
**SDG 4 – Quality Education

**Course Designer(s)**

1. Dr.K.B.Jayanthi – jayanthikb@ksrct.ac.in
2. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 6P2 | Embedded Systems Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 3 | 1.5 |

**Objectives**

- To familiarize the operators and registers in Embedded C
- To learn about ADC and DAC
- To interface peripherals and processors associated with embedded systems
- To understand the concept of UART communication
- To familiarize with RTOS in Embedded computing

**Pre-requisites**

- Microprocessors and Microcontrollers, Basics of C Programming

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Develop bare metal Embedded C programs to perform transmission and reception. | Apply |
| CO2 | Develop Embedded C programs for interfacing peripherals | Apply |
| CO3 | Develop multitasking bare metal Embedded C programs using RTOS | Apply |
| CO4 | Implement Embedded C programs for interfacing DC motors | Apply |
| CO5 | Create applications utilizing timers or external interrupts with PWM, and SPI interfaces | Evaluate |

**Mapping with Programme Outcomes**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | - | - | - | - |
| Understand | - | - | - | - |
| Apply | 50 | - | 100 | 100 |
| Analyse | - | - | - | - |
| Evaluate | - | 25 | - | - |
| Create | - | - | - | - |
| Total | 50 | 25 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 6P2 - Embedded Systems Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 0 | 0 | 3 | 45 | 1.5 | 60 | 40 | 100 |

**List of Experiments:**

1. Develop a bare metal Embedded C program to access GPIO ports *
2. Develop a bare metal Embedded C program to perform UART transmission and reception
3. Develop the bare metal Embedded C program for ADC and print the value in UART
4. Develop the bare metal Embedded C program for ADXL345 Accelerometer using the I2C *
5. Develop the multitasking bare metal Embedded C program using free RTOS for following task
   - Task-1: Blink LED for 1 second (using Vtask timer)
   - Task-2: Read ADXL345 print in UART
   - Task-3: Read ADC and trigger an LED once threshold meets and print the value in UART
6. Develop the bare metal Embedded C program for DC motor interface

**Open ended experiments:**

1. Develop an application using timer or external interrupts and PWM **
2. Develop an application using SPI interface

**Lab Manual**

| | |
|---|---|
| 1. | "Embedded Systems Lab Manual", Department of Electronics and Communication Engineering, KSRCT. |

*SDG 9 – Industry Innovation and Infrastructure

**SDG 7 – Affordable and Clean Energy

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 6P3 | Digital Communication Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 2 | 1 |

**Objectives**

- To obtain the operation of line coding and decoding methods
- To analyse and test digital communication systems using simulation software as well as laboratory components
- To obtain a better understanding of the operation of digital modulation schemes
- To understand error coding and decoding in digital telecommunication system.
- To measure the spectrum of filters

**Pre-requisites**

- Analog Communication

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Generate waveforms with line coding and decoding techniques. | Apply |
| CO2 | Demonstrate Delta Modulation. | Analyse |
| CO3 | Demonstrate the various digital pulse modulation techniques | Apply |
| CO4 | Develop programs for error control coding | Analyse |
| CO5 | Measure the spectrum for different filters | Apply |

**Mapping with Programme Outcomes**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | - | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | - | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | - | - | - | - |
| Understand | - | - | - | - |
| Apply | 25 | 25 | 50 | 50 |
| Analyse | 25 | - | 50 | 50 |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |
| Total | 50 | 25 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 6P3 - Digital Communication Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 0 | 0 | 2 | 30 | 1 | 60 | 40 | 100 |

**List of Experiments:**

1. Simulation of Line Coding and Decoding Techniques
2. Generate Delta Modulation waveforms
3. Simulation of ASK, FSK and PSK Modulation and Detection
4. Simulation of Quadrature Phase Shift Keying Modulation and Detection
5. Implementation of Convolutional Codes
6. Spectrum Measurement for low pass, high pass and band pass Filters
- Mini project

| **Lab Manual** | |
|---|---|
| 1. | "Digital Communication Lab Manual", Department of Electronics and Communication Engineering, KSRCT. |

*SDG 9 – Industry Innovation and Infrastructure

**Course Designer(s)**


1. Dr P Kumar – pkumar@ksrct.ac.in
2. Mr P Balamurugan – pbalamurugan@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 CG 0P5<br>Semester VI | Comprehension Test* | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 2 | 1 |

## Objectives

- To evaluate the knowledge gained in core courses relevant to the programme of study
- To assess the technical skill in solving complex engineering problems

## Pre-requisites

- Fundamental knowledge in all core subjects

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Infer knowledge in their respective programme domain. | Apply |
| CO2 | Attend interviews for career progression. | Apply |
| CO3 | Exhibit professional standards to solve engineering problems. | Apply |
| CO4 | Promote holistic approach to problem solving. | Apply |
| CO5 | Examine the competency of graduates in specific programme domain. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | 2 | - | - | - | - | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 2 | - | - | - | - | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 2 | - | - | - | - | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | - | - | - | - | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 2 | - | - | - | - | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

The overall knowledge of the candidate in various courses he/she studied shall be evaluated with multiple choice questions.

*SDG 4 - Quality Education

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E11 | Wearable Devices | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

## Objectives

- To explain the field of wearable devices and applications
- To identify the scope of wearable devices and the future roadmap
- To apply the sensors for wearable devices
- To apply the wearable cameras and microphones for navigation
- To solve the security issues, psychological effects and health issues related to wearable devices

## Pre-requisites

- Electronic Devices

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Summarize the wearable devices and their applications | Understand |
| CO2 | Explain the scope and future roadmap of wearable devices | Understand |
| CO3 | Identify the different sensors used in wearable devices | Apply |
| CO4 | Make use of the wearable cameras and microphones for navigation in wearable devices | Apply |
| CO5 | Solve the security issues, psychological effects and health concerns related to wearable devices | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 2 | 2 | 2 | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | 2 | 2 | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 2 | 2 | 2 | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | 20 | 20 | - | - | 34 | - |
| Understand | 40 | 80 | 20 | 20 | 20 | 33 | 20 |
| Apply | - | - | 20 | 80 | 80 | 33 | 80 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E11 - Wearable Devices | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Wearable Devices *,**,*****<br>Motivation for Development of Wearable Devices - The Emergence of Wearable Computing and Wearable Electronics - Intelligent Clothing, Sports, Healthcare, Fashion and Entertainment, Military, Environment Monitoring, Mining Industry, Public Sector and Safety. | [6] |
| **Scope of Wearable Devices*,**,*****<br>Role of Wearables - Attributes of Wearables - The Meta Wearables - Textiles and Clothing, Social Aspects - Interpretation of Aesthetics - Adoption of Innovation - On-Body Interaction. | [6] |
| **Sensors for Wearable Devices*,**,*****<br>Wearable Inertial Sensors - Accelerometers, Gyroscopic Sensors, Force and Pressure Measurement, Flexible Sensors - Flex Sensor, Pulse oximeter, Inertial sensor, Dehydration sensor, Nano Sensors - CNT Based Sensors. | [6] |
| **Wearable Cameras and Microphones for Navigation*,**,*****<br>Cameras in Wearable Devices - Navigation - Cameras in Smart-Watches - Microphones and AI For Respiratory Diagnostics and Clinical Trials - Wearable Assistive Devices for the Blind - Hearing and Touch sensation - Wearable devices with Global Positioning System (GPS) Integration for Tracking and Navigation. | [6] |
| **Security Issues and Psychological Effects of Wearables*,**,*****<br>Security and Privacy Issues in Wearable Technology - Psychological Effects of Wearables - Social Implications - Technology Acceptance Factors - Electromagnetic Intolerance and Other Risks. | [6] |
| **Practical:**<br>**Mini Project *,**,*****<br>• Design and assemble a wearable circuit incorporating sensors and necessary hardware components, along with functions of the finalized project.<br>**Tools used: MATLAB / Aurduino,** | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |

| **Text Book(s):** | |
|---|---|
| 1. | Toshiyo Tamura and Wenxi Chen, “Seamless Healthcare Monitoring”, Springer, 2018. |
| 2. | Edward Sazonov and Michael R. Neuman, “Wearable Sensors -Fundamentals, Implementation and Applications”, Elsevier Inc., 2014. |
| **Reference(s):** | |
| 1. | Aime Lay-Ekuakille and Subhas Chandra Mukhopadhyay, “Wearable and Autonomous Biomedical Devices and Systems for Smart Environment”, Springer, 2010. |
| 2. | Subhas C and Mukhopadhyay, “Wearable Electronics Sensors - For Safe and Healthy Living”, Springer International Publishing, 2015. |
| 3. | Haider Raad, “The Wearable Technology Handbook”, United Scholars Publication, 2017. |

*SDG 3 – Good Health and Well Being
**SDG 9 – Industry Innovation and Infrastructure
***SDG 11 Sustainable Cities and Communities

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Wearable Devices** | |
| 1.1 | Motivation for Development of Wearable Devices | 1 |
| 1.2 | The Emergence of Wearable Computing and Wearable Electronics | 1 |
| 1.3 | Applications in Intelligent Clothing, Sports | 1 |
| 1.4 | Applications in Healthcare | 1 |
| 1.5 | Applications in Fashion and Entertainment, Military | 1 |
| 1.6 | Applications in Environment Monitoring, Mining Industry, Public Sector and Safety | 1 |
| **2** | **Scope of Wearable Devices** | |
| 2.1 | Role of Wearables | 1 |
| 2.2 | Attributes of Wearables | 1 |
| 2.3 | The Meta Wearables – Textiles and Clothing | 1 |
| 2.4 | Social Aspects - Interpretation of Aesthetics | 1 |
| 2.5 | Adoption of Innovation | 1 |
| 2.6 | On-Body Interaction | 1 |
| **3** | **Sensors for Wearable Devices** | |
| 3.1 | Wearable Inertial Sensors - Accelerometers, Gyroscopic sensors | 1 |
| 3.2 | Force and Pressure Measurement | 1 |
| 3.3 | Flexible Sensors - Flex sensor | 1 |
| 3.4 | Pulse Oximeter | 1 |
| 3.5 | Inertial Sensor, Dehydration Sensor | 1 |
| 3.6 | Nano Sensors - CNT Based Sensors | 1 |
| **4** | **Wearable Cameras and Microphones for Navigation** | |
| 4.1 | Cameras in Wearable Devices, | 1 |
| 4.2 | Navigation and Cameras in Smart-Watches | 1 |
| 4.3 | Microphones and AI For Respiratory Diagnostics and Clinical Trials | 1 |
| 4.4 | Wearable Assistive Devices for The Blind | 1 |
| 4.5 | Hearing and Touch Sensation | 1 |
| 4.6 | Wearable devices with Global Positioning System (GPS) integration for tracking and navigation | 1 |
| **5** | **Security Issues and Psychological Effects of Wearables** | |
| 5.1 | Security and Privacy Issues in Wearable Technology | 1 |
| 5.2 | Psychological Effects of Wearables | 1 |
| 5.3 | Social Implications | 1 |
| 5.4 | Technology Acceptance Factors | 1 |
| 5.5 | Electromagnetic Intolerance and Other Risks | 2 |
| **Practical: (Mini Project)** | | |
| 1. | Design and assemble a wearable circuit incorporating sensors and necessary hardware components, along with functions of the finalized project. | 30 |

**Course Designer(s)**

1. Dr.D. Mugilan - mugilan@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E12 | IoT Hardware | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 1 | 0 | 4 | 3 |

## Objectives

- To evaluate the unique requirements and challenges associated with deploying IoT
- To develop practical skills in building functional IoT devices using open-source hardware
- To develop skills in combining different sensor types
- To analyze the advantages and challenges of utilizing cloud resources for IoT applications
- To design and implement IoT applications to enhance urban services and sustainability

## Pre-requisites

- Electronic devices and circuits, Basics of C Programming

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the fundamental concepts of the Internet of Things | Understand |
| CO2 | Demonstrate proficiency in utilizing open-source hardware | Apply |
| CO3 | Configure and optimize a variety of sensors | Apply |
| CO4 | Implement IoT physical servers and cloud infrastructure | Apply |
| CO5 | Execute comprehensive and tailored IoT applications in diverse domains | Evaluate |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO2 | 3 | 2 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | - | 3 | 2 | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | - | 3 | 3 | 2 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Assessment 1 (Presentation) | | Assessment 2 (CA Test) | Assessment 3 (Model – Presentation) | |
|---|---|---|---|---|
| **Assessment Parameters** | **Marks** | **Marks** | **Assessment Parameters** | **Marks** |
| Problem Identification | 10 | Questions from CO1 to CO4 As per CA Test Pattern | Innovation | 30 |
| Innovation | 30 | | Clarity in Presentation | 10 |
| Solution for problem | 10 | | Demo | 30 |
| Clarity in Presentation | 05 | | Completion of Report | 20 |
| Viva | 05 | | Viva | 10 |
| **Total** | **60** | **60** | **Total** | **100** |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **B.E - Electronics and Communication Engineering** | | | | | | | | |
| **60 EC E12 - IoT Hardware** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 1 | 0 | 4 | 75 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Internet of Things *** Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT - IoT Protocols, IoT communication models, Domain Specific IoT Applications. | [3+12] |
| **IoT Physical Devices and Endpoints** Opensource Hardware, Controlling Hardware - LED, Buzzer, Switching High Power Devices with Transistors, Controlling AC Power Devices with Relays, Controlling Servo Motor, Speed Control of DC Motor, Stepper Motor, Wired - Wireless Protocol Interfaces. | [3+12] |
| **Sensor Interfaces *** Sensors - Light Sensor, Temperature Sensor with Thermistor, Voltage Sensor, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, RFID, Level Sensors, Distance Measurement with ultrasound sensor, ADC and DAC, PWM | [3+12] |
| **IoT Cloud *** IoT Physical Servers and Cloud - Cloud Storage Models and Communication APIs Web Server - Web Server for IoT, Cloud for IoT | [3+12] |
| **Application development *** Biomedical, Agriculture, Smart City, Wearables, Smart Grid, Smart Retail, Smart Manufacturing, Transportation, Fleet Management, Predictive Maintenance | [3+12] |
| **Total Hours: (Lecture - 15; Practical - 60)** | **75** |

| **Text Book(s):** | |
|---|---|
| 1. | Arshdeep Bahga and Vijay Madisetti, VPT, "Internet of Things: A Hands-On Approach", 1st Edition, 2014. |
| 2. | Scott Klein and Matthijs Hoekstra, "IoT Solutions in Microsoft's Azure IoT Suite: Data Acquisition and Analysis in the Real World", 1st Edition, Wiley, 2016. |
| 3. | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things",1st Edition Cisco Press, 2017. |
| **Reference(s):** | |
| 1. | Zach Shelby and Dominique Guinard, "IoT Architecture: A Guide to Realizing Value in the Digital Enterprise", 1st Edition, O'Reilly Media, 2016. |
| 2. | Maciej Kranz, "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry", 1st Edition, 2016. |
| 3. | Vincent M. G. Gabaglio and Marco Mancuso, "IoT Applications for Electronics",1st Edition McGraw-Hill Education, 2017. |

*SDG 9 – Industry Innovation and Infrastructure

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Internet of Things** | |
| 1.1 | Definition and Characteristics of IoT | 1 |
| 1.2 | Sensors, Actuators | 1 |
| 1.3 | IoT Protocols, IoT Communication Models | 1 |
| **2** | **IoT Physical Devices and Endpoints** | |
| 2.1 | Opensource Hardware | 1 |
| 2.2 | Controlling Hardware | 1 |
| 2.3 | Wired - Wireless Protocol Interfaces | 1 |
| **3** | **Sensor Interfaces** | |
| 3.1 | Sensors- Light sensor, temperature sensor with thermistor, voltage sensor | 1 |
| 3.2 | Motion Detection Sensors, RFID, Level Sensors | 1 |
| 3.3 | ADC and DAC, PWM | 1 |
| **4** | **IoT Cloud** | |
| 4.1 | IoT Physical Servers and Cloud | 1 |
| 4.2 | Web server for IoT | 1 |
| 4.3 | Cloud for IoT | 1 |
| **5** | **Application development** | |
| 5.1 | Biomedical, Agriculture, Smart city | 1 |
| 5.2 | Smart Manufacturing | 1 |
| 5.3 | Predictive Maintenance | 1 |
| **6** | **Project** | |
| 6.1 | Problem Identification | 10 |
| 6.2 | Solution for Problem | 15 |
| 6.3 | Implementation | 20 |
| 6.4 | Presentation | 5 |
| 6.5 | Report | 5 |
| 6.6 | Demo | 5 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E13 | Radar Technologies | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

## Objectives

- To understand the basic concepts of radar system
- To understand the principles of signal detection in noise and radar waveforms
- To understand principles of radar transmitter and receiver
- To understand the principles of radar antennas
- To learn the concepts of MTI and pulse doppler radar

## Pre-requisites

- Electromagnetic Waves

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the Basics of radar technologies | Understand |
| CO2 | Apply the concepts related to detection of signals in noise and radar waveforms | Apply |
| CO3 | Describe the concepts of radar transmitter and receiver | Understand |
| CO4 | Explain the concepts of radar antenna and Design of phased array antennas | Apply |
| CO5 | Describe the concept of MTI and doppler radar | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | - | 20 | - | - | 40 | - |
| Understand | 30 | 30 | 40 | 30 | 20 | 50 | 20 |
| Apply | 10 | 70 | - | 70 | 80 | 10 | 80 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E13 - Radar Technologies | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Radar Concepts**<br>Radar Block Diagram, Radar Frequencies, Radar Coordinates, Radar Equation for Hard Targets and the SNR-Radar Cross Section of Targets, Radar Resolution Elements, Pulse, CW and FMCW Radars – Configurations, Transmitter Power- Pulse Repetition Frequency, Duty Ratio, Pulse Compression - Applications of Radar. | [6] |
| **Detection of Signals in Noise and Radar Waveforms**<br>Probabilities of Detection and False Alarm-M**atched Filter Receiver***- Detection Criteria -<br>Integration of Radar Pulses - Constant - False Alarm Rate Receivers - Radar Waveforms, Ambiguity Diagram. | [6] |
| **Radar Transmitter and Receiver**<br>**Types of Transmitters*** - Linear-Beam Power Tubes - Solid-State RF Power Sources- Magnetron - Klystron, Crossed - Filed Amplifier - Radar Receiver- Receiver Noise Figure - Digital Receivers, Duplexers and Receiver Protectors - Radar Displays - **Human Machine Interface (HMI)**.** | [6] |
| **Radar Antenna**<br>**Functions of radar antenna***- Antenna Parameters - Antenna Radiation Pattern and Aperture Illumination - Reflector Antennas- Electronically Steered Phased Array Antennas- Phase Shifters - Frequency - Scan Arrays- Architectures for Phased Arrays, Radiators for Phased Arrays - Mechanically Steered Planar Array Antennas. | [6] |
| **MTI and Pulse Doppler Radar**<br>Doppler and MTI radar- Delay - Line cancellers- Staggered Pulse Repetition Frequencies - Doppler Filter Banks- Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance Pulse Doppler Radar - MTD**, Tracking Radar****- Monopulse Tracking - Conical Scan and Sequential Lobing - Comparison of Trackers. Tracking Accuracy - Low Angle Tracking - Atmospheric & Weather Radars. | [6] |
| **Practical:**<br>1. Design of Radar System Using MATLAB and Simulink<br>2. Implementation of Matched Filter for Signal Detector using MATLAB<br>3. Study the Characteristics of Microwave Sources<br>4. Design of Phased Array Antennas using Ansys HFSS<br>5. Design and Implementation of Pulse-Doppler Radar System using MATLAB | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |

| **Text Book(s):** | |
|---|---|
| 1. | M.I.Skolnik, “Introduction to Radar Systems”, 2nd Edition, Tata McGraw Hill, 2017. |
| 2. | Peebles P Z, "Radar Principles", Wiley, 2016. |
| **Reference(s):** | |
| 1. | Richard J Doviak, Dusan S Zrnic , "Doppler Radar and Weather Observations", Academic Press, 2014 |
| 2. | Bringi V N, Chandrasekar V, "Polarimetric Doppler Weather Radar", Cambridge University Press, 2012. |
| 3. | Richards M A, Scheer J A and Holm W A, "Principles of Modern Radar", Scitech Publishing, 2014. |

* SDG 4 – Quality Education

**SDG 9 – Industry Innovation and Infrastructure

Passed in BoS Meeting held on 18/11/2023

Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Radar Concepts** | |
| 1.1 | Radar Block Diagram | 1 |
| 1.2 | Radar Frequencies, Radar Coordinates | 1 |
| 1.3 | Radar Equation for Hard Targets and the SNR-Radar Cross Section of Targets | 1 |
| 1.4 | Radar Resolution Elements, Pulse CW | 1 |
| 1.5 | FMCW Radars–Configurations | 1 |
| 1.6 | Transmitter Power- Pulse Repetition Frequency, Duty Ratio, Pulse Compression, Applications of Radar | 1 |
| **2.0** | **Detection of Signals in Noise and Radar Waveforms** | |
| 2.1 | Probabilities of Detection and False Alarm | 1 |
| 2.2 | Matched Filter Receiver-Detection Criteria | 1 |
| 2.3 | Integration of Radar Pulses | 1 |
| 2.4 | Constant-False Alarm Rate Receivers | 1 |
| 2.5 | Radar Waveforms, | 1 |
| 2.6 | Ambiguity Diagram. | 1 |
| **3.0** | **Radar Transmitter and Receiver** | |
| 3.1 | Types of Transmitters | 1 |
| 3.2 | Linear-Beam Power Tubes | 1 |
| 3.3 | Solid-State RF Power Sources | 1 |
| 3.4 | Magnetron- Klystron, Crossed-Filed Amplifier | 1 |
| 3.5 | Radar Receiver- Receiver Noise Figure- Digital Receivers | 1 |
| 3.6 | Duplexers and Receiver Protectors- Radar Displays-Human Machine Interface (HMI). | 1 |
| **4.0** | **Radar Antenna** | |
| 4.1 | Functions of Radar Antenna | 1 |
| 4.2 | Antenna Parameters- Antenna Radiation Pattern and Aperture Illumination | 1 |
| 4.3 | Reflector Antennas- Electronically Steered Phased Array Antennas- Phase Shifters | 1 |
| 4.4 | Frequency - Scan Arrays | 1 |
| 4.5 | Architectures for Phased Arrays | 1 |
| 4.6 | Radiators for Phased Arrays- Mechanically Steered Planar Array Antennas. | 1 |
| **5.0** | **MTI and Pulse Doppler Radar** | |
| 5.1 | Delay – Line Cancellers Staggered Pulse Repetition Frequencies- | 1 |
| 5.2 | Doppler Filter Banks | 1 |
| 5.3 | Digital MTI Processing - Moving Target Detector | 1 |
| 5.4 | limitations to MTI Performance Pulse Doppler Radar-MTD, Tracking Radar | 1 |
| 5.5 | Monopulse Tracking- Conical Scan and Sequential Lobing- Comparison of Trackers. | 1 |
| 5.6 | Tracking Accuracy-Low-Angle Tracking- Atmospheric & Weather Radars. | 1 |
| **Practical:** | | |
| 1. | Design of Radar System using MATLAB and Simulink | 6 |
| 2. | Implementation of Matched Filter for Signal Detector using MATLAB | 6 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 3. | Study the Characteristics of Microwave Sources | 6 |
| 4. | Design of Phased Array Antennas using Ansys HFSS | 6 |
| 5. | Design and Implementation of Pulse-Doppler Radar System using MATLAB | 6 |

**Course Designer(s)**

1. Mr.R.Satheeshkumar - satheeshkumar@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E14 | Optical Communication and Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

## Objectives

- To learn the basic elements of optical fiber transmission link, fiber modes, configurations and structures
- To enhance the knowledge on signal degradation in optical fibers
- To facilitate the knowledge about fiber optic sources and coupling techniques
- To provide knowledge about the operation of fiber optic receivers and parameters measurement
- To enrich the idea of optical fiber networks such as SONET/SDH and optical components

## Pre-requisites

- Electromagnetic Waves

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the basic concepts of optical communication | Understand |
| CO2 | Identify the different kind of losses & signal degradation in optical waveguides | Apply |
| CO3 | Explain about the optical sources and coupling techniques | Understand |
| CO4 | Apply the concepts of fiber optic receiver operation and parametric measurement techniques | Apply |
| CO5 | Describe the basic concepts of different optical components and optical networks. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 15 | - | 15 | - | - | 40 | - |
| Understand | 35 | 40 | 35 | 40 | 40 | 50 | 40 |
| Apply | 10 | 60 | 10 | 60 | 60 | 10 | 60 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E14 - Optical Communication and Networks | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Optical Fibers: Structures, Waveguiding, and Fabrication**<br>**Element of an Optical Fiber Transmission link*, Ray Optics*,** Optical Fiber Modes and Configurations - Single Mode Fibers - Graded Index Fiber Structure, Fiber Fabrication Techniques. | [6] |
| **Signal Degradation in Optical Fibers**<br>**Attenuation*** - Absorption Losses, Scattering Losses, Bending Losses, Core and Cladding Losses, Material Dispersion, Waveguide Dispersion, Intermodal Dispersion - Pulse Broadening in GI Fibers | [6] |
| **Fiber Optical Sources and Coupling**<br>**Optical sources*** - LEDs and LASER Diodes: Structures, Characteristics and Quantum Efficiency, Power Launching and Coupling, Fiber Alignment, Fiber Splicing. | [6] |
| **Fiber Optical Receivers and Measurements**<br>**PIN and APD*** - Structure and Working Principles, Noise in Detectors, Optical Receiver Operation - Fiber Optic Measurements – Attenuation, Dispersion, Refractive Index Profile and Cut- off Wavelength | [6] |
| **Optical Networks and Components**<br>**SONET and WDM Optical Networks****, Optical Couplers, Filters, Isolators, Switches and Amplifiers | [6] |
| **Practical:**<br>1. Analog transmission characteristics of fiber optic link<br>2. Attenuation and numerical aperture measurement in optical fibers<br>3. PI characteristics of LED and LASER diodes<br>4. Gain characteristics of APD and photodiode<br>5. Study of WDM using simulator | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |

| **Text Book(s):** | |
|---|---|
| 1. | Gerd Kaiser, “Optical Fiber Communications”, 5th Edition, Tata McGraw Hill Publishers, 2013. |
| 2. | John M. Senior, “Optical Fiber Communication”, 3rd Edition, Pearson Education, 2009. |
| **Reference(s):** | |
| 1. | Govind P. Agarval, “Fiber-Optic Communication Systems”, 4th Edition, John Wiley & Sons, 2010. |
| 2. | Rajiv Ramasamy and Kumar. N. Sivarajan, Galen H. Sasaki, “Optical Networks-A Practical Perspective”, 3rd Edition, Morgan Kauffman, 2010. |
| 3. | Ramaswami, Sivarajan and Sasaki “Optical Networks”, Morgan Kaufmann, 2009. |
| 4. | Vivekanand Mishra and Sunita P.Ugate, “Fiber – Optic Communication”, Wiley India, 2013. |

*SDG:4- Quality Education

**SDG:9 – Build resilient infrastructure and foster innovation

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Optical Fibers: Structures, Waveguiding, and Fabrication** | |
| 1.1 | Element of an Optical Fiber Transmission Link | 1 |
| 1.2 | Ray Optics | 1 |
| 1.3 | Optical Fiber Modes and Configurations | 1 |
| 1.4 | Single Mode Fibers | 1 |
| 1.5 | Graded Index Fiber Structure | 1 |
| 1.6 | Fiber Fabrication Techniques. | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| **2.0** | **Signal Degradation in Optical Fibers** | |
| 2.1 | Attenuation – Absorption Losses, Scattering Losses | 1 |
| 2.2 | Bending Losses, Core and Cladding Losses | 1 |
| 2.3 | Material Dispersion | 1 |
| 2.4 | Waveguide Dispersion | 1 |
| 2.5 | Intermodal Dispersion | 1 |
| 2.6 | Pulse Broadening in GI fibers | 1 |
| **3.0** | **Fiber Optical Sources and Coupling** | |
| 3.1 | Optical Sources- LEDs Structures, Characteristics | 1 |
| 3.2 | LED Quantum Efficiency | 1 |
| 3.3 | LASER Diodes: Structures | 1 |
| 3.4 | Characteristics and Quantum Efficiency | 1 |
| 3.5 | Power Launching and Coupling | 1 |
| 3.6 | Fiber Alignment & Fiber Splicing | 1 |
| **4.0** | **Fiber Optical Receivers and Measurements** | |
| 4.1 | PIN - Structure and Working Principles | 1 |
| 4.2 | APD - Structure and Working Principles | 1 |
| 4.3 | Noise in Detectors | 1 |
| 4.4 | Optical Receiver Operation | 1 |
| 4.5 | Fiber Optic Measurements – Attenuation, Dispersion | 1 |
| 4.6 | Refractive Index Profile and Cut- off Wavelength | 1 |
| **5.0** | **Optical Networks and Components** | |
| 5.1 | SONET | 1 |
| 5.2 | SONET Layers | 1 |
| 5.3 | WDM Optical Networks | 1 |
| 5.4 | Optical Couplers | 1 |
| 5.5 | Filters, Isolators | 1 |
| 5.6 | Switches and Amplifiers | 1 |
| **Practical:** | | |
| 1. | Analog Transmission Characteristics of Fiber Optic Link | 6 |
| 2. | Attenuation and Numerical Aperture Measurement in Optical Fibers | 6 |
| 3. | PI Characteristics of LED and LASER Diodes | 6 |
| 4. | Gain Characteristics of APD and Photodiode | 6 |
| 5. | Study of WDM using Simulator | 6 |

**Course Designer(s)**

1. Mr.R.Satheeshkumar - satheeshkumar@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E15 | Data Science | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

## Objectives

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Wrangling.
- To present and interpret data using visualization libraries in Python

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the data science process | Understand |
| CO2 | Use the different types of data description for data science process | Apply |
| CO3 | Illustrate the relationships between data | Apply |
| CO4 | Use the Python Libraries for Data Wrangling | Apply |
| CO5 | Apply visualization Libraries in Python to interpret and explore data | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 2 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | - | 10 | - | - | 10 | - |
| Understand | 30 | 20 | 20 | 20 | 20 | 40 | 20 |
| Apply | 10 | 80 | 30 | 80 | 80 | 50 | 80 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E15 - Data Science | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Data Science Process*** <br> Data Science: Benefits and Uses - Facets of Data - Data Science Process: Research Goals – Retrieving Data - Data Preparation - Exploratory Data Analysis - Build the Model - Presenting Findings and Building Applications - Data Mining - Data Warehousing - Statistical Descriptions of Data. | [6] |
| **Describing Data*** <br> Types of Data - Types of Variables - Describing Data with Tables and Graphs - Describing Data with Averages - Describing Variability - Normal Distributions and Standard (Z) Scores. | [6] |
| **Describing Relationships*** <br> Correlation - Scatter Plots - Correlation Coefficient for Quantitative Data - Computational Formula for Correlation Coefficient - Regression - Regression Line - Least Squares Regression Line - Standard Error of Estimate - Interpretation of R2 - Multiple Regression Equations - Regression Towards the Mean. | [6] |
| **Python Libraries for Data Wrangling**** <br> Basics of Numpy Arrays - Aggregations - Computations on Arrays –Comparisons, Masks, Boolean Logic – Fancy Indexing - Structured Arrays - Data Manipulation with Pandas - Data Indexing and Selection - Operating on Data - Missing Data - Hierarchical Indexing - Combining Datasets - Aggregation and Grouping - Pivot Tables. | [6] |
| **Data Visualization**** <br> Importing Matplotlib - Line Plots - Scatter Plots - Visualizing Errors – Density and Contour Plots – Histograms – Legends – Colors – Subplots - Text and Annotation - Customization - Three-Dimensional Plotting - Geographic Data with Basemap - Visualization with Seaborn. | [6] |
| **Practical:** <br> 1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI <br> 2. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages <br> 3. Working with Numpy arrays <br> 4. Working with Pandas data frames <br> 5. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set <br> 6. Use the Pima Indians Diabetes data set for performing the univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis <br> 7. Perform data exploration analysis using Matplotlib and Seaborn. <br> 8. Use the diabetes data set from UCI data set and perform the bivariate analysis: Linear and logistic regression modeling <br> 9. Apply and explore the plotting function such as Correlation and scatter plots on UCI data sets <br> 10. Apply and explore the plotting function histograms on UCI data sets | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |

| **Text Book(s):** | |
|---|---|
| 1. | David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2023. |
| 2. | Robert S. Witte and John S. Witte, “Statistics”, 11th Edition, Wiley Publications, 2017. |
| **Reference(s):** | |
| 1. | Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2023. |
| 2. | Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014. |
| 3. | Eric Pimpler, “Data Visualization and Exploration with R”, Geospatial Training service, 2017. |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | |
|---|---|
| 4. | Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020. |

*SDG 4 – Quality Education
**SDG 9 – Industry Innovation and Infrastructure

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Data Science Process** | |
| 1.1 | Data Science: Benefits and Uses, Facets of Data | 1 |
| 1.2 | Data Science Process | 1 |
| 1.3 | Research Goals, Retrieving Data, Data Preparation | 1 |
| 1.4 | Exploratory Data Analysis, Build the Model, Presenting Findings and Building Applications | 1 |
| 1.5 | Data Mining, Data Warehousing | 1 |
| 1.6 | Basic Statistical Descriptions of Data | 1 |
| **2** | **Describing Data** | |
| 2.1 | Types Of Data, Types of Variables | 1 |
| 2.2 | Describing Data with Tables and Graphs | 1 |
| 2.3 | Describing Data with Averages | 1 |
| 2.4 | Describing Variability | 1 |
| 2.5 | Normal Distributions | 2 |
| 2.6 | Standard (Z) Scores | |
| **3** | **Describing Relationships** | |
| 3.1 | Correlation, Scatter Plots | 1 |
| 3.2 | Correlation Coefficient for Quantitative Data | 1 |
| 3.3 | Computational Formula for Correlation Coefficient | 1 |
| 3.4 | Regression, Regression Line, Least Squares Regression Line | 1 |
| 3.5 | Standard Error Of Estimate, Interpretation Of R2 | 1 |
| 3.6 | Multiple Regression Equations, Regression Towards the Mean | 1 |
| **4** | **Python Libraries for Data Wrangling** | |
| 4.1 | Basics Of Numpy Arrays, Aggregations | 1 |
| 4.2 | Computations On Arrays, Comparisons | 1 |
| 4.3 | Masks, Boolean Logic, Fancy Indexing | 1 |
| 4.4 | Structured Arrays, Data Manipulation with Pandas | 1 |
| 4.5 | Data Indexing and Selection, Operating On Data, Missing Data | 1 |
| 4.6 | Hierarchical Indexing, Combining Datasets, Aggregation and Grouping, Pivot Tables | 1 |
| **5** | **Data Visualization** | |
| 5.1 | Importing Matplotlib, Line Plots, Scatter Plots | 1 |
| 5.2 | Visualizing Errors, Density and Contour Plots | 1 |
| 5.3 | Histograms, Legends, Colors | 1 |
| 5.4 | Subplots, Text and Annotation | 1 |
| 5.5 | Customization, Three-Dimensional Plotting | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.6 | Geographic Data with Basemap, Visualization With Seaborn | 1 |
| **Practical:** | | |
| 1. | Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI | 2 |
| 2. | Apply and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages | 2 |
| 3. | Demonstrate the working with Numpy arrays | 2 |
| 4. | Demonstrate the working with Pandas data frames | 3 |
| 5. | Illustrate the reading of data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set | 3 |
| 6. | Use the Pima Indians Diabetes data set for performing the univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis | 3 |
| 7. | Demonstrate the data exploration analysis using Matplotlib and Seaborn. | 3 |
| 8. | Use the diabetes data set from UCI data set and perform the bivariate analysis: Linear and logistic regression modeling | 4 |
| 9. | Apply and explore the plotting function such as Correlation and scatter plots on UCI data sets | 4 |
| 10. | Apply and explore the plotting function histograms on UCI data sets | 4 |

**Course Designer(s)**


1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Mrs.K.Vanitha – vanitha@ksrct.ac.in



Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023


CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E16 | Consumer Electronics | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

## Objectives

- To learn the working principles of audio television systems.
- To study the principle of pervasive devices.
- To study the working principle of home and office system
- To become familiar with power supply and wireless device
- To become familiar with product safety and liability issues

## Pre-requisites

- Basic knowledge of Electrical and Electronics Engineering

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the working principles of basic audio and television system | Understand |
| CO2 | Explain the functions of mobile phone | Apply |
| CO3 | Explain the operating principles of home Appliances | Apply |
| CO4 | Describe the working principles of wireless devices | Understand |
| CO5 | Discuss the safety issues and safety standards of electronic systems | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | 3 | 3 | - | 3 | 3 | - | - | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | - | 20 | - | - | 34 | - |
| Understand | 40 | 40 | 40 | 40 | 40 | 66 | 40 |
| Apply | - | 60 | - | 60 | 60 | - | 60 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E16 - Consumer Electronics | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Audio And Television System*** <br> Microphones, Loud Speaker - Digital Sound Recording on Disc-Dolby Systems, Stereo Amplifiers Principles of Television, Types of TV Camera And Picture Tube, **Principle and Working of HD TV, LCD TV, LED TV, cable TV, DTH and Set top box*** ** | [6] |
| **Pervasive Devices*** <br> Mobile Phone: Elements, Design - Mobile Information Architecture - Types of Mobile Operating System - Android - Preferences, The File System, The Options Menu and Intents. | [6] |
| **Home and Office Systems*** <br> Alexa Device, Digital Camera System, Microwave Oven, Washing Machine, Air Conditioners, Refrigerators, Construction and Working Principles of Inkjet Printer, Laser Printer | [6] |
| **Power Supply and Wireless Devices*** <br> Power Supplies SMPS/UPS - RFID, Ultrasonic remote transmitter, IR remote-control transmitter - Consumer IoT Devices-smart watches, smart glasses, and smart home technologies like text-controlled home appliances. | [6] |
| **Compliance**** <br> Product safety and liability issues- standards related to electrical safety and standards related to fire hazards, e.g., UL and VDE - EMI/EMC requirements and design techniques for compliance - ESD, RF interference and immunity. | [6] |
| **Practical:** <br> 1. Exploring the Frequency Response of Microphones in Different Environments <br> 2. Identifying and replacing Speakers, Microphone and Vibration motor in mobile phones <br> 3. Test the working function of the printer <br> 4. Investigating the Range and Signal Strength of an IR Remote Transmitter <br> 5. EMI Debugging using Oscilloscopes for consumer electronics. | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |

| **Text Book(s):** | |
|---|---|
| 1. | Bali S.P, “Consumer Electronics”, Pearson Education, 2018. |
| 2. | Gupta R.G. “Audio Video Systems”, 2nd Edition, McGraw-Hill, 2017 |
| **Reference(s):** | |
| 1. | Gulati R.R, “Monochrome & Color Television”, 2nd Edition, New Age international, 2017. |
| 2. | Gulati R.R, “Complete Satellite & Cable Television”, Revised Edition, New Age international, 2017. |
| 3. | Blair K, Benson, “Audio Engineering Hand book”, McGraw-Hill, 2017. |
| 4. | Brian Fling, “Mobile Design & Development”, 1st Edition, O’Reilly, 2016. |

*SDG 4 - Quality Education
**SDG 11 - Sustainable cities and communities
***SDG 15 - Life on Land

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Audio And Television System** | |
| 1.1 | Microphones, Loud Speaker, - Digital Sound Recording on Disc | 1 |
| 1.2 | Dolby Systems, Stereo Amplifiers Principles of Television | 1 |
| 1.3 | Types Of TV Camera And Picture Tube | 1 |
| 1.4 | Principle and working of HD TV, LCD TV, LED TV | 2 |
| 1.5 | Cable TV DTH and Set top box | 1 |
| **2** | **Pervasive Devices** | |
| 2.1 | Mobile Phone: Elements, Design | 1 |
| 2.2 | Mobile Information Architecture | 1 |
| 2.3 | Types Of Mobile Operating System | 1 |
| 2.4 | Android Overview | 1 |
| 2.5 | Preferences, The File System | 1 |
| 2.6 | Options Menu and Intents | 1 |
| **3** | **Home And Office Systems** | |
| 3.1 | Alexa | 1 |
| 3.2 | Digital Camera System | 1 |
| 3.3 | Microwave Oven | 1 |
| 3.4 | Washing Machine | 1 |
| 3.5 | Air Conditioners, Refrigerators | 1 |
| 3.6 | Construction And Working Principles Of Inkjet Printer, Laser Printer | 1 |
| **4** | **Power Supply and Wireless Devices** | |
| 4.1 | Power Supplies SMPS/UPS | 1 |
| 4.2 | RFID, Ultrasonic Remote Transmitter | 1 |
| 4.3 | IR Remote, Control Transmitter | 1 |
| 4.4 | Consumer IoT Devices-Smart Watches, Smart Glasses | 1 |
| 4.5 | Smart Home Technologies Like Text-Controlled Home Appliances | 2 |
| **5** | **Compliance** | |
| 5.1 | Product Safety and Liability Issues | 1 |
| 5.2 | Standards Related To Electrical Safety And Standards Related To Fire Hazards e.g.,UL and VDE | 2 |
| 5.3 | EMI/EMC Requirements and Design Techniques for Compliance | 1 |
| 5.4 | ESD, RF Interference and Immunity. | 2 |
| **Practical:** | | |
| 1. | **Exploring the Frequency Response of Microphones in Different Environments**<br>i) Discuss the significance of frequency response in capturing accurate audio and how it can vary between different microphone types and models.Record the audio using the microphone and the recording device | 4 |
| | ii) Explore how microphone placement affects frequency response by experimenting with different placement configurations during recordings. | 2 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 2. | **Identifying and replacing Speakers, Microphone and Vibration motor in mobile phones.**<br>i) Explain their functions and importance in the overall functionality of mobile devices. Begin with an overview of the internal components of mobile phones, focusing on speakers, microphones, and vibration motors. Discuss common issues that may arise with these components, such as malfunctioning or damaged parts. | 4 |
| | ii) Demonstrate proper safety procedures for handling electronic devices and components. Show examples of these components and explain their functions in a mobile device. | 2 |
| 3. | **Test the working function of the printer.**<br>i) Discuss common printing problems and their troubleshooting methods. Instruct students to set up the printer, connect it to a computer, and install the necessary drivers. Assign printing tasks to each group, such as printing text documents, images, or graphics | 4 |
| | ii) Encourage students to experiment with different settings (quality, paper type, color options, etc.) and to troubleshoot common printing issues they encounter (paper jams, poor print quality, connectivity problems, etc.). | 2 |
| 4. | **Investigating the Range and Signal Strength of an IR Remote Transmitter.**<br>i) Explain the concept of signal strength and how it affects the range of an IR transmitter | 4 |
| | ii) Discuss the importance of understanding the range and signal strength for practical applications. | 2 |
| 5. | **EMI Debugging using Oscilloscopes for consumer electronics**.<br>i) Explaining the concept of EMI and its significance in consumer electronics. Discuss common sources of EMI, such as switching power supplies, digital circuits, and wireless communication. | 4 |
| | ii) Demonstrate how to use various controls and settings on the oscilloscope, such as vertical and horizontal scales, triggering, and waveform analysis features. | 2 |

**Course Designer(s)**

1. Dr.S.Malarkhodi - malarkhodi@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E17 | Speech and Audio Processing | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

**Objectives**

- To study basic concepts of processing speech and audio signals
- To study and analyse various M-band filter-banks for audio coding
- To understand audio coding based on transform coders
- To study time and frequency domain speech processing methods
- To understand the predictive analysis of speech

**Prerequisite**

- Digital Signal Processing

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe and Analyse the modeling of speech signal and audio signal | Understand |
| CO2 | Explain the concepts and transform techniques of filter banks in speech and audioprocessing | Apply |
| CO3 | Describe various audio coding and transform coders | Apply |
| CO4 | Analyse the time domain and frequency domain methods for speech processing | Apply |
| CO5 | Explain the predicitive analysis of speech using various methods. | Understand |

**Mapping with Programme Outcomes**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 3 | - |
| CO2 | 3 | 3 | 3 | 3 | | - | - | - | - | - | - | - | 3 | 3 | - |
| CO3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | 3 | | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 3 | - |
| CO5 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 3 | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 10 | - | 10 | - | - | 20 | - |
| Understand | 40 | 30 | 40 | 30 | 30 | 60 | 30 |
| Apply | 10 | 70 | 10 | 70 | 70 | 20 | 70 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E17 - Speech and Audio Processing | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Mechanics of Speech and Audio*** Review of Signal Processing Theory-Speech Production Mechanism – Nature of Speech Signal – Discrete Time Modelling of Speech Production – Classification of Speech Sounds – Phones – Phonemes – Phonetic and Phonemic Alphabets – Articulatory Features. Absolute Threshold of Hearing – Critical Bands – Simultaneous Masking, Masking – Asymmetry, and Spread of Masking Non – simultaneous Masking – Perceptual Entropy – Basic Measuring Philosophy – Subjective versus Objective Perceptual Testing – The Perceptual Audio Quality Measure (PAQM) - Cognitive Effects in Judging Audio Quality. | [6] |
| **Time-Frequency Analysis: Filter Banks and Transforms*** Analysis-Synthesis Framework for M-band Filter Banks – Filter Banks for Audio Coding: Design Considerations – Quadrature Mirror and Conjugate Quadrature Filters – Tree-Structured QMF and CQF M-band Banks – Cosine Modulated 'Pseudo QMF' M-band Banks – Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) – Discrete Fourier and Discrete Cosine Transform – Pre-echo Distortion – Pre-echo Control Strategies. | [6] |
| **Audio Coding and Transform Coders*** Lossless Audio Coding – Lossy Audio Coding – ISO-MPEG-1A, 2A, 2A-Advaned, 4A Audio Coding – Optimum Coding in the Frequency Domain – Perceptual Transform Coder – Brandenburg – Johnston Hybrid Coder – CNET Coders – Adaptive Spectral Entropy Coding – Differential Perceptual Audio Coder – DFT Noise Substitution – DCT with Vector Quantization – MDCT with Vector Quantization. | [6] |
| **Time and Frequency Domain Methods for Speech Processing*** Time domain parameters of Speech signal – Methods for extracting the parameters: Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods Homomorphic Speech Analysis: Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders. | [6] |
| **Predictive Analysis of Speech*** Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method– Covariance method – Solution of LPC equations – Cholesky method – Durbin"s Recursive algorithm– Lattice formation and solutions–Comparison of different methods–Application of LPC parameters– Pitch detection using LPC parameters – Formant analysis – VELP – CELP. | [6] |
| **Practical:**<br>1. Design a 16-level quantizer with uniform quantization (μ-law with μ=255),FA (α=0.5, N=5)<br>2. Design a 16-level quantizer with Non uniform quantization (μ-law with μ=255),FA (α=0.5, N=5)<br>3. Use a Levinson Durbin recursion to computer LP coefficients and filter the speech signals with the resulting LP filter to form the LP residual<br>4. Explore the consequences on the residual (error signal) in terms of the frame size and predictor order.<br>5. Compute the LP residual and ensure that you can perfectly reconstruct a speech signal from it through the LP synthesis filter.<br>6. Explore transforming the coefficients to other forms such as reflection coefficients, Log Area Ratios, Line Spectral Frequencies<br>7. Explore the use of a lattice structure as opposed to a direct form structure for the analysis and synthesis filters.<br>8. Implement a Long Term Predictor to operate on the residual – examine the effects on the residual of different sub-frame lengths and the ranges of delays searched. | [30] |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 9. Implement an Inverse LTP – ensure that your system is perfect reconstruction from LTP input to Inverse LTP output.<br>10. Construct a complete system that incorporates LP analysis filter, LTP, Inverse LTP and LP synthesis filter. | | |
| **Total Hours: (Lecture - 30; Practical - 30)** | | **60** |
| **Text Book(s):** | | |
| 1. | B.Gold and N.Morgan, "Speech and Audio Signal: Processing: Processing and Perception of Speech and Music", 2nd Edition, Wiley and Sons, 2011. | |
| 2. | Rabiner L.R and Schafer R.W, "Digital Processing of Speech Signals", Pearson Education, Delhi, India, 2004. | |
| | | |
| 1. | Mark Kahrs, Karlheinz Brandenburg, Kluwer, "Applications of Digital Signal Processing to Audio and Acoustics", Auris Reference, 2017. | |
| 2. | Udo Zölzer, "Digital Audio Signal Processing", 2nd Edition, John Wiley & sons Ltd, 2008. | |
| 3. | Vijay K. Madisetti, "The Digital Signal Processing Handbook: Video, Speech and Audio Signal Processing", CRC Press, 2009. | |
| 4. | Paul Hill, "Audio and Speech Processing with MATLAB", 1st Edition, CRC Press, 2020. | |

*SDG 4 - Quality Education

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Mechanics of Speech and Audio*** | |
| 1.1 | Review of Signal Processing Theory, Speech Production Mechanism | 1 |
| 1.2 | Nature of Speech Signal &Discrete Time Modelling of Speech Production | 1 |
| 1.3 | Classification of Speech Sound | 1 |
| 1.4 | Threshold of Hearing | 1 |
| 1.5 | Simultaneous Masking & Non Simultaneous Masking | 1 |
| 1.6 | Perceptual Entropy | 1 |
| **2** | **Time-Frequency Analysis: Filter Banks and Transforms*** | |
| 2.1 | Analysis & Synthesis Framework for M-band Filter Banks | 1 |
| 2.2 | Filter Banks for Audio Coding | 1 |
| 2.3 | Structured QMF and CQF M-band Banks | 1 |
| 2.4 | Cosine Modulated 'Pseudo QMF' M-band Banks and its reconstruction | 1 |
| 2.5 | Discrete Fourier and Discrete Cosine Transform | 1 |
| 2.6 | Pre-echo Distortion & Pre-echo Control Strategies | 1 |
| **3** | **Audio Coding and Transform Coders*** | |
| 3.1 | Lossless Audio Coding & Lossy Audio Coding | 1 |
| 3.2 | ISO-MPEG | 1 |
| 3.3 | Optimum Coding in the Frequency Domain & Perceptual Transform Coder | 1 |
| 3.4 | Brandenburg & Johnston Hybrid Coder, CNET Coders & Adaptive Spectral Entropy Coding | 1 |
| 3.5 | Differential Perceptual Audio Coder DFT Noise Substitution | 1 |
| 3.6 | DCT & MDCT with Vector Quantization. | 1 |
| **4** | **Time and Frequency Domain Methods for Speech Processing*** | |
| 4.1 | Time domain parameters of Speech signal & Methods for extracting the parameters | 1 |
| 4.2 | Zero crossing Rate & Silence Discrimination using ZCR and energy Short Time Fourier analysis | 1 |
| 4.3 | Pitch Extraction using time domain methods | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.4 | Pitch Extraction using frequency domain methods | 1 |
| 4.5 | Formant and Pitch Estimation | 1 |
| 4.6 | Homomorphic Vocoders | 1 |
| **5** | **Predictive Analysis of Speech*** | |
| 5.1 | Formulation of Linear Prediction problem in Time Domain | 1 |
| 5.2 | Auto correlation method & Covariance method | 1 |
| 5.3 | Cholesky method & Durbin"s Recursive algorithm | 1 |
| 5.4 | Lattice formation and solutions, Comparison & Application of LPC parameters | 1 |
| 5.5 | Pitch detection using LPC parameters – Formant analysis | 1 |
| 5.6 | VELP – CELP | 1 |
| **Practical:** | | |
| 1. | Design a 16-level quantizer with uniform quantization (μ-law with μ=255),FA (α=0.5, N=5) | 2 |
| 2. | Design a 16-level quantizer with Non uniform quantization (μ-law with μ=255),FA (α=0.5, N=5) | 2 |
| 3. | Use a Levinson Durbin recursion to computer LP coefficients and filter the speech signals with the resulting LP filter to form the LP residual | 2 |
| 4. | Explore the consequences on the residual (error signal) in terms of the frame size and predictor order. | 2 |
| 5. | Compute the LP residual and ensure that you can perfectly reconstruct a speech signal from it through the LP synthesis filter. | 4 |
| 6. | Explore transforming the coefficients to other forms such as reflection coefficients, Log Area Ratios, Line Spectral Frequencies | 4 |
| 7. | Explore the use of a lattice structure as opposed to a direct form structure for the analysis and synthesis filters. | 4 |
| 8. | Implement a Long Term Predictor to operate on the residual – examine the effects on the residual of different sub-frame lengths and the ranges of delays searched. | 2 |
| 9. | Implement an Inverse LTP – ensure that your system is perfect reconstruction from LTP input to Inverse LTP output. | 4 |
| 10. | Construct a complete system that incorporates LP analysis filter, LTP, Inverse LTP and LP synthesis filter. | 4 |

**Course Designer(s)**

1. Dr.P.Babu - pbabu@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E21 | Human Assist Devices | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To understand the basic principles of assistive technology.
- To learn technology and sensory Impairments.
- To explore assist devices for vital organs and advancements in technology.
- To identify medical assist devices for disabled persons.
- To study about recent techniques used in clinical applications.

## Pre-requisites

- Electronic Devices

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Comprehend the Assistive Technology (AT) used for mobility. | Remember |
| CO2 | Summarize the AT for sensory impairment of vision and hearing. | Understand |
| CO3 | Uncover the assist devices for vital organs and advancements in AT. | Understand |
| CO4 | Describe the principles of medical assist devices. | Apply |
| CO5 | Discuss about recent techniques used in clinical applications. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | 2 | - | - | 3 | 3 | 3 | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | 2 | - | - | 3 | 3 | 3 | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | 2 | - | - | 3 | 3 | 3 | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | 2 | - | - | 3 | 3 | 3 | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | 2 | - | - | 3 | 3 | 3 | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 40 |
| Understand | 40 | 30 | 50 |
| Apply | - | 10 | 10 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E – Electronics and Communication Engineering | | | | | | | | |
| 60 EC E21 – Human Assist Devices | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Assistive Technology for Mobility*** <br> Basic Assessment and Devices for Mobility: Walking Canes, Wheelchairs, Mobility Scooters - Wheel Chair Seating and Positioning - Fuzzy Logic Expert System for Automatic Tuning of Myoelectric Prostheses - Intelligent Prosthesis. | [9] |
| **Assistive Technology and Sensory Impairments*** <br> Visual and Auditory Impairment, Artificial visual Implants: Lens Implant, Corneal Implant, Artificial cornea - Electronic Travel Aids - Augmentative Methods for Dual Sensory Hearing Impairment - Hearing Aids - Cochlear Implants - Haptic as a Substitute for Vision. | [9] |
| **Assist Devices for Vital Organs and Advancements in Technology*** <br> Cardiac Assist Devices, Intra - Aortic Balloon Pump (IABP), Auxiliary Ventricles - Dialysis for Kidneys, Intermittent Positive Pressure Breathing (IPPB) Type Assistance for Lungs- Latest Use of Assistive Technology for Chronic Heart Diseases - New Media in Assisting Healthcare- Future Trends in Assistive Technology, Virtual Reality Based Training System for Disabled Children. | [9] |
| **Medical assist devices*** <br> Functioning and Different Types of Artificial Heart - Types of Haemodialysis - Wearable Artificial Kidney and its Implantation - Operating Principle of Ventilator -Types of Deafness and its Hearing Aids. | [9] |
| **Recent Trends*** <br> Transcutaneous Electric Nerve Simulator, Bio-feedback, Diagnostic and Point-of-care devices - Rehabilitation devices. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Oliver Wendt, Raymond W. Quist, Lyle L. Lloyd, “Assistive Technology: Principles and Applications for Communication Disorders and Special Education”, 2011. |
| 2. | Kenneth J. Turner, “Advances in Home Care Technologies: Results of the match Project”, Springer,1st Edition, 2011. |
| **Reference(s):** | |
| 1. | Gerr. M. Craddock “Assistive Technology-Shaping the future”, IOS Press, 1st Edition, 2003 |
| 2. | Marion. A. Hersh, Michael A. Johnson, “Assistive Technology for visually impaired and blind”, Springer Science & Business Media, 1st Edition, 2010. |
| 3. | Donald R. Peterson, Joseph D. Bronzino,” Medical Devices and Human Engineering”,3rd Edition Three volume set, CRC press, 2014. |
| 4. | Kenneth J. Turner, “Advances in Home Care Technologies: Results of the match Project”, Springer, 1st Edition, 2011. |

*SDG 3 – Good Health and Well Being

**Assignment Activity:**

**Assignment 1:**

1. Questions related to the advancements in assistive technologies for mobility and resolve sensory impairments.
2. Case study on assistive devices for learning.

**Assignment 2:**

1. Questions related to the common and personal assistive devices & rehabilitation devices.
2. Poster presentation on Latest technologies in assistive devices for chronic heart diseases.

**Assignment 3:**

1. Case study on rehabilitation devices in daily life to serve disabilities.

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Assistive Technology for Mobility*** | |
| 1.1 | Basic Assessment | 1 |
| 1.2 | Devices for Mobility: Walking Canes | 1 |
| 1.3 | Wheelchairs | 1 |
| 1.4 | Power Wheelchairs | 1 |
| 1.5 | Mobility Scooters | 1 |
| 1.6 | Wheel Chair Seating and Positioning | 1 |
| 1.7 | Measurement of seating variables | 1 |
| 1.8 | Fuzzy Logic Expert System for Automatic Tuning of Myoelectric Prostheses | 1 |
| 1.9 | Intelligent Prosthesis | 1 |
| **2.0** | **Assistive Technology and Sensory Impairments*** | |
| 2.1 | Visual and Auditory Impairment | 1 |
| 2.2 | Artificial visual Implants: Lens Implants | 1 |
| 2.3 | Corneal Implant | 1 |
| 2.4 | Artificial cornea | 1 |
| 2.5 | Electronic Travel Aids: High Tech Navigation Devices | 1 |
| 2.6 | Talking street signs and Elevators | 1 |
| 2.7 | Augmentative Methods for Dual Sensory Hearing Impairment: Hearing Aids | 1 |
| 2.8 | Cochlear Implants | 1 |
| 2.9 | Haptic as a Substitute for Vision | 1 |
| **3.0** | **Assist Devices for Vital Organs and Advancements in Technology*** | |
| 3.1 | Cardiac Assist Devices | 1 |
| 3.2 | Intra - Aortic Balloon Pump (IABP) | 1 |
| 3.3 | Auxiliary Ventricles | 1 |
| 3.4 | Dialysis for Kidneys | 1 |
| 3.5 | Intermittent Positive Pressure Breathing (IPPB) Type Assistance for Lungs | 1 |
| 3.6 | Latest Use of Assistive Technology for Chronic Heart Diseases | 1 |
| 3.7 | New Media in Assisting Healthcare | 1 |
| 3.8 | Future Trends in Assistive Technology | 1 |
| 3.9 | Virtual Reality Based Training System for Disabled Children | 1 |
| **4.0** | **Medical assist devices*** | |
| 4.1 | Functioning of Artificial Heart | 1 |
| 4.2 | Different Types of Artificial Heart | 1 |
| 4.3 | Types of Haemodialysis | 1 |
| 4.4 | Wearable Artificial Kidney | 1 |
| 4.5 | Implantation of Wearable Artificial Kidney | 1 |
| 4.6 | Operating Principle of Ventilator | 1 |
| 4.7 | Types of Deafness | 1 |
| 4.8 | Types of Hearing Aids | 2 |
| **5.0** | **Recent Trends*** | |
| 5.1 | Transcutaneous Electric Nerve Simulator | 1 |
| 5.2 | Bio-feedback Network | 1 |
| 5.3 | Diagnostic Devices | 2 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.4 | Point-of-care Devices | 2 |
| 5.5 | Rehabilitation Devices: Assistive technology in daily life | 1 |
| 5.6 | Technology in Home | 1 |
| 5.7 | Technology for Recreation | 1 |

**Course Designer(s)**

1. Mrs.K.Gogila Devi - gogiladevi@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E22 | IoT Product Development | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 1 | 0 | 4 | 3 |

## Objectives

- To Identifying and Gathering comprehensive requirements for IoT products
- To Acquire skills in Schematic Block Designing
- To gain proficiency in designing PCB layouts
- To develop proficiency in "3D Modelling" and "Designing" of enclosures
- To develop skills in debugging and functional verification of IoT products

## Pre-requisites

- Electronic devices and circuits, Basics of C Programming, IoT Hardware

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Demonstrate comprehensive skill to analysis IoT product requirement | Understand |
| CO2 | Execute the entire schematic design process | Apply |
| CO3 | Demonstrate proficiency in PCB Designing and prototyping | Apply |
| CO4 | Apply skills in 3D modelling and 3D printing to create enclosers | Apply |
| CO5 | Demonstrate competence in IoT hardware Programming | Analyse |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | 3 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | 3 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | 3 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | 3 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Assessment 1 (Presentation) | | Assessment 2 (CA Test) | Assessment 3 (Model – Presentation) | |
|---|---|---|---|---|
| **Assessment Parameters** | **Marks** | **Marks** | **Assessment Parameters** | **Marks** |
| Problem Identification | 10 | Questions from CO1 to CO4 As per CA Test Pattern | Innovation | 30 |
| Innovation | 30 | | Clarity in Presentation | 10 |
| Solution for problem | 10 | | Demo | 30 |
| Clarity in Presentation | 05 | | Completion of Report | 20 |
| Viva | 05 | | Viva | 10 |
| **Total** | **60** | **60** | **Total** | **100** |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E22 - IoT Product Development | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 1 | 0 | 4 | 75 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **IoT Product Requirement Analysis *** Identifying and Gathering Requirements, Requirements Specification and Documentation, Validation and Verification of Requirements, Managing Requirement Changes, Requirements for IoT Security and Privacy. | [3+12] |
| **Schematic Design for IoT Product *** Schematic Block Designing, Components Selection, Datasheet Analysis, Schematic Designing, Simulation and Verification, Schematic Validation. | [3+12] |
| **PCB Design for IoT Product *** PCB Design Requirements, PCB Grade and Fabrication Capability Settings, IPC Standards, PCB Designing, EMI and EMC Compliance, PCB Prototyping, Assembling of Components, Testing of Prototype PCB. | [3+12] |
| **Encloser Designing *** Encloser Design Requirements, 3D Modelling and Designing, Encloser Design Validation, 3D Printing - Assembling of Prototype with Encloser. | [3+12] |
| **Programming and Testing *** Choosing of Compiler, Programming Standards, Functional Embedded C Programming and Debugging, Functional Verification. | [3+12] |
| **Total Hours: (Lecture - 15; Practical - 60)** | **75** |

| **Text Book(s):** | |
|---|---|
| 1. | Dave Shackleford, "IoT Security: A Guide for IT and Security Professionals", 1st Edition O'Reilly Media, 2015. |
| 2. | Paul Scherz, Simon Monk, "Practical Electronics for Inventors", 4th Edition, McGraw-Hill Education, 2016. |
| 3. | C. P. Wong, "Printed Circuit Board Basics for Non-Engineers", 3rd Edition, Wiley-IEEE Press, 2018. |
| **Reference(s):** | |
| 1. | Rajkumar Buyya, Amir Vahid Dastjerdi, Morgan Kaufmann, "Internet of Things: Principles and Paradigms", 1st Edition, 2016. |
| 2. | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Cisco Press, 2017. |

*SDG 9 – Industry Innovation and Infrastructure

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **IoT Product Requirement Analysis** | |
| 1.1 | Identifying and Gathering Requirements | 1 |
| 1.2 | Requirements Specification and documentation | 1 |
| 1.3 | Managing Requirement Changes | 1 |
| **2** | **Schematic Design for IoT Product** | |
| 2.1 | Schematic Block Designing | 1 |
| 2.2 | Components Selection, Datasheet Analysis | 1 |
| 2.3 | Schematic Validation | 1 |
| **3** | **PCB Design for IoT Product** | |
| 3.1 | PCB Design Requirements | 1 |
| 3.2 | PCB Grade and Fabrication Capability Settings | 1 |
| 3.3 | IPC Standards | 1 |
| **4** | **Encloser Designing** | |
| 4.1 | Encloser Design Requirements | 1 |
| 4.2 | 3D Modelling and Designing | 1 |
| 4.3 | Encloser Design Validation | 1 |
| **5** | **Programming and Testing** | |
| 5.1 | Choosing Of Compiler, Programming Standards | 1 |
| 5.2 | Functional Embedded C Programming | 1 |
| 5.3 | Functional Verification | 1 |
| **6** | **Project** | |
| 6.1 | Problem Identification | 10 |
| 6.2 | Solution for Problem | 15 |
| 6.3 | Implementation | 20 |
| 6.4 | Presentation | 5 |
| 6.5 | Report | 5 |
| 6.6 | Demo | 5 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E23 | Avionics Systems | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To impart knowledge on fundamentals of avionics and power systems.
- To impart knowledge on radio navigation systems.
- To impart knowledge, understand the flight instruments.
- To impart knowledge on the concepts of power plant systems, recorders.
- To impart knowledge on different advanced radar systems.

## Pre-requisites

- Radar Technologies

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the power supply systems, sources, generation, distribution systems and navigation systems | Understand |
| CO2 | Articulate the position, speed, direction of the object, warning and collision avoidance systems | Understand |
| CO3 | State the various flight instruments and their working | Understand |
| CO4 | Describe the different communication systems, control systems, recorders. | Understand |
| CO5 | Explain the advanced radar systems used in avionics | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | - | - | 2 | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 2 | - | 3 | 2 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 2 | - | - | 2 | - | 3 | 3 | 3 | - | 3 | 2 | 2 | 3 |
| CO4 | 2 | 3 | 3 | - | - | 1 | - | 3 | 3 | 3 | - | 2 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | 1 | - | 3 | 3 | 3 | - | 2 | 2 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 12 | 12 | 20 |
| Understand | 48 | 48 | 80 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **B.E - Electronics and Communication Engineering** | | | | | | | | |
| **60 EC E23 - Avionics Systems** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Introduction to Flight-Theory of Flight and Control Surfaces**<br>Brief about Avionics - Evolution of Avionics - Brief about Various Avionic Systems on board an Aircraft - Power supply systems-Electrical Power Sources - Power Generation and Distribution Systems - Navigation Systems-Electrical Navigation Systems - Compasses, Inertial Navigation Systems (INS) | [9] |
| **Radio Navigation Systems**<br>Automatic Direction Finder (ADF) - Global Positioning System (GPS) - Very High Frequency Omni-Range (VOR)-Instrument Landing System (ILS) - Air Traffic Control System (ATC) - Distance Measuring Equipment (DME) - Ground Proximity Warning System (GPWS) -Traffic Collision Avoidance System (TCAS) - Weather Radar<br>Hands - on: Simulation of GPS Receiver Model | [9] |
| **Flight Instruments** *<br>Air Data Systems/ Computers (ADS/ADC), Pitot Static Systems - Air Speed Indicator (ASI) - Vertical Speed Indicator (VSI) - Barometric Altimeters - Radio Altimeters - Artificial Horizon or Attitude Indicator-Flight Directors (FD) | [9] |
| **Power Plant Systems***<br>Communication Systems - VHF, HF, Data-Link, Voice Scramblers - Automatic Flight Control Systems (AFCS) - Automatic Flight Guidance Systems (AFGS) - Autopilot - Miscellaneous Systems - Collision Avoidance Systems (CAS), Flight Data Recorders (FDR), Cockpit Voice Recorders (CVR) - Space Avionics - Challenges in Design Model-Based Design of Safety - Critical Avionics Systems | [9] |
| **Advanced Radar Systems***<br>Helmet Mounted Target Designation System (HMTDS) - Full Authority Digital Engine (or Electronics) Control (FADEC) - Avionics of Unmanned Aerial Vehicles (UAV) - All Electric Aircraft-Design of In-flight Entertainment Systems<br>Hands - on: Verification of Avionics Systems Using Simulink Test and Simulink Real-Time | [9] |
| **Total Hours:** | **45** |

| | |
|---|---|
| **Text Book(s):** | |
| 1. | Dr Albert Helfrick, "Principles of Avionics", 8th Edition, Avionics Communications, 2015 |
| **Reference(s):** | |
| 1. | Ian Moir and Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", 3rd Edition, Wiley, 2011. |
| 2. | Collinson RPG, "Introduction to Avionics Systems", 3rd Edition, Springer, Jun 2011 |
| 3. | Pallett E H J, "Aircraft Instruments and Integrated Systems", 1st Edition, Avionics Communications, 1992. |

*SDG 4 – Quality Education

**Assignment activity**:

**Assignment 1** – Covers Module 1 & 2

1. Power generation and distribution systems, Navigation Systems, Electrical Navigation Systems.
2. Instrument Landing System (ILS), Air Traffic Control System (ATC).

**Assignment 2** – Covers Module 3, 4 & 5

1. Barometric Altimeters, Radio Altimeters.
2. Flight Data Recorders (FDR), Cockpit Voice Recorders (CVR).

**Assignment 3** – Covers Module 5

1. Full Authority Digital Engine (or electronics) Control (FADEC), Avionics of Unmanned Aerial Vehicles (UAV)

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Introduction to Flight-Theory of Flight and Control Surfaces** | |
| 1.1 | Brief about Avionics - Evolution of Avionics | 1 |
| 1.2 | Brief about various Avionic systems on board an aircraft | 1 |
| 1.3 | Power supply systems | 1 |
| 1.4 | Electrical Power Sources | 1 |
| 1.5 | Power generation and distribution systems | 1 |
| 1.6 | Navigation Systems | 1 |
| 1.7 | Electrical Navigation Systems | 1 |
| 1.8 | Inertial Navigation Systems | 2 |
| **2.0** | **Radio Navigation Systems** | |
| 2.1 | Automatic Direction Finder (ADF) | 1 |
| 2.2 | Global Positioning System (GPS) | 1 |
| 2.3 | Very High Frequency Omni-Range (VOR) | 1 |
| 2.4 | Instrument Landing System (ILS) | 1 |
| 2.5 | Air Traffic Control System (ATC) | 1 |
| 2.6 | Distance Measuring Equipment (DME) | 1 |
| 2.7 | Ground Proximity Warning System (GPWS) | 1 |
| 2.8 | Traffic Collision Avoidance System (TCAS) | 1 |
| 2.9 | Weather Radar | 1 |
| **3.0** | **Flight Instruments** * | |
| 3.1 | Air Data Systems/ Computers (ADS/ADC) | 2 |
| 3.2 | Pitot Static Systems | 1 |
| 3.3 | Air Speed Indicator (ASI) | 1 |
| 3.4 | Vertical Speed Indicator (VSI) | 1 |
| 3.5 | Barometric Altimeters-Radio | 1 |
| 3.6 | Altimeters | 1 |
| 3.7 | Artificial Horizon or Attitude Indicator | 1 |
| 3.8 | Flight Directors (FD) | 1 |
| **4.0** | **Power Plant Systems*** | |
| 4.1 | Communication systems-VHF, HF, Data-link, Voice scramblers | 1 |
| 4.2 | Automatic Flight Control Systems (AFCS) | 1 |
| 4.3 | Automatic Flight Guidance Systems (AFGS) | 1 |
| 4.4 | Autopilot | 1 |
| 4.5 | Miscellaneous Systems-Collision Avoidance Systems (CAS) | 1 |
| 4.6 | Flight Data Recorders (FDR) | 1 |
| 4.7 | Cockpit Voice Recorders (CVR) | 1 |
| 4.8 | Space avionics | 1 |
| 4.9 | Challenges in design | 1 |
| **5.0** | **Advanced Radar Systems*** | |
| 5.1 | Helmet Mounted Target Designation System (HMTDS) | 2 |
| 5.2 | Full Authority Digital Engine (or electronics) Control (FADEC) | 2 |
| 5.3 | Avionics of Unmanned Aerial Vehicles (UAV) | 2 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.4 | All Electric Aircraft | 1 |
| 5.5 | Design of In-flight Entertainment Systems | 2 |

**Course Designer(s)**

**1.** Mr S.Pradeep - pradeeps@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E24 | Wireless Sensor Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To understand the fundamentals of wireless sensor network
- To gain knowledge on routing protocols of WSN
- To get exposed to 6LoWPAN technology
- To gain knowledge about operating system related to WSN
- To expand knowledge about operating system related to 6LoWPAN

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Examine the wireless sensor networks architecture and design principles | Understand |
| CO2 | Identify the functionality of various routing protocols. | Understand |
| CO3 | Outline the 6LoWPAN architecture with header compression techniques | Understand |
| CO4 | Infer the different protocols and sensor networks | Apply |
| CO5 | Build modules and be familiar with the OS used in wireless sensor networks | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 2 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 2 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | - | 20 |
| Understand | 40 | 40 | 40 |
| Apply | - | 20 | 40 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E – Electronics and Communication Engineering | | | | | | | | |
| 60 EC E24 – Wireless Sensor Networks | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Wireless Sensor Network Architecture**<br>Challenges - Comparison with Ad hoc Network - Node Architecture and Network Architecture - Design Principles - Service Interfaces - Gateway - Short Range Radio Communication Standards - IEEE 802.15.4 - Zigbee and Bluetooth. | [9] |
| **Routing Protocols***<br>Fundamentals - Low duty cycle and Wakeup Concepts - Contention and Schedule Based Protocols - SMAC - BMAC - Routing protocols – Requirements - Classification - SPIN - Directed Diffusion – LEACH - PEGASIS. | [9] |
| **6LoWPAN***<br>6LoWPAN Architecture - Protocol Stack - Adaptation Layer - Link layers – Routing - Mesh - Under - Route - Over - Header Compression - Stateless Header Compression - Context - Based Header Compression - Fragmentation and Reassembly - Mobility - Mobile IPv6, Proxy Home Agent - Proxy MIPv6 - NEMO. | [9] |
| **Application***<br>Design Issues - Real-time Streaming and Sessions - Publish/Subscribe - Web Service Paradigms - Common Protocols - Web Service Protocols, MQ Telemetry Transport for Sensor Networks (MQTT-S) - ZigBee compact application protocol (CAP) - Service discovery - Simple network management protocol (SNMP). | [9] |
| **Sensor Network Platforms**<br>TinyOS - NesC - Interfaces - modules - configuration - Programming in TinyOS using NesC. TOSSIM - Simulation environment - Cooja simulator, Programming.<br>Case Study: Underground Tunnel Mobile Target Tracking, Zigbee Smart Home Automation System | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Holger Karl, Andreas Willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley & Sons 2007. |
| 2. | Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017. |
| **Reference(s):** | |
| 1. | Hongmei Deng, Wei Li and Dharma P. Agrawal, “Routing security in Wireless Ad hoc Networks", IEEE Communication Magazine, 2002. |
| 2 | Zach Shelby Sensinode and Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet” John Wiley and Sons, 2009. |
| 3 | Philip Levis, “TinyOS Programming”, 2006 –www.tinyos.net. |
| 4. | The Contiki Operating System.http://www.sics.se/Contiki |

*SDG4 Quality Education

**Assignment activity:**

**Assignment 1:**

1. Poster Presentation on Routing Protocol

**Assignment 2:**

1. Video Presentation on Application on WSN

**Assignment 3:**

1. Case Study Presentation on Wireless Sensor Architecture

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Wireless Sensor Network Architecture** | |
| 1.1 | Challenges | 1 |
| 1.2 | Comparison with Ad hoc Network | 1 |
| 1.3 | Node Architecture | 1 |
| 1.4 | Network Architecture | 1 |
| 1.5 | Design Principles, | 1 |
| 1.6 | Service Interfaces, Gateway | 1 |
| 1.7 | Short Range Radio Communication standards | 1 |
| 1.8 | Zigbee | 1 |
| 1.9 | Bluetooth | 1 |
| **2.0** | **Routing Protocols** | |
| 2.1 | Fundamentals, Low Duty Cycle Protocols | 1 |
| 2.2 | Wakeup Concepts | 1 |
| 2.3 | Contention and Schedule Based Protocols – SMAC | 1 |
| 2.4 | BMAC | 1 |
| 2.5 | Routing Protocols – Requirements | 1 |
| 2.6 | SPIN | 1 |
| 2.7 | Directed Diffusion | 1 |
| 2.8 | LEACH | 1 |
| 2.9 | PEGASIS | 1 |
| **3.0** | **6LoWPAN** | |
| 3.1 | 6LoWPAN Architecture, Protocol Stack | 1 |
| 3.2 | Adaptation Layer | 1 |
| 3.3 | Link layers, Addressing | 1 |
| 3.4 | Routing - Mesh-Under- Route-Over | 1 |
| 3.5 | Header Compression - Stateless Header Compression | 1 |
| 3.6 | Context- Based Header Compression | 1 |
| 3.7 | Fragmentation and Reassembly | 1 |
| 3.8 | Mobile Ipv6, Proxy Home Agent | 1 |
| 3.9 | Proxy Mipv6, NEMO Routing | 1 |
| **4.0** | **Application** | |
| 4.1 | Design Issues, Real-Time Streaming | 1 |
| 4.2 | Sessions Publish/Subscribe | 1 |
| 4.3 | Web Service Paradigms, | 1 |
| 4.4 | Common Protocols | 1 |
| 4.5 | Web Service Protocols | 1 |
| 4.6 | MQ Telemetry Transport for Sensor Networks (MQTT-S) | 1 |
| 4.7 | Zigbee Compact Application Protocol (CAP) | 1 |
| 4.8 | Service Discovery | 1 |
| 4.9 | Simple Network Management Protocol (SNMP) | 1 |
| **5.0** | **Sensor Network Platforms** | |
| 5.1 | Tinyos | 1 |
| 5.2 | Nesc Interfaces, | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.3 | Modules, Configuration | 1 |
| 5.4 | Programming in Tinyos Using Nesc | 1 |
| 5.5 | Tossim | 1 |
| 5.6 | Simulation Environment - Cooja Simulator | 1 |
| 5.7 | Simulation Environment - Programming | 1 |
| 5.8 | Underground Tunnel Mobile Target Tracking | 1 |
| 5.9 | Zigbee Smart Home Automation System | 1 |

**Course Designer(s)**

1. Mr S Jayamani - jayamani@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E25 | Digital Image Processing | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

## Objectives

- To study the concept of digital image fundamentals
- To learn about simple image enhancement techniques in Spatial and Frequency domain.
- To explain the concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To learn the concept of image compression and recognition methods

## Pre-requisites

- Signals and Systems

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the fundamentals of image. | Remember |
| CO2 | Discuss image enhancement techniques in spatial domain and perform histogram equalization. | Apply |
| CO3 | Analyse image restoration through various filters. | Apply |
| CO4 | Explain the concepts of segmentation. | Apply |
| CO5 | Discuss the algorithms for lossy and lossless compression. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | - | 20 | - | - | 34 | - |
| Understand | 40 | 30 | 20 | 30 | 30 | 51 | 30 |
| Apply | - | 70 | 20 | 70 | 70 | 15 | 70 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E – Electronics and Communication Engineering**

**60 EC E25 - Digital Image Processing**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VI | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Digital Image Fundamentals and Transforms*** Steps in Digital Image Processing – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships Between Pixels - Color Image Fundamentals - RGB, HSI Models, Two Dimensional Mathematical Preliminaries, 2D transforms: DFT, DCT. | [6] |
| **Image Enhancement**** Basic Gray Level Transformations – Histogram Processing – Histogram Matching – Spatial Filtering – Smoothing Spatial Filters – Sharpening Spatial Filters- Ideal, Butterworth and Gaussian Filters, Homomorphic Filtering, Color Image Enhancement. | [6] |
| **Restoration*** Model of the Image Degradation / Restoration Process- Mean Filters – Order – Statistics Filters- Adaptive Filters – **Inverse Filtering**** – Minimum Mean Square Error Filtering – **Constrained Least Squares Filtering**** – Geometric Mean Filter. | [6] |
| **Image Segmentation*** Edge Detection – Thresholding – Region Based Segmentation Region Based Segmentation – Region Growing – Region Splitting and Merging – Morphological Processing- Erosion and Dilation, **Segmentation By Morphological Watersheds.***** | [6] |
| **Image Compression and Recognition*** Need For Data Compression, Huffman, Run Length Encoding Codes, JPEG Standard, Boundary Representation, Fourier Descriptor, Regional Descriptors Texture - Patterns and Pattern Classes** - Recognition Based on Matching. | [6] |
| **Practical:**<br>1.Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)<br>2. Implementation of Relationships between Pixels<br>3. Contrast stretching of a low contrast image and finding Histogram, Histogram Equalization.<br>4. Implementation of Transformations of an Image.<br>5. Implementation of image restoring techniques.<br>6. Display of bit planes of an Image.<br>7.Implementation of image sharpening filters and Edge Detection using Gradient Filters<br>8.Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)<br>9 Image Compression by DCT, DPCM, HUFFMAN coding.<br>10. Implementation of image sharpening filters and Edge Detection using Gradient Filters<br><br>**Tools used: MATLAB** | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |
| **Text Book(s):** | |
| 1. Rafael C Gonzalez, Richard E. Woods, 'Digital Image Processing', 4th Edition, Pearson Education, 2018. | |
| 2. Jain A.K, 'Fundamentals of Digital Image Processing', New Edition, Prentice Hall of India, 2016. | |
| **Reference(s):** | |
| 1. Rafael C Gonzalez, Richard E. Woods, 'Digital Image Processing', Prentice Hall, 3rd Edition, 2016. | |
| 2. William K. Pratt, 'Digital Image Processing ', John Wiley, New York, 2016 | |
| 3. Dudgeon D.E and Mersereau RM, 'Multidimensional Digital Signal Processing ', Prentice Hall Professional Technical Reference, 2016. | |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | |
|---|---|
| 4. | Yao Wang, JoernOstermann, and Ya-Qin Zhang,' Video Processing and Communications', Prentice Hall, 2016. |

*SDG 4- Quality Education
**SDG 8-Decent work and economic growth
***SDG 11- Sustainable cities and communities

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Digital Image Fundamentals and Transforms** | |
| 1.1 | Steps in Digital Image Processing, Elements of Visual Perception | 1 |
| 1.2 | Image Sensing and Acquisition, Image Sampling and Quantization | 2 |
| 1.3 | Relationships Between Pixels, Color Image Fundamentals, RGB, HIS Models | 2 |
| 1.4 | Two-Dimensional Mathematical Preliminaries, 2D Transforms – DFT, DCT | 1 |
| **2** | **Electrical and Emission Control System** | |
| 2.1 | Basic gray level transformations | 2 |
| 2.2 | Histogram Processing, Histogram Matching, Spatial Filtering, Smoothing Spatial Filters | 2 |
| 2.3 | Sharpening Spatial Filters, Homomorphic Filtering, Smoothing Spatial Filters | 2 |
| **3** | **Restoration** | |
| 3.1 | Model of the Image Degradation / Restoration Process | 1 |
| 3.2 | Mean Filters, Order Statistics Filters, Adaptive Filters | 2 |
| 3.3 | Inverse Filtering, Minimum Mean Square Error Filtering, Constrained Least Squares Filtering | 2 |
| 3.4 | Geometric Mean Filter | 1 |
| **4** | **Image Segmentation** | |
| 4.1 | Edge Detection, Thresholding, Region Based Segmentation | 2 |
| 4.2 | Region Based Segmentation, Region Growing, Region Splitting and Merging | 2 |
| 4.3 | Morphological Processing, Erosion and Dilation, Segmentation by Morphological Watersheds | 2 |
| **5** | **Image Compression and Recognition** | |
| 5.1 | Need For Data Compression, Huffman, Run Length Encoding Codes | 2 |
| 5.2 | JPEG Standard, Boundary Representation, Fourier Descriptor, Regional Descriptors | 2 |
| 5.3 | Topological Feature, Texture, Patterns and Pattern Classes, Recognition Based on Matching | 2 |
| **Practical:** | | |
| 1. | Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale) | 4 |
| 2. | Implementation of Relationships between Pixels | 2 |
| 3. | Contrast stretching of a low contrast image and finding Histogram, Histogram Equalization | 4 |
| 4. | Implementation of Transformations of an Image | 2 |
| 5. | Implementation of image restoring techniques | 4 |
| 6. | Display of bit planes of an Image | 2 |
| 7. | Implementation of image sharpening filters and Edge Detection using Gradient Filters | 4 |
| 8. | Implementation of Image Smoothening Filters (Mean and Median filtering of an Image) | 2 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 9. | Image Compression by DCT, DPCM, HUFFMAN coding | 4 |
| 10. | Implementation of image sharpening filters and Edge Detection using Gradient Filters | 2 |

**Course Designer(s)**


1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Dr.S.Malarkhodi - malarkhodi@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E26 | Optoelectronic Devices | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To know the basics of solid state physics and understand the nature and characteristics of light.
- To understand the operation of different display devices and their applications.
- To learn the principle of optical detection mechanism in different detection devices.
- To understand different light modulation techniques and optical switching.
- To study the opto electronic integrated circuits in transmitters and receivers.

## Pre-requisites

- Electron devices

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Illustrate the concept of light wave theory and solid state physics | Understand |
| CO2 | Describe the operation of various display devices | Understand |
| CO3 | Discuss the working principle of optical detection devices | Understand |
| CO4 | Describe the construction and properties of optical modulator and Optoelectronic Devices and Identify their applications | Understand |
| CO5 | Describe the optoelectronic applications and guided wave devices | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 40 |
| Understand | 40 | 40 | 40 |
| Apply | - | - | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E26 - Optoelectronic Devices | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Elements of Light and Solid State Physics*** Wave Nature of Light - Polarization, Interference - Diffraction, Quantum Mechanical Concept - Band Structure and Carrier Effective Masses - Scattering and Carrier Mobilities Semiconductors Statistics - Carrier Recombination. | [9] |
| **Display Devices and Lasers*** Photo Luminescence - Cathode Luminescence - Electro Luminescence - Injection Luminescence – LED - Plasma Display - Liquid Crystal Displays - Numeric Displays - Laser Emission – Absorption – Radiation - Population Inversion - Optical Feedback - Threshold Condition - Laser Modes - Classes of Lasers - Laser Applications. | [9] |
| **Optical Detection Devices*** Photo Detector - Thermal Detector - Photo Devices - Photo Conductors - Detector Performance. | [9] |
| **Optoelectronic Modulators and Switches*** Analog and Digital Modulation - Electro-Optic modulators - Magneto Optic Devices - Acoustic Devices Optical - Switching and Logic Devices. | [9] |
| **Optoelectronic Integrated Circuits*** Hybrid and Monolithic Integration - Application of Opto Electronic Integrated Circuits - Integrated Transmitters and Receivers - Guided wave devices. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Pallab Bhattacharya, “Semiconductor Opto Electronic Devices”, 2nd Edition, Prentice Hall of India Pvt., Ltd. New Delhi, 2017. |
| 2. | Jasprit Singh, “Opto Electronics: As Introduction to Materials and Devices”, 2nd Edition, Mc Graw -Hill International, 1998. |
| **Reference(s):** | |
| 1. | Gupta S.C, “Opto Electronic Devices and Systems”, 2nd Edition, Prentice Hall of India, 2015. |
| 2. | Wilson J and Hawkes J, “Opto Electronics: An Introduction”, 3rd Edition, Prentice Hall, 1998. |
| 3. | Aamir T. Grifel and Henry L. Bertoni, “Guided wave opto-electronics: Device characterization, analysis and design”, 1st Edition, Plenium Press, 1995. |
| 4. | Richard Osgood Jr. and Xiang Meng ,"Principles of Photonic Integrated Circuits: Materials, Device Physics, Guided Wave Design",1st Edition, Springer, 2021. |

*SDG 7 - Ensure access to affordable, reliable, sustainable and modern energy for all

**Assignment Activity :**

**Assignment 1:**
1. Seminar in Scattering and Carrier Mobilities Semiconductors Statistics
2. Group discussion on Luminescence Techniques

**Assignment 2:**
1. Demo on Optical Detection Devices.

**Assignment 3:**
1. Seminar on Modulator techniques.

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Elements of Light and Solid State Physics** | |
| 1.1 | Wave nature of light | 1 |
| 1.2 | Polarization | 1 |
| 1.3 | Interference | 1 |
| 1.4 | Diffraction | 1 |
| 1.5 | Quantum Mechanical Concept | 1 |
| 1.6 | Band Structure and Carrier Effective Masses | 1 |
| 1.7 | Scattering and Carrier Motilities | 1 |
| 1.8 | Semiconductors Statistics | 1 |
| 1.9 | Carrier Recombination | 1 |
| **2** | **Display Devices and Lasers** | |
| 2.1 | Photo Luminescence | 1 |
| 2.2 | Cathode Luminescence | 1 |
| 2.3 | Electro Luminescence, Injection Luminescence | 1 |
| 2.4 | LED, Plasma Display | 1 |
| 2.5 | Liquid Crystal Displays, Numeric Displays | 1 |
| 2.6 | Laser Emission, Absorption, Radiation, Population Inversion | 1 |
| 2.7 | Optical Feedback, Threshold Condition | 1 |
| 2.8 | Laser Modes, Classes of Lasers | 1 |
| 2.9 | Laser Applications | 1 |
| **3** | **Optical Detection Devices** | |
| 3.1 | Photo detector | 1 |
| 3.2 | Quantum mechanics of photon interaction | 1 |
| 3.3 | Thermal detector | 1 |
| 3.4 | Fundamental Principles of Thermal Detection | 1 |
| 3.5 | Photo Devices | 1 |
| 3.6 | Types of Photo Devices | 1 |
| 3.7 | Photo Conductors | 1 |
| 3.8 | Photoconductivity Mechanism | 1 |
| 3.9 | Detector performance | 1 |
| **4** | **Optoelectronic Modulators and Switches** | |
| 4.1 | Analog Modulation | 1 |
| 4.2 | Digital Modulation | 1 |
| 4.3 | Electro-optic modulators | 1 |
| 4.4 | Key Parameters and Characteristics | 1 |
| 4.5 | Magneto optic Devices | 1 |
| 4.6 | Types of Magneto-Optic Devices | 1 |
| 4.7 | Acoustic devices | 1 |
| 4.8 | Optical Switching Devices | 1 |
| 4.9 | Optical Logic Devices | 1 |
| **5** | **Optoelectronic Integrated Circuits** | |
| 5.1 | hybrid Integration | 1 |
| 5.2 | Monolithic Integration | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.3 | Opto Electronic Integrated Circuits | 1 |
| 5.4 | Application of Opto Electronic Integrated Circuits | 1 |
| 5.5 | Integrated transmitters | 1 |
| 5.6 | Directly Modulated and External Modulated | 1 |
| 5.7 | Integrated Receivers | 1 |
| 5.8 | Performance Metrics | 1 |
| 5.9 | Guided wave devices | 1 |

**Course Designer(s)**

1. M.Devaki - devaki@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E27 | Therapeutic Equipment | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To study the fundamentals of bioelectric signals and methods of recording various bio- potentials
- To evaluate the measurement of bio-chemical and non-electrical parameters
- To explore the various functional blocks present is cardiac care units and various assist devices
- To develop an understanding of the physiotherapy and diathermy equipment
- To study the electrical safety in the hospital environment

## Pre-requisites

- Nil

## Course Outcomes

**On the successful completion of the course, students will be able to**

| | | |
|---|---|---|
| **CO1** | Discuss and analyze bioamplifiers | Understand |
| **CO2** | Describe vital and non-electrical parameters | Understand |
| **CO3** | Explain about the pacemaker and defibrillator | Apply |
| **CO4** | Demonstrate the function of assist devices. | Apply |
| **CO5** | Describe about electrical safety of medical equipment in the hospital environment | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO2 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO4 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 3 | - |
| CO5 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 3 | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 30 |
| Understand | 50 | 20 | 30 |
| Apply | - | 30 | 40 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC E27 - Therapeutic Equipment**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Bio Potential Recording*** Cell Potential-Half-cell Potential, Electrodes -Types of Electrodes, Signal Conditioning circuits Characteristics of Amplifiers, Differential Amplifiers, Filters, Isolation Amplifier, Design concepts. ECG, EEG, EMG, PCG, EOG, Lead System and Recording Methods, Typical Waveform, Frequency Spectrum, Abnormal Waveforms. Evoked Response. | [9] |
| **Measurement of Non Electrical Parameter *** Measurements of Respiration Rate, Temperature, Pulse rate, Blood pressure Measurements - Direct, Indirect. Blood flow Measurements – In vitro, In vivo, Gas Flow Measurements. Lung Volume Measurement – Spirometer. | [9] |
| **Cardiac Care Units ***** Pace Makers - Different Types, Batteries for Pace Makers, Design Concept. DC Defibrillators, Asynchronous and Synchronous Types, Patient Monitoring System, Principles of Bio Telemetry. | [9] |
| **Assist Devices **** Heart Lung Machine-Condition to be satisfied by the H/L System. Different Types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process. Hemodialyser Indication and Principle of Hemodialysis, Membrane, Dialysate, Different types of Hemodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type. Respiratory aids- Types of Ventilators – Pressure, Volume, and Time controlled. | [9] |
| **Diathermy, Stimulator and Patient Safety ***** Diathermy-Physiological Effects of HF radiation, Depth of Penetration, Short Wave, Ultrasonic and Microwave Diathermy, Surgical Diathermy, Hazards and Safety Procedures. Medical Stimulators – Intensity Duration Curve, Current Waveforms - Galvanic, Faradic, Surged Faradic, Exponential, Biphasic, TENS, Interferential Therapy. Electrical Safety-Leakage Current, Micro and Macro Electric Shock, GFI Units, Earthing Scheme, Electrical Safety Analyser. | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**

| | |
|---|---|
| 1. | Geddes L.A and Baker L.E., "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley and Sons, Reprint 2008 |
| 2. | John G.Webster, "Medical Instrumentation Application and Design", 4thEdition, John Wiley and Sons, New York, 2009. |

**Reference(s):**

| | |
|---|---|
| 1. | Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2014. |
| 2. | Richard S.Cobbold, "Transducers for Biomedical Measurements; Principle and applications", John Wiley and sons, 1992. |
| 3. | Antony Y.K.Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008. |
| 4. | Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007. |

* SDG 4 - Quality Education
**SDG 9 - Industry Innovation and Infrastructure
***SDG 15 - Life on land

**Assignment Activity:**

Assignment 1 - Group Discussion on Amplifiers
Assignment 2 - Seminar on Defibrillators
Assignment 3 - Case Study on Diathermy

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. Of Hours |
|---|---|---|
| **1.0** | **Bio Potential Recording** | |
| 1.1 | Cell Potential-Half-cell potential | **1** |
| 1.2 | Electrodes-types of electrodes | **1** |
| 1.3 | Signal Conditioning circuits | **1** |
| 1.4 | Characteristics of Amplifiers, Differential Amplifiers | **1** |
| 1.5 | Filters, Isolation Amplifier | **1** |
| 1.6 | Design concepts. ECG, EEG, EMG, PCG, EOG | **1** |
| 1.7 | lead system and recording methods | **1** |
| 1.8 | typical waveform, frequency spectrum, abnormal waveforms | **1** |
| 1.9 | Evoked Response | **1** |
| **2.0** | **Measurement of Non Electrical Parameter** | |
| 2.1 | Measurements of Respiration Rate | **1** |
| 2.2 | Temperature, Pulse rate, Blood pressure Measurements | **2** |
| 2.3 | Direct, Indirect. Blood flow Measurements | **2** |
| 2.4 | in vitro, In vivo, Gas flow measurements | **2** |
| 2.5 | Lung volume measurement – Spirometer | **2** |
| **3.0** | **Cardiac Care Units** | |
| 3.1 | Pace makers - different types | **1** |
| 3.2 | batteries for pace makers | **2** |
| 3.3 | Design Concept. DC defibrillators | **1** |
| 3.4 | asynchronous and synchronous types | **2** |
| 3.5 | patient monitoring system | **2** |
| 3.6 | principles of bio telemetry | **1** |
| **4.0** | **Assist Devices** | |
| 4.1 | Heart Lung Machine | **1** |
| 4.2 | Condition to be satisfied by the H/L System | **1** |
| 4.3 | Different types of Oxygenators | **1** |
| 4.4 | Pumps, Pulsatile and Continuous Types | **1** |
| 4.5 | Monitoring Process. Hemodialyser Indication and Principle of Hemodialysis | **1** |
| 4.6 | Membrane, Dialysate, Different types of Hemodialysers | **1** |
| 4.7 | Monitoring Systems, Wearable Artificial Kidney | **1** |
| 4.8 | Implanting Type. Respiratory aids | **1** |
| 4.9 | Types of Ventilators – Pressure, Volume, and Time controlled | **1** |
| **5.0** | **Diathermy, Stimulator and Patient Safety** | |
| 5.1 | Diathermy-Physiological effects of HF radiation | **1** |
| 5.2 | Depth of Penetration, short wave | **1** |
| 5.3 | Ultrasonic and microwave diathermy | **1** |
| 5.4 | Surgical diathermy, Hazards and safety procedures | **1** |
| 5.5 | Medical Stimulators – Intensity Duration Curve | **1** |
| 5.6 | Current waveforms - Galvanic, Faradic, surged faradic, exponential, biphasic, TENS, Interferential therapy | **2** |
| 5.7 | Electrical Safety-Leakage current, Micro and macro electric shock | **1** |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.8 | GFI units, Earthing Scheme, Electrical safety Analyser. | **1** |

**Course Designer(s)**

1. Dr.S.Malarkhodi – malrkhodi@ksrct.ac.in

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

# K.S.Rangasamy College of Technology (Autonomous)

**Curriculum & Syllabi**

**for**

**Minor Degree**

# Electronics and Communication Engineering

# (Internet of Things)

**(For batch admitted in 2024-2025)**

# R 2022

**Accredited by NAAC with 'A++' grade,**

**Approved by AICTE, Affiliated to Anna University, Chennai.**

**KSR Kalvi Nagar, Tiruchengode – 637 215.**

**Namakkal District, Tamil Nadu, India.**

**K.S.RANGASAMY COLLEGEOF TECHNOLOGY, TIRUCHENGODE – 637215**
**(Autonomous)**
**DEPARTMENT OF ECE**
**MINOR DEGREE PROGRAMME - INTERNET OF THINGS**
**LIST OF COURSES**

| S.No. | Course Code | Course Name | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | 60 EC M01 | Internet of Things and its Application | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | 60 EC M02 | Security of Cyber Physical Systems | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | 60 EC M03 | Embedded Systems for IoT | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | 60 EC M04 | IoT Processors | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | 60 EC M05 | IoT Device Development and Integration | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | 60 EC M06 | Industrial IoT and Industry 4.0 | PE | 3 | 3 | 0 | 0 | 3 |
| | | | | Total | 18 | 0 | 0 | 18 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC M01 | Internet of Things and its Application | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To make students know the IoT ecosystem.
- To explore the structural components of IoT systems.
- To provide an understanding of the technologies and the standards relating to the internet of things.
- To explore a wide array of IoT applications across various industries.
- To develop skills on IoT technical planning.

## Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Analyze the evolution and convergence of web technologies leading to the IoT universe. | Understand |
| CO2 | Expalin the value chains associated with M2M and IoT technologies. | Understand |
| CO3 | Construct an outline of an IoT architecture using appropriate architectural principles. | Understand |
| CO4 | Assess the potential benefits and challenges of implementing IoT in specific industries like retail, oil and gas, and healthcare. | Apply |
| CO5 | Analyze the privacy and security challenges associated with data aggregation and sharing in smart cities. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | - | 3 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO2 | 3 | 3 | 3 | - | 2 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO3 | 3 | 3 | 3 | - | 2 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO4 | 3 | 3 | 2 | - | 3 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 10 | 10 |
| Understand | 40 | 20 | 30 |
| Apply | - | 30 | 60 |
| Analyze | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC M01 - Internet of Things and its Application | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Understanding IoT*** IoT & Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization | [9] |
| **M2M to IoT *** M2M to IoT – M2M Value Chains, IoT Value Chains, An Emerging Industrial Structure for IoT, Building an Architecture, Main Design Principles and Needed Capabilities, An IoT Architecture Outline, Standards Considerations. | [9] |
| **IoT Architecture*** IoT Architecture – State of the Art, Architecture Reference Model – Introduction, Reference Model and Architecture, IoT Reference Model, IoT Reference Architecture – Functional View, Information View, Deployment and Operational View, Other Relevant Architectural Views. | [9] |
| **IoT Applications*** IoT Applications for Value Creations, IoT Applications for Industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth. | [9] |
| **Privacy, Security, and Governance in IoT**** Internet of Things Privacy, Security and Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT – Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, "Internet of Things", 2nd Edition, John Wiley & Sons, 2020. |
| 2. | Nitesh Dhanjani, "Abusing the Internet of Things", 1st Edition, Shroff Publisher/O'Reilly Publisher, 2015. |
| **Reference(s):** | |
| 1. | Cuno Pfister, "Getting Started with the Internet of Things", 6th Edition, Shroff Publisher/Maker Media, 2018. |
| 2. | Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013. |
| 3. | Massimo Banzi, Michael Shiloh "Make: Getting Started with the Arduino", 4th Edition, Shroff Publisher/Maker Media Publishers, 2022. |

* SDG 9 - Industry, innovation and infrastructure
** SDG 16 - Peace, justice, and strong institutions

**Assignment Activity**

**Assignment 1:** Design a simple IoT weather station using an embedded system
**Assignment 2**: Transmit the data from the weather station to the Cloud server for further analysis and visualization
**Assignment 3:** Mini Project

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| Course Contents and Lecture Schedule | | |
|---|---|---|
| **S. No.** | **Topics** | **No. of hours** |
| **1** | **Understanding IoT** | |
| 1.1 | IoT & Web Technology: The Internet of Things Today | 1 |
| 1.2 | Time for Convergence | 1 |
| 1.3 | Towards the IoT Universe, Internet of Things Vision | 1 |
| 1.4 | IoT Applications, Future Internet Technologies | 1 |
| 1.5 | Infrastructure, Networks and Communication | 1 |
| 1.6 | Processes, Data Management, Security, | 1 |
| 1.7 | Privacy & Trust | 1 |
| 1.8 | Device Level Energy Issues | 1 |
| 1.9 | IoT Related Standardization | 1 |
| **2** | **M2M to IoT** | |
| 2.1 | M2M to IoT – A Basic Perspective | 1 |
| 2.2 | M2M Value Chains | 1 |
| 2.3 | IoT Value Chains | 1 |
| 2.4 | An emerging industrial structure for IoT | 1 |
| 2.5 | An Architectural Overview | 1 |
| 2.6 | Building an architecture | 1 |
| 2.7 | Main design principles and needed capabilities | 1 |
| 2.8 | An IoT architecture outline | 1 |
| 2.9 | Standards considerations | 1 |
| **3** | **IoT Architecture** | |
| 3.1 | IoT Architecture -State of the Art | 1 |
| 3.2 | Architecture Reference Model | 1 |
| 3.3 | Reference Model and architecture | 1 |
| 3.4 | IoT reference Model | 1 |
| 3.5 | IoT Reference Architecture | 1 |
| 3.6 | Functional View | 1 |
| 3.7 | Information View | 1 |
| 3.8 | Deployment and Operational View | 1 |
| 3.9 | Other Relevant architectural views | 1 |
| **4** | **IoT Applications** | |
| 4.1 | IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts | 1 |
| 4.2 | Brownfield IoT, Smart Objects, Smart Applications | 1 |
| 4.3 | Four Aspects in your Business to Master IoT | 1 |
| 4.4 | Value Creation from Big Data and Serialization | 1 |
| 4.5 | IoT for Retailing Industry | 1 |
| 4.6 | IoT for Oil and Gas Industry | 1 |
| 4.7 | Opinions on IoT Application and Value for Industry | 1 |
| 4.8 | Home Management | 1 |
| 4.9 | eHealth | 1 |
| 5 | **Privacy, Security, and Governance in IoT** | |
| 5.1 | Internet of Things Privacy, | 1 |
| 5.2 | Security and Governance Introduction | 1 |
| 5.3 | Governance | 1 |
| 5.4 | Privacy and Security Issues | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.5 | Contribution from FP7 Projects | 1 |
| 5.6 | Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities | 1 |
| 5.7 | First Steps Towards a Secure Platform | 1 |
| 5.8 | Smart Approach. Data Aggregation for the IoT in Smart Cities | 1 |
| 5.9 | Security | 1 |
| | | |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC M02 | Security of Cyber Physical Systems | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objectives**

- To learn the basics of security and various types of security issues.
- To study different cryptography techniques available and various security attacks.
- To explore network security and how they are implemented in real world.
- To analyze potential privacy vulnerabilities within Software-Defined Networks.
- To get an insight of various issues of Web security and biometric authentication.

**Pre-requisites**

- Microprocessors and Microcontrollers, Basics of C Programming

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the nature and scope of information system security and privacy | Understand |
| CO2 | Evaluate the architecture of applied cryptography and its role in ensuring information integrity | Apply |
| CO3 | Assess security challenges specific to the Internet of Things (IoT) environment | Apply |
| CO4 | Identify security challenges unique to SDNs and understand their impact on network infrastructure | Apply |
| CO5 | Develop strategies for secure deployment and operation of CPS in real-world scenarios | Apply |

**Mapping with Programme Outcomes**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | 2 | 3 | 2 | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO2 | 3 | 3 | 3 | 2 | 2 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO3 | 3 | 3 | 3 | 3 | 2 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO4 | 3 | 3 | 2 | 3 | 3 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO5 | 3 | 3 | 3 | 2 | 3 | 2 | - | 3 | 3 | 3 | - | 2 | - | - | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 30 |
| Apply | 40 | 40 | 60 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC M02 - Security of Cyber Physical Systems | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| V | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Security and Privacy in Information Systems *** Information System Security and Privacy: Nature and Scope, History of Information Security and Privacy, Information and Data Privacy, Security of Technical Systems in Organizations, Issues in Information Security Issues in Information Privacy. | [9] |
| **Applied Cryptography and Intrusion Detection** Applied Cryptography and Intrusion Detection, Architecture of Applied Cryptography, One Way Hash Function and Integrity, Encryption Algorithms and Confidentiality, Digital Signature and Authentication (DH, RSA, 2 class). | [9] |
| **Security and Privacy in Internet of Things (IoT) *** Internet of Things Security, Security and Privacy for IoT Case Study: Smart Home, Smart Grid Network, Modern Vehicle, Wearable Computing & BYOD, Mobile Health Care. | [9] |
| **Security and Privacy in Software-Defined Networks *** Software-Defined Networks, Security for Software-Defined Networks, Privacy Leakages for Software-Defined Networks, Case Studies: How to Attack Software - Defined Networks. | [9] |
| **Security of Cyber-Physical Systems (CPS) *** Cyber - Physical Systems (CPS), CPS - Platform Components, CPS Implementation Issues, Intelligent CPS, Secure Deployment of CPS. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Nina Godbole, “Cyber Security”, John Wiley & Sons. 2018. |
| 2. | Li Da Xu, Shancang Li, “Securing the Internet of Things”, 1st Edition, Syngress Publishing, 2017. |
| **Reference(s):** | |
| 1. | Alasdair Gilchrist, “IoT Security Issues”, 1st Edition, De Gruyter, 2017. |
| 2. | Sean Smith, “The Internet of Risky Things”, Sean Smith, 1st Edition, Shroff Publisher/O’Reilly, 2017. |

* SDG 9 - Industry, innovation and infrastructure

**Assignment Activity**

**Assignment 1:** Potential security threats and privacy concerns associated with IoT devices
**Assignment 2:** Case study about Security and Privacy in the Internet of Things (IoT)
**Assignment 3:** Case study - Cyber Physical Systems

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Security and Privacy in Information Systems** | |
| 1.1 | Information System Security | 1 |
| 1.2 | Privacy | 1 |
| 1.3 | Nature and Scope | 1 |
| 1.4 | History of Information Security and Privacy | 1 |
| 1.5 | Information Privacy | 1 |
| 1.6 | Data Privacy | 1 |
| 1.7 | Security of Technical Systems in Organizations | 1 |
| 1.8 | Issues in Information Security | 1 |
| 1.9 | Issues in Information Privacy | 1 |
| **2** | **Applied Cryptography and Intrusion Detection** | |
| 2.1 | Applied Cryptography | 1 |
| 2.2 | Intrusion Detection | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 2.3 | Architecture of Applied Cryptography | 1 |
| 2.4 | One Way Hash Function and Integrity | 1 |
| 2.5 | Encryption Algorithms | 1 |
| 2.6 | Confidentiality | 1 |
| 2.7 | Digital Signature and Authentication - DH | 1 |
| 2.8 | Digital Signature and Authentication - RSA | 1 |
| 2.9 | Digital Signature and Authentication - 2 class) | 1 |
| **3** | **Security and Privacy in Internet of Things (IoT)** | |
| 3.1 | Internet of Things Security | 1 |
| 3.2 | Security for IoT | 1 |
| 3.3 | Privacy for IoT | 1 |
| 3.4 | Case Study: Smart Home | 1 |
| 3.5 | Case Study: Smart Grid Network | 1 |
| 3.6 | Case Study: Modern Vehicle | 1 |
| 3.7 | Case Study: Wearable Computing | 1 |
| 3.8 | Case Study: BYOD | 1 |
| 3.9 | Case Study: Mobile Health Care | 1 |
| **4** | **Security and Privacy in Software-Defined Networks** | |
| 4.1 | Software-Defined Networks | 1 |
| 4.2 | Attacks in SDN | 1 |
| 4.3 | Vulnerabilities in SDN | 1 |
| 4.4 | Network Security Enhancement using SDN | 1 |
| 4.5 | Challenge of Integrating Legacy Protocols | 1 |
| 4.6 | Cross Domain Connection | 1 |
| 4.7 | Security for Software-Defined Networks | 1 |
| 4.8 | Privacy Leakages for Software-Defined Networks | 1 |
| 4.9 | Case Studies: How to Attack Software-Defined Networks | 1 |
| **5** | **Security of Cyber-Physical Systems (CPS** | |
| 5.1 | Cyber - Physical Systems (CPS) | 1 |
| 5.2 | CPS - Platform components | 1 |
| 5.3 | CPS implementation issues | 1 |
| 5.4 | Intelligent CPS | 1 |
| 5.5 | Secure Deployment of CPS | 1 |
| 5.6 | Advanced Cyber-Physical Systems Security Concepts | 1 |
| 5.7 | Physical issues in security | 1 |
| 5.8 | Security Requirements of CPS | 1 |
| 5.9 | Security Goals | 1 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC M03 | Embedded Systems for IoT | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To make students know the basic concept and architecture of embedded systems.
- To explore the design principles and components of embedded systems.
- To comprehend the various types of inputs and outputs in embedded IoT systems.
- To delve into the technologies and protocols enabling IoT systems
- To have knowledge about the IoT enabled technology.

## Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the fundamental pillars of Embedded IoT and the concept of the internet of devices | Understand |
| CO2 | Identify common sensors, actuators, and embedded processors used in IoT applications. | Apply |
| CO3 | Describe the usage of digital and analog inputs and outputs, including bus communication. | Understand |
| CO4 | Explore IoT platforms like IBM Watson IoT, Eclipse IoT, AWS IoT, Azure IoT Suite, and Google Cloud IoT. | Analyze |
| CO5 | Examine real-world case studies of IoT integration with cloud platforms. | Analyze |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 2 | 3 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO2 | 3 | 3 | 2 | 2 | 3 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO3 | 3 | 3 | 3 | 2 | 2 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO4 | 3 | 3 | 3 | 3 | 2 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| CO5 | 3 | 3 | 2 | 3 | 3 | - | - | 3 | 3 | 3 | - | 2 | - | - | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 20 |
| Apply | 40 | 30 | 60 |
| Analyse | - | 10 | 10 |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S. Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC M03 - Embedded Systems for IoT**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Fundamentals of Embedded IoT Systems ***<br>Purpose and Requirement Specification, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Pillars of Embedded IoT and Physical Devices: The internet of Devices. | [9] |
| **Design of Embedded Systems and Components ***<br>Design of Embedded Systems: Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture. | [9] |
| **Inputs and Outputs in Embedded IoT ***<br>Inputs and Outputs: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, Bus In, Bus Out, and Bus in Out, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768). | [9] |
| **IoT Enabling Technologies and Protocols ***<br>IoT Enabling Technologies: Communications, RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, XMPP, Node-RED, Platforms, IBM Watson IoT - Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE Predix, Xively, macchina.io, Carriots. | [9] |
| **Web and Cloud Integration for IoT ***<br>Web of Things and Cloud of Things: Web of Things Versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers, Cloud Offerings and IoT Case Studies: Cloud Storage Models, Communication API. | [9] |
| **Total Hours:** | **45** |

| | |
|---|---|
| **Text Book(s):** | |
| 1. | RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, "Internet of Things", 2nd Edition, John Wiley and Sons, 2020. |
| 2. | Klaus Elk, "Embedded Software for the IoT", 3rd Edition, De Gruyter, 2018. |
| 3. | Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed", 1st Edition, Wiley, 2018. |
| **Reference(s):** | |
| 1. | Elizabeth Gootman et. al, "Designing Connected Products", 1st Edition, Shroff Publisher/O'Reilly Publisher, 2015. |

* SDG 9 - Industry, innovation and infrastructure

**Assignment activity**

**Assignment 1:** Design a simple IoT weather station using an embedded system

**Assignment 2:** Transmit the data from the weather station to the Cloud server for further analysis and visualization

**Assignment 3:** Case study - Web and Cloud Integration for IoT

Passed in BoS Meeting held on 18/11/2023

Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| Course Contents and Lecture Schedule | | |
|---|---|---|
| **S. No.** | **Topics** | **No. of hours** |
| **1** | **Fundamentals of Embedded IoT Systems** | |
| 1.1 | Purpose and requirement specification | 1 |
| 1.2 | IoT level specification | 1 |
| 1.3 | Functional view specification | 1 |
| 1.4 | Operational view specification | 1 |
| 1.5 | Device integration | 1 |
| 1.6 | Component integration | 1 |
| 1.7 | Pillars of Embedded IoT | 1 |
| 1.8 | Physical Devices | 1 |
| 1.9 | The internet of devices | 1 |
| **2** | **Design of Embedded Systems and Components** | |
| 2.1 | Design of Embedded Systems | 1 |
| 2.2 | Common Sensors | 1 |
| 2.3 | Actuators | 1 |
| 2.4 | Components | 1 |
| 2.5 | Embedded Processors | 1 |
| 2.6 | Memory Architectures | 1 |
| 2.7 | Software architecture | 1 |
| 2.8 | System Integration | 1 |
| 2.9 | Onboard Communication interfaces | 1 |
| **3** | **Inputs and Outputs in Embedded IoT** | |
| 3.1 | Inputs and Outputs: Digital Inputs and Outputs, Digital Inputs, Digital Outputs | 1 |
| 3.2 | Bus In, Bus Out, and Bus in Out, | 1 |
| 3.3 | Analog Inputs and Outputs | 1 |
| 3.4 | Analog Inputs, Analog Outputs | 1 |
| 3.5 | Pulse Width Modulation (PWM) | 1 |
| 3.6 | Accelerometer | 1 |
| 3.7 | Magnetometer | 1 |
| 3.8 | SD Card | 1 |
| 3.9 | Local File System (LPC1768) | 1 |
| **4** | **IoT Enabling Technologies and Protocols** | |
| 4.1 | IoT Enabling Technologies: Communications, RFID and NFC (Near-Field Communication) | 1 |
| 4.2 | Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee | 1 |
| 4.3 | Z-Wave, LoRa, Protocols, HTTP, WebSocket | 1 |
| 4.4 | MQTT, CoAP, XMPP | 1 |
| 4.5 | Node-RED, Platforms | 1 |
| 4.6 | IBM Watson IoT—Bluemix, Eclipse IoT | 1 |
| 4.7 | AWS IoT, Microsoft Azure IoT Suite | 1 |
| 4.8 | Google Cloud IoT | 1 |
| 4.9 | ThingWorx, GE Predix, Xively, macchina.io, Carriots | 1 |
| **5** | **Web and Cloud Integration for IoT** | |
| 5.1 | Web of Things and Cloud of Things: Web of Things versus Internet of Things | 1 |
| 5.2 | Two Pillars of the Web | 1 |
| 5.3 | Architecture Standardization for WoT | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.4 | Platform Middleware for WoT | 1 |
| 5.5 | Cloud of Things | 1 |
| 5.6 | IoT Physical Servers | 1 |
| 5.7 | Cloud Offerings | 1 |
| 5.8 | IoT Case Studies: Cloud Storage Models | 1 |
| 5.9 | Communication API | 1 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC M04 | IoT Processors | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- Learn the architecture and features of ARM.
- Study the exception handling and interrupts in CORTEX M3
- Program the CORTEX M3
- Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller.
- Understand the concepts of System – On – Chip (SoC)

## Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the architecture and features of ARM | Understand |
| CO2 | List the concepts of exception handling | Understand |
| CO3 | Develop programs using ARM CORTEX M3/M4 | Apply |
| CO4 | Discuss the architecture of STM32L15XXX ARM CORTEX M3/M4 | Understand |
| CO5 | Design an SoC for any application | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | 2 | - | - | - |
| CO2 | 3 | 3 | 2 | - | 3 | - | - | - | - | - | - | 2 | - | - | - |
| CO3 | 3 | 3 | 3 | - | 2 | - | - | - | - | - | - | 2 | - | - | - |
| CO4 | 3 | 3 | 3 | - | 2 | - | - | - | - | - | - | 2 | - | - | - |
| CO5 | 3 | 3 | 2 | - | 3 | - | - | - | - | - | - | 2 | - | - | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 10 | 10 |
| Understand | 40 | 10 | 30 |
| Apply | - | 40 | 60 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S. Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC M04 - IoT Processors**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VI | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **ARM and CORTEX-M3 *** ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence | [9] |
| **CORTEX Exception Handling and Interrupts*** Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency | [9] |
| **CORTEX M3/M4 Programming*** Cortex M3/M4 Programming: Typical Development Flow, Using C, Exception Programming Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation, Memory Protection Unit and other CORTEX M3 Features, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration. | [9] |
| **STM32L15XXX ARMCORTEX M3/M4 Microcontroller and Debugging Tools** STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In – Circuit Emulator (ICE), Logic Analyser. | [9] |
| **System - on - Chip *** System Architecture: Components of the System Processors, Processor Architectures, Memory and Addressing, System Level Interconnection – SOC Design Approach – Application Studies – AES, 3D Graphics Processor. Image Compression and Video Compression. | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**

| | |
|---|---|
| 1. | Joseph Yiu, "The Definitive Guide to the ARM CORTEX M3/M4", 2nd Edition, Elsevier, 2010. |
| 2. | Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developers Guide Designing and Optimizing System Software", Elsevier, 2006. |
| 3. | Michael J Flynn and Wayne Luk, "Computer System Design, System on Chip", 1st Edition, Wiley India, 2011. |

**Reference(s):**

| | |
|---|---|
| 1. | Steve Furber, "ARM System – on – Chip Architecture", 2nd Edition, Pearson, 2015. |
| 2. | CORTEX M Series ARM Reference Manual, 2007 |
| 3. | CORTEX M3 Technical Reference Manual,2005 |
| 4. | STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97, 2023. |

* SDG 4 - Quality education

**Assignment activity**

**Assignment 1:** Identify any notable IoT products or projects that leverage Cortex-M3? How does it enhance their functionality or performance?

**Assignment 2:** Develop a temperature monitoring system using a Cortex M3/M4 microcontroller for an IoT application

**Assignment 3:** Case study – System on Chip

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **ARM and CORTEX-M3 *** | |
| 1.1 | ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture | 1 |
| 1.2 | Cortex M3 Basics: Registers, Stack Pointer, | 1 |
| 1.3 | Link Register, Program Counter | 1 |
| 1.4 | Special Registers | 1 |
| 1.5 | Operation Mode | 1 |
| 1.6 | Exceptions and Interrupts | 1 |
| 1.7 | Vector Tables | 1 |
| 1.8 | Stack Memory Operations | 1 |
| 1.9 | Reset Sequence | 1 |
| **2.0** | **CORTEX Exception Handling and Interrupts *** | |
| 2.1 | Exception Types, Priority, Vector Tables | 1 |
| 2.2 | Interrupt Inputs and Pending behaviour | 1 |
| 2.3 | Fault Exceptions | 1 |
| 2.4 | Supervisor Call and Pendable Service Call | 1 |
| 2.5 | NVIC: Nested Vector Interrupt Controller | 1 |
| 2.6 | Basic Interrupts | 1 |
| 2.7 | Nested Interrupts | 1 |
| 2.8 | Tail – Chaining Interrupts | 1 |
| 2.9 | Late Arrivals and Interrupt Latency | 1 |
| **3.0** | **CORTEX M3/M4 Programming *** | |
| 3.1 | Cortex M3/M4 Programming: Typical Development Flow | 1 |
| 3.2 | Using C, Exception Programming Using Interrupts | 1 |
| 3.3 | Exception/Interrupt Handlers | 1 |
| 3.4 | Software Interrupts, Vector Table Relocation | 1 |
| 3.5 | Memory Protection Unit | 1 |
| 3.6 | Other CORTEX M3 Features | 1 |
| 3.7 | MPU Registers, Setting up the MPU | 1 |
| 3.8 | Power Management | 1 |
| 3.9 | Multiprocessor Configuration | 1 |
| **4.0** | **STM32L15XXX ARMCORTEX M3/M4 Microcontroller and Debugging Tools** | |
| 4.1 | STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture | 1 |
| 4.2 | Power Control, Reset and Clock Control | 1 |
| 4.3 | STM32L15XXX Peripherals: GPIOs | 1 |
| 4.4 | System Configuration Controller, NVIC | 1 |
| 4.5 | ADC, Comparators, GP Timers | 1 |
| 4.6 | USART Development and Debugging Tools: Software and Hardware tools like Cross Assembler | 1 |
| 4.7 | Compiler, Debugger, Simulator | 1 |
| 4.8 | In – Circuit Emulator(ICE) | 1 |
| 4.9 | Logic Analyser | 1 |
| **5.0** | **System - on - Chip *** | |
| 5.1 | System Architecture: Components of the System Processors | 1 |
| 5.2 | Processor Architectures | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.3 | Memory and Addressing | 1 |
| 5.4 | System Level Interconnection | 1 |
| 5.5 | SOC Design Approach | 1 |
| 5.6 | Application Studies – AES | 1 |
| 5.7 | 3D Graphics Processor | 1 |
| 5.8 | Image Compression | 1 |
| 5.9 | Video Compression | 1 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC M05 | IoT Device Development and Integration | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To understand the foundational concepts of IoT.
- To give students hands-on experience using different IoT architectures.
- To provide skills for interfacing sensors and actuators with different IoT architectures.
- To develop skills on data collection and logging in the cloud.
- To familiarize with Raspberry Pi

## Pre-requisites

- Microprocessors and Microcontrollers, Basics of C Programming

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the fundamental concepts of the Internet of Things (IoT) and its components. | Understand |
| CO2 | Develop a basic understanding of the Arduino Uno board and its features. | Apply |
| CO3 | Discuss the ESP 8266-12E Node MCU board and its capabilities. | Understand |
| CO4 | Configure headless operation and connect Raspberry Pi 3 remotely via SSH. | Analyze |
| CO5 | Discuss the 'plug and play' cloud platforms for IoT device integration. | Analyze |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 2 | - | - | - |
| CO2 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | 2 | - | - | - |
| CO3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | 2 | - | - | - |
| CO4 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | 2 | - | - | - |
| CO5 | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | 2 | - | - | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 20 |
| Apply | 40 | 30 | 60 |
| Analyse | - | 10 | 10 |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S. Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC M05 - IoT Device Development and Integration**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **IoT and Device Components *** IoT – Components, IoT Building Blocks, Sensors and Actuators, IoT Devices, IoT Boards (Arduino Uno, ESP 8266-12E Node MCU, and Raspberry Pi). | [9] |
| **IoT Development **** Arduino Uno – Getting Started with the Uno Boards, Blink Program, Connection of Sensors to the Uno Board, Reading Values of Sensors from the Uno Board, Interrupts. Interfacing Temperature/Humidity using GSM Module. | [9] |
| **Cloud Integration *** ESP 8266 -12E Node MCU – ESP Board, Micropython and Esplorer IDE, Interfacing Sensors to the ESP Board, Interfacing ESP board to WiFi, Interfacing ESP with the Cloud, Interrupts, ESP32 Vs ESP 8266 board. Case Study: Switching Light on /off Remotely. Case Study: Voice-Based Home Automation for Switching Lights on/off. | [9] |
| **Processor for IoT Development *** Raspberry Pi – Installing the Raspbian OS, Headless - Computer and Rpi Configuration to Connect through SSH via Ethernet, Headless - Connecting Rpi Remotely without Ethernet Cable via SSH, IP address, Rpi – Testing the GPIO pins through Scripts. | [9] |
| **Processor Integration and IoT Platform **** Raspberry pi- Interfacing with Sensor DHT11, Raspberry pi Python Library Install - Cloud Platform for Integration to IOT Device – Actuator (LED) - Integration through Python. Raspberry Pi versions Comparison, LoRawan /LPWAN. | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**

| | |
|---|---|
| 1. | Rao M, "Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects", 1st Edition, Packt Publishing Ltd, 2018. |
| 2. | Baichtal J, "Arduino for beginners: essential skills every maker need", 1st Edition, Pearson Education, 2013. |
| 3. | Schwartz M, "Internet of Things with ESP8266", 1st Edition, Packt Publishing Ltd, 2016. |

**Reference(s):**

| | |
|---|---|
| 1. | Richardson M, & Wallace S, "Getting Started with Raspberry PI", O'Reilly Publisher Media, Inc, 1st Edition, 2012.Steve Furber, ARM System – on – Chip Architecture, 2nd Edition, Pearson, 2015. |

* SDG 9 **–** Industry, innovation and infrastructure

** SDG 12 **–** Responsible consumption and production

**Assignment activity**

**Assignment 1**: Covers Module 1 & 2 Questions related to the problems and simulation / Hands on

**Assignment 2:** Design an IoT based system for reading /sending values from sensors to the internet via GSM module.

**Assignment 3**: Mini Project

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **IoT and Device Components** | |
| 1.1 | IoT– Components | 1 |
| 1.2 | IoT building blocks | 1 |
| 1.3 | Sensors | 1 |
| 1.4 | Actuators | 1 |
| 1.5 | IoT Devices | 1 |
| 1.6 | IoT Boards – Arduino Uno | 1 |

Passed in BoS Meeting held on 18/11/2023

Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 1.7 | ESP 8266-12E | 1 |
| 1.8 | Node MCU | 1 |
| 1.9 | Raspberry Pi | 1 |
| **2.0** | **IoT Development** | |
| 2.1 | Arduino Uno – getting Started with the Uno boards, | 1 |
| 2.2 | Blink Program | 1 |
| 2.3 | Connection of Sensors to the Uno Board | 1 |
| 2.4 | Reading Values of Sensors from the Uno board | 1 |
| 2.5 | Interrupts | 1 |
| 2.6 | Interfacing Temperature and Humidity Sensor | 1 |
| 2.7 | Interfacing GSM Module | 1 |
| 2.8 | Interfacing GSM Module – Sending Data | 1 |
| 2.9 | Interfacing GSM Module – Receiving Data | 1 |
| **3.0** | **Cloud Integration** | |
| 3.1 | ESP 8266-12E Node MCU –ESP Board | 1 |
| 3.2 | Micropython and Esplorer IDE | 1 |
| 3.3 | Interfacing Sensors to the ESP Board | 1 |
| 3.4 | Interfacing ESP board to WiFi | 1 |
| 3.5 | Interfacing ESP with the Cloud | 1 |
| 3.6 | ESP Interrupts | 1 |
| 3.7 | ESP32 Vs ESP 8266 board | 1 |
| 3.8 | Case Study: Switching Light on /off Remotely | 1 |
| 3.9 | Case Study: Voice-Based Home Automation for Switching Lights on/off | 1 |
| **4.0** | **Processor for IoT Development** | |
| 4.1 | Raspberry Pi | 1 |
| 4.2 | Installing the Raspbian OS | 1 |
| 4.3 | Networks | 1 |
| 4.4 | Headless - Computer Configuration to connect through SSH via Ethernet | 1 |
| 4.5 | Headless - Rpi Configuration to connect through SSH via Ethernet | 1 |
| 4.6 | Headless - connecting Rpi3 Remotely without Ethernet cable via SSH | 1 |
| 4.7 | IP address | 1 |
| 4.8 | Rpi 3 - Testing the GPIO pins | 1 |
| 4.9 | Rpi 3 - Testing the GPIO pins through Scripts | 1 |
| **5.0** | **Processor Integration and IoT Platform** | |
| 5.1 | Raspberry pi- Interfacing with Sensor DHT11 | 1 |
| 5.2 | Raspberry pi Python Library Install | 1 |
| 5.3 | Cloud Platform basics | 1 |
| 5.4 | Cloud Platform for Integration to IOT Device | 1 |
| 5.5 | Actuator (LED) | 1 |
| 5.6 | Integration through Python | 1 |
| 5.7 | Raspberry Pi versions Comparison | 1 |
| 5.8 | LoRawan | 1 |
| 5.9 | LPWAN | 1 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC M06 | Industrial IoT and Industry 4.0 | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- Gain knowledge of key concepts of Industry 4.0
- Examine cutting-edge technologies for Industry 4.0
- Acquire skills to identify, assess, and mitigate cybersecurity risks
- Delve into the layers of Industrial IoT (IIoT) architecture
- Develop the ability to apply Industry 4.0 principles and technologies

## Pre-requisites

- Internet of Things

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Assess the impact of Industry 4.0 on traditional production systems and identify opportunities for improvement. | Understand |
| CO2 | Discuss the strategies for integrating Industry 4.0 technologies into existing production systems to enhance efficiency and productivity. | Understand |
| CO3 | Assess the effectiveness of cybersecurity measures in protecting critical infrastructure and minimizing potential disruptions. | Analyze |
| CO4 | Implement end-to-end IIoT solutions tailored to specific application domains, considering factors such as data security, latency, and scalability. | Analyze |
| CO5 | Identify key application domains of Industry 4.0 technologies, including the oil, chemical, pharmaceutical, and manufacturing industries. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| CO3 | 3 | 3 | 2 | 3 | 3 | 3 | - | 3 | 3 | - | - | 3 | - | - | - |
| CO4 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - |
| CO5 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | - | - | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 10 | 10 |
| Understand | 40 | 10 | 20 |
| Apply | - | 30 | 60 |
| Analyse | - | 10 | 10 |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC M06 - Industrial IoT and Industry 4.0 | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Industry 4.0 Essentials *** Sensing & Actuation, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories | [9] |
| **Industry 4.0 Evolution *** Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis | [9] |
| **Cybersecurity *** Cybersecurity in Industry 4.0, Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems, Industrial IoT: Business Model and Reference Architecture | [9] |
| **IIoT Layers *** IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking, Big Data Analytics and Software Defined Networks: IIoT Analytics - Machine Learning and Data Science | [9] |
| **Application Domains **** Oil, Chemical and Pharmaceutical Industry, Applications of UAVs in Industries, Milk Processing and Packaging Industries, Manufacturing Industries | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Misra S, Mukherjee A, and Roy A, “Introduction to IoT”, Cambridge University Press, 2021. |
| 2. | Misra S, Roy C, and Mukherjee A, “Introduction to Industrial Internet of Things and Industry 4.0”, CRC Press,2020. |
| 3. | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Cisco Press, 2017. |
| **Reference(s):** | |
| 1. | Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", 2021. |
| 2. | Alexander Manu, “Digital Transformation and Industry 4.0: A Guide for Executives and Decision Makers”, 2022. |

*SDG 9 – Industry Innovation and Infrastructure
**SDG 7 – Affordable and Clean Energy

**Assignment Activity**

**Assignment 1**- Explanatory questions in Industry 4.0 Essential, Evolution and cybersecurity.
**Assignment 2 -** Mini project on IIoT
**Assignment 3**- Case studies on Application Domains.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Industry 4.0 Essentials** | |
| 1.1 | Sensing & actuation | 1 |
| 1.2 | Industry 4.0: Globalization and Emerging Issues | 1 |
| 1.3 | Industry 4.0: Emerging Issues | 1 |
| 1.4 | The Fourth Revolution | 1 |
| 1.5 | LEAN Production Systems | 1 |
| 1.6 | LEAN Production Systems | 1 |
| 1.7 | Smart and Connected Business Perspective | 1 |
| 1.8 | Smart Factories | 1 |

Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 1.9 | Smart Factories | 1 |
| **2.0** | **Industry 4.0 Evolution** | |
| 2.1 | Cyber Physical Systems | 1 |
| 2.2 | Next Generation Sensors | 1 |
| 2.3 | Collaborative Platform | 1 |
| 2.4 | Product Lifecycle Management | 1 |
| 2.5 | Product Lifecycle Management | 1 |
| 2.6 | Augmented Reality and Virtual Reality | 1 |
| 2.7 | Artificial Intelligence | 1 |
| 2.8 | Big Data | 1 |
| 2.9 | Advanced Analysis | 1 |
| **3.0** | **Cybersecurity** | |
| 3.1 | Cybersecurity in Industry 4.0 – Manufacturing | 1 |
| 3.2 | Cybersecurity in Industry 4.0 – Shipping and Cargo | 1 |
| 3.3 | Cybersecurity in Industry 4.0 – Medical | 1 |
| 3.4 | Industrial Processes | 1 |
| 3.5 | Industrial Sensing & Actuation | 1 |
| 3.6 | Industrial Internet Systems | 1 |
| 3.7 | Industrial Internet Systems | 1 |
| 3.8 | Business Model | 1 |
| 3.9 | Reference Architecture | 1 |
| **4.0** | **IIoT Layers** | |
| 4.1 | IIoT Sensing | 1 |
| 4.2 | IIoT Processing | 1 |
| 4.3 | IIoT Communication | 1 |
| 4.4 | IIoT Networking | 1 |
| 4.5 | Big Data Analytics | 1 |
| 4.6 | Software Defined Networks | 1 |
| 4.7 | IIoT Analytics | 1 |
| 4.8 | Machine Learning | 1 |
| 4.9 | Data Science | 1 |
| **5.0** | **Application Domains** | |
| 5.1 | Oil Industries | 1 |
| 5.2 | Chemical industry | 1 |
| 5.3 | Pharmaceutical industry | 1 |
| 5.4 | Applications of UAVs in Industries | 1 |
| 5.5 | Milk Processing Industries | 1 |
| 5.6 | Packaging Industries | 1 |
| 5.7 | Manufacturing Industries | 1 |
| 5.8 | Smart Energy Management | 1 |
| 5.9 | Environmental Monitoring | 1 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/11/2023
Approved in Academic Council Meeting held on 23/12/2023

CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**

**(An Autonomous Institution affiliated to Anna University)**

B.E. / B.Tech. Degree Programme

**SCHEME OF EXAMINATIONS**

(For the candidates admitted in 2024-2025)

**SEVENTH SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1. | 60 HS 002 | Engineering Economics and Financial Accounting | 2 | 40 | 60 | 100 | 45 | 100 |
| 2. | 60 EC 701 | Antennas and Microwave Engineering | 2 | 40 | 60 | 100 | 45 | 100 |
| 3. | 60 EC 702 | Computer Networks | 2 | 40 | 60 | 100 | 45 | 100 |
| 4. | 60 EC E3* | Professional Elective III | 2 | 40 | 60 | 100 | 45 | 100 |
| 5. | 60 EC E4* | Professional Elective IV | 2 | 40 | 60 | 100 | 45 | 100 |
| 6. | 60 AC 001 | Research Skill Development | 1 | 100 | 00 | 100 | 00 | 100 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 7. | 60 AB 00* | NCC\NSS\NSO\ YRC\RRC\Yoga \Fine Arts | 2 | 50 | 50 | 100 | 45 | 100 |
| **PRACTICAL** | | | | | | | | |
| 8. | 60 EC 7P1 | RF Laboratory | 2 | 60 | 40 | 100 | 45 | 100 |
| 9. | 60 EC 7P2 | Networks Laboratory | 2 | 60 | 40 | 100 | 45 | 100 |
| 10. | 60 EC 7P3 | Project Work - Phase I | 2 | 100 | 00 | 100 | 00 | 100 |
| 11. | 60 CG 0P6 | Internship | - | 100 | - | 100 | - | 100 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination, 50 marks for theory cum practical End Semester Examination and 40 marks for practical End semester Examination.

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 HS 002 | Engineering Economics and Financial Accounting | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | HS | 3 | 0 | 0 | 3 |

## Objectives

- To know about the economic principles underlying demand, supply, and market structure
- To understand the concept related to types of business organization and types of banking
- To know about concepts in financial accounting and capital budgeting
- To understand the different methods of pricing and appraisal of projects
- To know the application of break-even analysis in engineering projects

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Summarize the basic concepts of economics, demand, supply, and market structure | Understand |
| CO2 | Interpret the forms of business organization and functions of commercial and central bank | Understand |
| CO3 | Examine the basis of financial accounting and capital budgeting techniques | Analyse |
| CO4 | Demonstrate the different types of pricing strategies and comprehensive project feasibility in diverse business | Apply |
| CO5 | Demonstrate the break even analysis in engineering projects and business | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | 2 | 3 | - | 3 | - | - | - | 3 | 2 | 3 | 3 | 3 |
| CO2 | - | - | - | - | - | 2 | 2 | - | - | - | 3 | 3 | - | 3 | - |
| CO3 | - | - | 2 | 3 | - | - | - | - | - | - | 3 | - | 2 | 2 | - |
| CO4 | 2 | - | - | 3 | - | 2 | - | - | - | - | - | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | - | - | 2 | 2 | - | - | 2 | 2 | 3 | 2 | 2 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 25 | 25 | 35 |
| Understand | 35 | 25 | 45 |
| Apply | - | 10 | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**Common to CIVIL, EEE, ECE, CSE, IT, AI&DS, CSE(AIML), EE (VLSI D&T), BT, FT**

**60 HS 002 - Engineering Economics and Financial Accounting**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Basic Economics**<br>Definition of Economics – Nature and Scope of Economics, Basic Concepts of Economics, Factors of Production - Definition of Demand – Law of Demand, Exception to Law of Demand, Factors Affecting Demand, Elasticity of Demand, Demand Forecasting – Definition of Supply – Factors Affecting Supply, Elasticity of Supply – Market Structure – Perfect Competition, Imperfect Competition – Monopoly, Duopoly, Oligopoly, and Bilateral Monopoly. | [9] |
| **Organization and Business Financing***<br>Forms of Business – Sole Proprietorship, Partnership, Joint Stock Company, Cooperative Organization, State Enterprise - Mixed Economy - Money and Banking – Kinds of Banking, Functions of Commercial Banks and Central Bank – Definition of Monetary Policy and its Types – Types of financing - Short Term Borrowing, Long Term Borrowing - Internal Generation of Funds – External Commercial Borrowings. | [9] |
| **Financial Accounting and Capital Budgeting**<br>The Balance Sheet and Related Concepts – The Profit and Loss Statement and Related Concepts – Financial Ratio Analysis – Definition of Working Capital – Types, Factors – Definition of Capital Budgeting - Techniques – Average Rate of Return, Payback Period, Net Present Value, Profitability Index Method and Internal Rate of Return. | [9] |
| **Cost Analysis**<br>Types of Costing – Traditional Costing Approach - Activity Based Costing - Fixed Cost – Variable Cost – Marginal Cost – Cost Output Relationship in the Short Run and in Long Run – Pricing Practice – Full Cost Pricing – Marginal Cost Pricing – Going Rate Pricing – Bid Pricing – Pricing for a Rate of Return – Project Appraisal - Appraisal process, - Cost Benefit Analysis – Feasibility Reports — Technical Feasibility, Economic Feasibility, Financial Feasibility, Managerial Feasibility, Operational Feasibility. | [9] |
| **Break Even Analysis**<br>Basic Assumptions –Break-Even Chart – Profit Zone in Break-Even Chart, Loss Zone in Break-Even Chart, Angle of Incidence – Managerial Uses of Break-Even Analysis, Applications of Break-Even Analysis in Engineering Projects. | [9] |
| **Total Hours:** | **45** |

| | |
|---|---|
| **Text Book(s):** | |
| 1. | Khan M.Y., Jain P.K., "Financial Management ", 8th Edition, McGraw Hill Education, 2018. |
| 2. | Maheshwari K.L., Varshney R.L., "Managerial Economics", 22nd Edition, S Chand and Co., New Delhi, 2018. |
| **Reference(s):** | |
| 1. | Samuelson P.A., "Economics – An Introductory", 16th Edition, New Age Publications, New Delhi, 2019. |
| 2. | Barthwal R.R., "Industrial Economics – An Introductory", 4th Edition, New Age Publications, New Delhi, 2021. |
| 3. | Bhattacharyya S. K., John Deardon, "Accounting for Management Text and Cases", 3rd Edition, S Chand Publication, 2018 |

*SDG 9 – Increase Industry Innovation and Infrastructure

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Basic Economics** | |
| 1.1 | Definition of economics – Nature and Scope of Economics | 1 |
| 1.2 | Basic Concepts of Economics, Factors of Production | 1 |
| 1.3 | Definition of Demand – Law of Demand | 1 |
| 1.4 | Exception to Law of Demand | 1 |
| 1.5 | Factors Affecting Demand, Elasticity of Demand | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 1.6 | Demand Forecasting | 1 |
| 1.7 | Definition of Supply – Factors Affecting Supply, Elasticity of Supply | 1 |
| 1.8 | Market Structure – Perfect Competition, Imperfect Competition | 1 |
| 1.9 | Monopoly, Duopoly, Oligopoly, and Bilateral Monopoly | 1 |
| **2.0** | **Organization and Business Financing** | |
| 2.1 | Forms of Business – Sole Proprietorship, Partnership | 1 |
| 2.2 | Joint Stock Company, Cooperative Organization, State Enterprise | 1 |
| 2.3 | Mixed Economy - Money and banking | 1 |
| 2.4 | Kinds of Banking | 1 |
| 2.5 | Functions of Commercial Banks and Central Bank | 1 |
| 2.6 | Definition of Monetary Policy and its Types | 1 |
| 2.7 | Types of Financing | 1 |
| 2.8 | Short Term Borrowing, Long Term Borrowing | 1 |
| 2.9 | Internal Generation of Funds, External Commercial Borrowings | 1 |
| **3.0** | **Financial Accounting and Capital Budgeting** | |
| 3.1 | The Balance Sheet and Related Concepts | 1 |
| 3.2 | The Profit and Loss Statement and Related Concepts | 1 |
| 3.3 | Financial Ratio Analysis | 2 |
| 3.4 | Definition of Working Capital – Types, Factors | 2 |
| 3.5 | Definition of Capital Budgeting - Techniques | 1 |
| 3.6 | Average Rate of Return, Payback Period | 1 |
| 3.7 | Net Present Value, Profitability Index Method and Internal Rate of Return | 1 |
| **4.0** | **Cost Analysis** | |
| 4.1 | Types of Costing - Traditional Costing Approach - Activity Based Costing | 1 |
| 4.2 | Fixed Cost – Variable Cost – Marginal Cost | 1 |
| 4.3 | Cost Output Relationship in the Short Run and in Long Run | 1 |
| 4.4 | Pricing Practice – Full Cost Pricing | 1 |
| 4.5 | Marginal Cost Pricing, Going Rate Pricing | 1 |
| 4.6 | Bid Pricing, Pricing for a Rate of Return | 1 |
| 4.7 | Project Appraisal - Appraisal Process - Cost Benefit Analysis | 1 |
| 4.8 | Feasibility Reports -–– Technical Feasibility, Economic Feasibility | 1 |
| 4.9 | Financial Feasibility, Managerial Feasibility, Operational Feasibility. | 1 |
| **5.0** | **Break Even Analysis** | |
| 5.1 | Basic Assumptions – Break-Even Chart | 2 |
| 5.2 | Profit Zone in Break-Even Chart, Loss Zone in Break-Even Chart | 2 |
| 5.3 | Angle of Incidence | 1 |
| 5.4 | Managerial Uses of Break-Even Analysis | 2 |
| 5.5 | Applications of Break-Even Analysis in Engineering Projects | 2 |

**Course Designer(s)**

**1.** Mr.V.S.Vijayachander - vijayachander@ksrct.ac.in
2. Dr.E.kalaivani - kalaivanie@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 701 | Antennas and Microwave Engineering | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objectives

- To learn radiation mechanism and fundamental parameters for antennas.
- To analyse the design concepts of linear and planer antenna arrays.
- To design and analyse various types of antenna and their performance characteristics.
- To study the microwave passive devices.
- To learn the functioning of microwave sources.

## Pre-requisites

- Electromagnetic Waves

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Interpret the radiation mechanism of wired antennas and calculate the fundamental parameters for antennas. | Apply |
| CO2 | Develop linear and planar antenna arrays and their radiation patterns. | Apply |
| CO3 | Design VHF, UHF, Microwave antennas and antenna beamforming techniques and Illustrate techniques for antenna measurement. | Apply |
| CO4 | Discuss the microwave passive devices such as isolator, circulator, Directional couplers etc. | Understand |
| CO5 | Illustrate the working of the high power and low power microwave devices. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | 2 | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | 2 | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | 2 | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | - | 2 | - | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | - | 2 | - | 3 | 3 | - | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 30 | 30 | 50 |
| Apply | 20 | 20 | 30 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 701 - Antennas and Microwave Engineering | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **EM Radiation and Antenna Parameter*** Radiation Mechanism - Single Wire, Two Wire and Current Distribution - Hertzian Dipole - Halfwave Dipole and Monopole - Radiation Pattern - Beamwidth - Field Regions - Radiation Power Density - Radiation Intensity - Directivity and Gain - Bandwidth - Polarization - Input Impedance - Efficiency - Antenna Effective Length and Area - Friis Transmission Equation. | [9] |
| **Linear and Planar Arrays*** Array of Two Point Sources - N-Element Linear Array - End Fire Array, Directivity, Radiation Pattern - Pattern Multiplication - Non-Uniform Excitation - Binomial Distribution - Arrays: Planar Array, Circular Array, Phased Array Antenna. | [9] |
| **VHF, UHF and Microwave Antennas*** Yagi-Uda Antenna - Aperture Antennas - Horn Antenna - Parabolic Reflector Antenna - Microstrip Antenna - Smart Antennas - Conformal Antennas - Antenna Beamforming Techniques. Antenna Measurements: Radiation Pattern, Gain and Directivity Measurement | [9] |
| **Microwave Passive components*** Microwave Networks - ABCD, 'S' Parameter and its Properties - E-Plane Tee, H-Plane Tee, Magic Tee and Multi-Hole Directional Coupler - Principle of Faraday Rotation, Isolator, Circulator and Phase Shifter. | [9] |
| **Microwave Sources*** Microwave Frequencies and Applications - Microwave Tubes: TWT, Klystron Amplifier, Reflex Klystron & Magnetron - Semiconductor Devices: Gunn Diode, Tunnel Diode, IMPATT Diode. | [9] |
| **Total Hours:** | **45** |
| **Text Book(s):** | |

| | |
|---|---|
| 1. | K.D.Prasad, "Antenna and Wave Propagation", Satya Prakasham, 2021. |
| 2. | Samuel Y.Liao, "Microwave Devices and Circuits", 3rd Edition, Prentice Hall of India, 2008. |
| **Reference(s):** | |
| 1. | John D. Kraus Ronald J.Marhefka, and Ahmed S.Khan, "Antennas and Wave Propagation", 5th Edition, McGraw-Hill, 2017. |
| 2. | Constantine A. Balanis, "Antenna Theory: Analysis and Design", 4th Edition, John Wiley & Sons, 2016. |
| 3. | David M.Pozar, "Microwave Engineering", 4th Edition, John Wiley & Sons, 2014. |
| 4. | Robert E.Collin, "Foundations for Microwave Engineering", 2nd Edition, Wiley, Reprint 2009. |

*SDG 9 – Industry Innovation and Infrastructure

**Assignment Activity:**

**Assignment 1:**

1. Group problem solving in antenna parameters and antenna arrays

**Assignment 2:**

1. Poster Presentation on various types of antennas and its applications.

**Assignment 3:**

1. Presentation on real life examples of Microwave devices and sources

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **EM Radiation and Antenna Parameter** | |
| 1.1 | Radiation Mechanism - Single wire, Two wire and Current distribution | 1 |
| 1.2 | Hertzian Dipole-Electric and Magnetic Field Components | 1 |
| 1.3 | Hertzian Dipole-Power Radiated | 1 |
| 1.4 | Halfwave Dipole and Monopole | 1 |
| 1.5 | Radiation Pattern, Beamwidth, Field Regions | 1 |
| 1.6 | Radiation Power Density, Radiation Intensity, Directivity and Gain | 1 |
| 1.7 | Bandwidth, Polarization, Input impedance | 1 |
| 1.8 | Efficiency, Antenna Effective Length and Area | 1 |
| 1.9 | Friis Transmission Equation | 1 |
| **2.0** | **Linear and Planar Arrays** | |
| 2.1 | Array of Two Point Sources- Case1 | 1 |
| 2.2 | Array of Two Point Sources- Case2 | 1 |
| 2.3 | N-Element Linear Array- End Fire Array | 1 |
| 2.4 | N-Element Linear Array- Directivity, Radiation Pattern | 1 |
| 2.5 | Pattern Multiplication | 1 |
| 2.6 | Non-Uniform Excitation - Binomial Distribution | 1 |
| 2.7 | Arrays: Planar Array, | 1 |
| 2.8 | Circular Array | 1 |
| 2.9 | Phased Array Antenna | 1 |
| **3.0** | **VHF, UHF and Microwave Antennas** | |
| 3.1 | Yagi-Uda Antenna | 1 |
| 3.2 | Aperture Antennas – Horn Antenna | 1 |
| 3.3 | Parabolic Reflector Antenna | 1 |
| 3.4 | Microstrip Antenna | 1 |
| 3.5 | Smart Antennas | 1 |
| 3.6 | Conformal Antennas | 1 |
| 3.7 | Antenna Beamforming Techniques | 1 |
| 3.8 | Antenna Measurements: Radiation Pattern | 1 |
| 3.9 | Gain and Directivity measurement | 1 |
| **4.0** | **Microwave Passive Components** | |
| 4.1 | ABCD Parameter | 1 |
| 4.2 | ‘S’ Parameter and Its Properties | 1 |
| 4.3 | E-Plane Tee | 1 |
| 4.4 | H-Plane Tee | 1 |
| 4.5 | Magic Tee | 1 |
| 4.6 | Multi-Hole Directional Coupler | 1 |
| 4.7 | Principle of Faraday Rotation | 1 |
| 4.8 | Isolator, Circulator | 1 |
| 4.9 | Phase Shifter | 1 |
| **5.0** | **Microwave Sources** | |
| 5.1 | Microwave Frequencies and Applications | 1 |
| 5.2 | TWT | 1 |
| 5.3 | Klystron Amplifier | 1 |
| 5.4 | Reflex Klystron | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.5 | Magnetron | 1 |
| 5.6 | Gunn diode | 1 |
| 5.7 | Tunnel diode | 1 |
| 5.8 | IMPATT Diode - Construction | 1 |
| 5.9 | IMPATT Diode - Power and Efficiency Measurement | 1 |

**Course Designer(s)**


1. Ms.C.Saraswathy - saraswathy@ksrct.ac.in
2. Mr.D.Poornakumar - poornakumard@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 702 | Computer Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objectives

- To get an understanding on the fundamentals of networks and concepts of OSI, TCP/IP reference model
- To learn the datalink layer functions.
- To understand routing in the network layer
- To explore methods of communication and congestion control by the transport layer and application layer protocols.
- To study the network security mechanisms

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the Network Models, layers and functions | Understand |
| CO2 | Deploy the error & flow control mechanisms and medium access control | Apply |
| CO3 | Classify the network with IP address and compare the routing protocols | Apply |
| CO4 | Describe the various transport layer and application layer protocols | Understand |
| CO5 | Apply the network security mechanisms. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 30 | 30 | 50 |
| Apply | 20 | 20 | 40 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC 702 - Computer Networks**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Data Communications and Networking**<br>Data Communications - Networks - Network Types - Protocol Layering - Networking Models: OSI Model, TCP/IP Protocol Suite, OSI Vs TCP/IP - Measurement of Network Performance - Connecting Devices - **Network Slicing principles and Software Defined Networking Architecture*.** | [9] |
| **Data Link Layer****<br>Nodes and Links, Services - Three Methods of Switching - Error Detection and Correction: CRC and Check Sum - Data Link Control: HDLC and PPP - Multiple Access Protocols - IEEE Standards: 802.3 and IEEE 802.11, Comparison of Wired and Wireless LAN -VLAN. | [9] |
| **Network Layer****<br>Network Layer Services - Packet Switching: Datagram and Virtual Circuit Approach - IPV4 - IPV6 - DHCP - ICMP - Unicast Routing Protocols: Distance Vector, Link State and Path Vector Routing. | [9] |
| **Transport Layer and Application Layer****<br>Transport Layer Services - UDP - TCP - Sliding Window Protocols - Congestion Control - Quality of Service - Application Layer Paradigms - Client - Server Programming - Domain Name System - World Wide Web and HTTP – FTP - Electronic Mail - SNMP. | [9] |
| **Network Security**<br>Network security Threats - Cryptography - Security in the Internet: IP Security, Firewalls and Virtual Private Network (VPN) - RTP - **Data Privacy: Protecting Sensitive Data, Uses Cases - Cyber Security: Cyber Crime and Information Security*.** | [9] |
| **Total Hours:** | **45** |

**Text Book(s):**

| | |
|---|---|
| 1. | Behrouz A Forouzan, "Data Communication and Networking", 6th Edition, Tata McGraw-Hill, New Delhi, 2022. |
| 2. | William Stallings, "Cryptography and Network Security", 7th Edition, Pearson Education, 2017. |

**Reference(s):**

| | |
|---|---|
| 1. | Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kauffmann Publishers Inc., 2012. |
| 2. | Nina Godbole, Sunit Belapure, "Cyber Security", Wiley India, New Delhi, 2012. |
| 3. | Nataraj Venkataramanan, Ashwin Shriram, "Data Privacy: Principles and Practice", CRC Press, 2016. |
| 4. | Ahsan Kazmi S.M, Latif U. Khan, Choong Seon Hong, Nguyen H. Tran, "Network Slicing for 5G and Beyond Networks", Springer International Publishing, 2020. |

*SDG 9 – Industry Innovation and Infrastructure

**SDG 4 – Quality Education

**Assignment Activity:**

**Assignment 1:**

1. Group problem solving in CRC
2. Poster Presentation on connecting devices
3. Prepare a case study on wireless LAN

**Assignment 2:**

1. Group problem solving in subnetting
2. Configure and implementation of router within a network using Packet Tracer

**Assignment 3:**

1. Presentation on Network Security

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Data Communications and Networking** | |
| 1.1 | Data Communications, Networks, Network Types | 1 |
| 1.2 | Protocol Layering | 1 |
| 1.3 | Networking Models: OSI Model | 1 |
| 1.4 | TCP/IP Protocol Suite | 1 |
| 1.5 | OSI Vs TCP/IP | 1 |
| 1.6 | Measurement of Network Performance | 1 |
| 1.7 | Connecting Devices | 1 |
| 1.8 | Network Slicing principles | 1 |
| 1.9 | Software Defined Networking Architecture | 1 |
| **2.0** | **Data Link Layer** | |
| 2.1 | Nodes and Links, Services and Three Methods of Switching | 1 |
| 2.2 | Error Detection and Correction: CRC | 1 |
| 2.3 | Check Sum | 1 |
| 2.4 | Data Link Control: HDLC | 1 |
| 2.5 | PPP | 1 |
| 2.6 | Multiple Access Protocols | 1 |
| 2.7 | IEEE Standards: 802.3 | 1 |
| 2.8 | IEEE 802.11, Comparison of Wired and Wireless LAN | 1 |
| 2.9 | VLAN | 1 |
| **3.0** | **Network Layer** | |
| 3.1 | Network Layer Services | 1 |
| 3.2 | Packet Switching: Datagram and Virtual Circuit Approach | 1 |
| 3.3 | IPV4 | 1 |
| 3.4 | IPV6 | 1 |
| 3.5 | DHCP | 1 |
| 3.6 | ICMP | 1 |
| 3.7 | Unicast Routing Protocols: Distance Vector Routing | 1 |
| 3.8 | Link State Routing | 1 |
| 3.9 | Path Vector Routing | 1 |
| **4.0** | **Transport Layer and Application Layer** | |
| 4.1 | Transport Layer Services | 1 |
| 4.2 | UDP and TCP | 1 |
| 4.3 | Sliding Window Protocols | 1 |
| 4.4 | Congestion Control and Quality of Service | 1 |
| 4.5 | Application Layer Paradigms and Client - Server Programming | 1 |
| 4.6 | Domain Name System | 1 |
| 4.7 | World Wide Web and HTTP | 1 |
| 4.8 | FTP - Electronic Mail | 1 |
| 4.9 | SNMP | 1 |
| **5.0** | **Network Security** | |
| 5.1 | Network security Threats and | 1 |
| 5.2 | Cryptography | 1 |
| 5.3 | Security in the Internet: IP Security | 1 |
| 5.4 | Firewalls | 1 |
| 5.5 | Virtual Private Network (VPN) | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.6 | RTP | 1 |
| 5.7 | Data Privacy: Protecting Sensitive Data | 1 |
| 5.8 | Uses Cases | 1 |
| 5.9 | Cyber Security: Cyber Crime and Information Security | 1 |

**Course Designer(s)**


1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Mrs.K.Vanitha - vanitha@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 AB 001 | National Cadet Corps (Air wing) | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | HS | 2 | 0 | 2 | 3 |

## Objectives

- To designed especially for NCC Cadets to educate basic military knowledge
- To develop character, camaraderie, discipline, secular outlook
- To inculcate spirit of adventure, sportsman spirit
- To teach selfless service amongst cadets by working in teams
- To learn military subjects including weapon training and motivate them to join in tri-services

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion | Remember |
| CO2 | Demonstrate the sense of discipline with smartness and have basic knowledge of weapons and their use and handling | Remember |
| CO3 | Illustrate various forces and moments acting on aircraft | Understand |
| CO4 | Outline the concepts of aircraft engine and rocket propulsion | Understand |
| CO5 | Design, build and fly chuck gliders/model airplanes and display static models | Create |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | - | - | - | - | 3 |
| CO2 | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | 3 |
| CO3 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 3 |
| CO4 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 3 |
| CO5 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 3 |

3 - Strong; 2 - Medium; 1 - Some

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Common to ALL Branches** | | | | | | | | |
| **60 AB 001 - National Cadet Corps (Air wing)** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **NCC Organisation and National Integration*** NCC Organization – History of NCC- NCC Organization – NCC Training – NCC Uniform – Promotion of NCC cadets – Aim and Advantages of NCC Training – NCC Badges of Rank – Honors" and Awards – Incentives for NCC Cadets by Central and State Govt. History and Organization of IAF – Indo-PakWar-1971 – Operation Safed Sagar .National Integration – Unity in diversity – Contribution of Youth in Nation Building-National Integration Council – Images and Slogans on National Integration. | [12] |
| **Drill and Weapon Training*** Basic Physical Training – Various Exercises for Fitness (with Demonstration) – Food – Hygiene and Cleanliness. Drill – Words of Commands- Position and Commands– Sizing and Forming – Saluting – Marching – Turning on the march and wheeling – Saluting on the march – Sidepace, Pace forward and to the rear – Marking time – Drill with arms – Ceremonial drill – Guard mounting.(WITH DEMONSTRATION) | [12] |
| **Principles of Flight*** Laws of Motion – Forces Acting on Aircraft - Bernoulli"s Theorem - Staling – Primary control surfaces - Secondary control surfaces – Aircraft recognition. | [12] |
| **Aero Engines*** Introduction of Aero Engine – Types of Engines – Piston Engine – Jet Engines –Turboprop Engines – Basic Flight Instruments – Modern trends. | [12] |
| **Aero Modeling*** History of Aero modelling – Materials used in Aeromodeling – Types of Aeromodels – Static Models – Gliders – Control line models – Radio Control Models-Building and Flying of Aeromodels. | [12] |
| **Total Hours: (Lecture - 30; Practical - 30):** | 60 |
| **Text Book(s):** | |

| | |
|---|---|
| 1. | "National Cadet Corps- A Concise hand book of NCC Cadets", Ramesh Publishing House, NewDelhi,2014. |
| **Reference(s):** | |
| 1. | "Cadets Handbook–Common Subjects SD/SW", published by DGNCC,New Delhi. |
| 2. | "Cadets Handbook-Specialized Subjects SD/SW", published by DGNCC,NewDelhi. |
| 3. | "NCCOTA Precise", published by DGNCC, NewDelhi. |

*SDG 4 – Quality Education

## Course Designer(s)

1. Flt Lt V.R.SADASIVAM- sadasivam@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 AB 002 | National Cadet Corps - ARMY WING | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | HS | 2 | 0 | 2 | 3 |

## Objectives

- Develop character, camaraderie
- Inculcate discipline, secular outlook
- Enrich the spirit of adventure, sportsman spirit
- Ideals of selfless service amongst cadets by working in teams
- Improve qualities such as self-discipline, self-confidence, self-reliance and dignity of labour in the cadets

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion. | Understand |
| CO2 | Demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders. | Apply |
| CO3 | Basic knowledge of weapons and their use and handling. | Understand |
| CO4 | Aware about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils | Analyse |
| CO5 | Acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | - | - | - | - | - | 1 | - | 3 | - | - | - | - | - | - | 3 |
| CO2 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | 3 |
| CO3 | - | - | - | - | - | 1 | - | 3 | - | - | - | - | - | - | 3 |
| CO4 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | 3 |
| CO5 | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K. S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Common to all Branches | | | | | | | | |
| 60 AB 002 – National Cadet Corps (Army Wing) | | | | | | | | |
| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **NCC Organization & National Integration*** NCC Organization – History of NCC - NCC Organization- NCC Training – NCC Uniform – Promotion of NCC cadets – Aim and Advantages of NCC Training- NCC Badges of Rank - Honors' and Awards – Incentives for NCC Cadets by Central and State Govt. National Integration - Unity in Diversity - Contribution of Youth in Nation Building - National Integration Council- Images and Slogans on National Integration | [12] |
| **Basic Physical Training & Drill*** Basic Physical Training – various Exercises for Fitness (with Demonstration) – Food – Hygiene and Cleanliness. Drill – Words of Commands - Position and Commands – Sizing and Forming – saluting – Marching- Turning on the March and Wheeling – Saluting on the March - Side Pace, Pace Forward and to the Rear – Marking time – Drill with arms- Ceremonial Drill - Guard Mounting. ( WITH DEMONSTRATION). | [16] |
| **Weapon Training*** Main Parts of a Rifle – Characteristics of .303 rifle - Characteristics of .22 Rifle – Loading and Unloading – Position and Holding Safety Precautions – Range Procedure- MPI and Elevation – Group and Snap Shooting – Long/Short Range Firing (WITH PRACTICE SESSION) – Characteristics of 5.56mm rifle - Characteristics of 7.62mm SLR- LMG- Carbine Machine Gun – Pistol. | [12] |
| **Social Awareness and Community Development*** Aims of Social Service – Various Means and Ways of Social Services – Family Planning – HIV and AIDS – Cancer its Causes and Preventive Measures - NGO and their Activities- Drug Trafficking- Rural Development Programmes – MGNREGA-SGSYJGSY-NSAP – PMGSY–Terrorism and Counter Terrorism – Corruption – Female Foeticide – Dowry – Child Abuse-RTI Act – RTE Act – Protection of Children from Sexual Offences Act – Civic Sense and Responsibility | [12] |
| **Specialized Subject (ARMY)*** Basic Structure of Armed Forces - Military History – War Heroes - Battles of Indo-Pak war – ParamVir Chakra – Career in the Defence Forces – Service Tests and Interviews. | [08] |
| **Total Hours: (Lecture - 30; Practical - 30):** | **60** |
| **Text Book(s):** | |
| **1.** National Cadet Corps- A Concise handbook of NCC Cadets by Ramesh Publishing House, New Delhi, 2014. | |
| **2.** Cadets Handbook- Specialized Subjects SD/SW published by DG NCC, New Delhi, 2014. | |
| **Reference(s):** | |
| 1. "Cadets Handbook – Common Subjects SD/SW" by DG NCC, New Delhi, 2019. | |
| 2. "Cadets Handbook – Specialised Subjects SD/SW" by DG NCC, New Delhi, 2017. | |

* SDG 4 - Quality Education

**Course Contents and Lecture Schedule**

| S.No. | Topic | No. of Hours |
|---|---|---|
| **1** | **NCC Organization & National Integration** | |
| 1.1 | NCC Organization | 1 |
| 1.2 | History of NCC and NCC Organization | 1 |
| 1.3 | NCC Training and NCC Uniform | 1 |
| 1.4 | Promotion of NCC cadet, Aim and advantages of NCC Training | 1 |
| 1.5 | NCC badges of Rank, Honors' and Awards, Incentives for NCC cadets by central and state govt | 2 |
| 1.6 | National Integration, Unity in diversity | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 1.7 | Contribution of youth in nation building | 2 |
| 1.8 | National integration council | 1 |
| 1.9 | Images and Slogans on National Integration | 2 |
| **2** | **Basic Physical Training & Drill** | |
| 2.1 | Basic physical Training – various exercises for fitness (with Demonstration)- | 3 |
| 2.2 | Food – Hygiene and Cleanliness. | 1 |
| 2.3 | Drill- Words of commands- position and commands- sizing and forming- | 3 |
| 2.4 | saluting- marching- turning on the march and wheeling- | 3 |
| 2.5 | saluting on the march- side pace, pace forward and to the rear- marking time- | 3 |
| 2.6 | Drill with arms- ceremonial drill- guard mounting. (WITH DEMONSTRATION) | 3 |
| **3** | **Weapon Training Main Parts of a Rifle** | |
| 3.1 | Characteristics of 0.303 rifle | 1 |
| 3.2 | Characteristics of 0.22 rifle | 2 |
| 3.3 | Loading and unloading, position and holding safety precautions | 2 |
| 3.4 | Range procedure, MPI and Elevation- | 2 |
| 3.5 | Group and Snap shooting Long/Short range firing (WITH PRACTICE SESSION) | 3 |
| 3.6 | Characteristics of 5.56mm rifle | 1 |
| 3.7 | Characteristics of 7.62mm | 1 |
| **4** | **Social Awareness and Community Development** | |
| 4.1 | Aims of Social service, Various Means and ways of social services | 1 |
| 4.2 | Family planning, HIV and AIDS | 1 |
| 4.3 | Cancer its causes and preventive measures | 1 |
| 4.4 | NGO and their activities, Drug trafficking | 1 |
| 4.5 | Rural development programmes | 1 |
| 4.6 | MGNREGA, SGSY, JGSY, NSAP, PMGSY | 2 |
| 4.7 | Terrorism and counter terrorism, Corruption | 1 |
| 4.8 | female foeticide, dowry, child abuse | 1 |
| 4.9 | RTI Act, RTE Act | 1 |
| 4.10 | Protection of children from sexual offences act | 1 |
| 4.11 | Civic sense and responsibility | 1 |
| **5** | **Specialized Subject (ARMY)** | |
| 5.1 | Basic structure of Armed Forces | 1 |
| 5.2 | Military History, War heroes | 1 |
| 5.4 | battles of Indo - Pak war | 1 |
| 5.3 | Param Vir Chakra, | 1 |
| 5.5 | Career in the Defence forces | 2 |
| 5.6 | Service tests and interviews. | 2 |

**Course Designer(s)**

1. Mr.E.Chandra Kumar - chandrakumar@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 AC 001 | Research Skill Development | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | AC | 1 | 0 | 0 | 0 |

## Objectives

- To identify research problems, formulate hypotheses, collect data and test hypotheses
- To prepare and submit quality manuscripts and understand peer review process
- To utilize software tools for effective manuscript preparation and visualization of research data
- To familiarize different journal metrics and author-level quality indicators
- To protect creative works, inventions, and branding elements using IPR

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Develop structured scientific approach to plan and execute research work | Apply |
| CO2 | Comply with the journal requirements to publish research findings effectively | Understand |
| CO3 | Apply various software tools during the manuscript preparation | Apply |
| CO4 | Select suitable journals to publish the work using different publication metrics | Analyse |
| CO5 | Apply the appropriate form of IP protection to a specific invention or creation | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 2 | 2 | 2 | 2 | - | 2 | 2 | 3 | 3 | 3 | - | 3 | 3 | - | 2 |
| CO2 | - | - | - | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | - | 2 |
| CO3 | - | - | - | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | - | 2 |
| CO4 | - | - | - | - | - | - | - | 3 | 3 | - | - | 3 | 3 | - | 2 |
| CO5 | - | - | 2 | 2 | - | - | - | 3 | 3 | 3 | - | 3 | 3 | - | 2 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

One review at end of the semester

| Parameters | Weightage (Marks) |
|---|---|
| Research Problem Identification (Research gap, SDG, Objectives) | 10 |
| Literature Review preparation (Clarity, Number and quality of sources) | 20 |
| Patent Draft/ Manuscript Preparation (Structure, Content) | 20 |
| Use of software tools (Plagiarism, Reference Management, etc.,) | 10 |
| Journal Identification (Aim & scope of the journal, journal metrics) | 10 |
| Presentation & Viva voce | 30 |
| **Total** | **100** |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **60 AC 001 – Research Skill Development** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 1 | 0 | 0 | 15 | 0 | 100 | - | 100 |

| | |
|---|---|
| **Research - Scientific Approach*** <br> Types of Research - Identification and Clarification of The Problem - Formulating Hypothesis, Selection of Sample and Tools of Data Collection - Testing the Hypothesis - Conclusion | [3] |
| **Manuscript Preparation*** <br> Structure of a Manuscript - Types of Manuscript - Graphical Abstract - Highlights - Literature Review - Citation - Reference Style - Plagiarism – Journal Selection - Peer Review Process | [3] |
| **Research Toolkit*** <br> Software Tools for Writing Enhancement - Literature Review - Reference Management - Data Analysis and Visualization - Drawing - Plagiarism | [3] |
| **Research Publication Metrics*** <br> Journal Index: Scopus - Web of Science - SCI - UGC Care - Q Journal; Journal Metrics: Impact Factor, Cite Score; Quality Indicators: H-Index - i-10 Index - Citations | [3] |
| **Intellectual Property Rights*** <br> Patents - Industrial Designs - Copyright - Trademarks - Geographical Indications - Trade Secrets | [3] |
| **Total Hours:** | **15** |

**Reference(s):**


| | |
|---|---|
| 1. | Kothari, C.R. and Gaurav Garg, “Research Methodology: Methods and Techniques”, New Age International Publishers, 2023 |
| 2. | Chawla H S., “Introduction to Intellectual Property Rights”, CBS Publishers and Distributors Private Limited, 2019 |


*SDG 9 – Industry Innovation and Infrastructure

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

## Course Contents and Lecture Schedule

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Research - Scientific Approach** | |
| 1.1 | Types of Research - Identification and Clarification of The Problem - Formulating Hypothesis | 2 |
| 1.2 | Selection of Sample and Tools of Data Collection - Testing the Hypothesis - Conclusion | 1 |
| **2** | **Manuscript Preparation** | |
| 2.1 | Structure of a Manuscript - Types of Manuscript - Graphical Abstract - Highlights | 1 |
| 2.2 | Literature Review | 1 |
| 2.3 | Citation - Reference Style – Plagiarism, Journal Selection - Peer Review Process | 1 |
| **3** | **Research Toolkit** | |
| 3.1 | Software Tools for Writing Enhancement | 1 |
| 3.2 | Literature Review, Reference Management | 1 |
| 3.3 | Data Analysis and Visualization – Drawing, Plagiarism | 1 |
| **4** | **Research Publication Metrics** | |
| 4.1 | Journal Index: Scopus - Web of Science - SCI - UGC Care - Q Journal; | 1 |
| 4.2 | Journal Metrics: Impact Factor, Cite Score | 1 |
| 4.3 | Quality Indicators: h-index - i-10 index - Citations | 1 |
| **5** | **Intellectual Property Rights** | |
| 5.1 | Patents | 1 |
| 5.2 | Industrial Designs - Copyright | 1 |
| 5.3 | Trademarks - Geographical Indications - Trade Secrets | 1 |

## Course Designer

1. Dr.M.Kathirselvam - mkathirselvam@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 7P1 | RF Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 2 | 1 |

## Objectives

- To demonstrate the performance of array antennas and Yagi-Uda antenna.
- To analyse the radiation pattern of horn antenna and microwave antennas.
- To analyse the performance of antenna beamforming techniques.
- To study the basic parameters of microwave devices.
- To identify the characteristics of microwave devices.

## Pre-requisites

- Electromagnetic Waves

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Analyse the performance of array antennas and Yagi-Uda antenna | Apply |
| CO2 | Analyse the radiation pattern of horn antenna and design the microstrip antenna. | Apply |
| CO3 | Implement the antenna beamforming techniques. | Apply |
| CO4 | Measure VSWR and Impedance for the microwave passive components | Apply |
| CO5 | Interpret the characteristics of microwave sources. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | 2 | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | - | 2 | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | 2 | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | 2 | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | 2 | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) |
|---|---|---|---|---|
| | Lab | Activity | | |
| Remember | - | - | - | - |
| Understand | 25 | - | 50 | 50 |
| Apply | 25 | 25 | 50 | 50 |
| Analyse | - | - | - | - |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |
| Total | 50 | 25 | 100 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 7P1 - RF Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 0 | 0 | 2 | 30 | 1 | 60 | 40 | 100 |

**List of Experiments*:**

1. Performance analysis of array antennas
2. Measurement of antenna radiation pattern of Yagi-Uda antenna.
3. Performance analysis of horn antenna.
4. Design of microstrip antenna.
5. Performance analysis of antenna beamforming techniques.
6. Frequency and wavelength measurement
7. Measurement of S-parameters, coupling factor, directivity, insertion loss and isolation of a directional coupler using X-band waveguide test bench set up.
8. VSWR and impedance measurement.
9. Study of the characteristics of a reflex klystron oscillator.
10. Study of Gunn-oscillator characteristics using X-band waveguide test bench.

**Lab Manual**

| | |
|---|---|
| 1. | "RF Laboratory Manual", Department of Electronics and Communication Engineering, KSRCT. |

*SDG 9 – Industry Innovation and Infrastructure

**Course Designer(s)**

1. Ms.C.Saraswathy – saraswathy@ksrct.ac.in
2. Mr.D.Poornakumar-poornakumard@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 7P2 | Networks Laboratory | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 2 | 1 |

## Objectives

- To demonstrate the functioning of network topology and error detection and error correction techniques
- To study the performance of routing protocols
- To apply the sliding window protocols
- To analyse the performance of wired and wireless networks
- To develop an application based on cryptography

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Implement and realize the network topology | Apply |
| CO2 | Implement the data link layer protocols | Apply |
| CO3 | Implement the routing mechanisms and analyse the performance of wired/ wireless networks | Apply |
| CO4 | Implement sliding window protocols | Apply |
| CO5 | Develop an application based on cryptographic algorithms | Analyse |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Lab Experiments Assessment (Marks) | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|
| | Lab | Activity | | | |
| Remember | - | - | - | - | - |
| Understand | - | - | - | - | - |
| Apply | 50 | 25 | 70 | - | 70 |
| Analyse | - | - | 30 | - | 30 |
| Evaluate | - | - | - | - | - |
| Create | - | - | - | - | - |
| Total | 50 | 25 | 100 | - | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 7P2 - Networks Laboratory | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 0 | 0 | 2 | 30 | 1 | 60 | 40 | 100 |

**List of Experiments:**

1. Implement the Data Link Layer framing methods - Bit stuffing/Character stuffing*
2. Implementation of Error Detection / Correction Techniques – LRC/CRC/Hamming code*
3. Implementation of Stop and Wait Protocol/Go back-N/Selective Repeat Protocols*
4. Implementation of IP addressing scheme for finding the class of an IP address*
5. Application based on cryptographic algorithms*
6. Implement and realize the Network Topology – Star/Bus/Ring
7. Implementation of Distance Vector Routing algorithm*
8. Implementation of Link State Routing algorithm*
9. Apply various application tools using RIP/OSPF and analyse the performance of wired/wireless network using Qualnet**
10. Configuration of FTP using CISCO Packet Tracer**

The following tools can be used – C, NS2, Qualnet, CISCO Packet Tracer

*SDG 9 – Industry Innovation and Infrastructure

**SDG 4 – Quality Education

**Course Designer(s)**


1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Mrs.K.Vanitha - vanitha@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 7P3 | Project Work - Phase I | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 4 | 2 |

## Objectives

- To help the students apply their academic knowledge and technical skills in a specific domain
- To facilitate the students to identify, formulate and solve engineering problems
- To help the students design a system, component or process to meet the desired needs within realistic constraints
- To work and communicate efficiently in multidisciplinary terms
- To develop an understanding of professional and ethical responsibility in students

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Identify engineering problems in their domain of interest and carry out literature review in the chosen technical area | Understand |
| CO2 | Analyse and identify an appropriate technique to solve the problem. | Analyse |
| CO3 | Design engineering solution, do experimentation / simulation / programming / fabrication/ collect and interpret data utilizing a systems approach | Analyse |
| CO4 | Communicate effectively in oral and written forms | Apply |
| CO5 | Demonstrate the knowledge, skills and attitudes of a professional engineer as an individual and member of a team | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

**(Internal Assessment: 100 Marks)**

| Review I (R1) | | | Review II (R2) | | Review III (R3) | | | Total (R1+R2+ R3) | Internal |
|---|---|---|---|---|---|---|---|---|---|
| Literature Survey | Topic Identification & Justification | Work Plan | Approach | Conclusion | Demo-Existing System | Presentation | Report | Total | |
| 10 | 10 | 10 | 20 | 20 | 10 | 10 | 10 | 100 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 7P3 - Project Work - Phase I | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 0 | 0 | 4 | 60 | 2 | 100 | 00 | 100 |

1 A committee is constituted with the project coordinator, project guide and HOD/Senior professor in the department
2 Three reviews have to be conducted by the committee
3 Problem should be selected by every batch of students
4 Students must do a literature survey collecting a minimum of 1 survey paper and 2 technical papers related to their work
5 Report has to be prepared by the students as per the format
6 Preliminary implementation can be done if possible Internal evaluation has to be done based on the three reviews for 100 marks *

*SDG 4 – Quality Education

**Course Designer(s)**


1. Dr.C.Rajasekaran - rajasekaran@ksrct.ac.in
2. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**

**(An Autonomous Institution affiliated to Anna University)**

B.E. / B.Tech. Degree Programme

**SCHEME OF EXAMINATIONS**

(For the candidates admitted in 2024-2025)

**EIGHTH SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1. | 60 EC E5* | Professional Elective V | 2 | 40 | 60 | 100 | 45 | 100 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| **PRACTICAL** | | | | | | | | |
| 2. | 60 EC 8P1 | Project Work - Phase II | 3 | 60 | 40 | 100 | 45 | 100 |
| 3. | 60 CG 0P6 | Internship | - | 100 | - | 100 | - | 100 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** End semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for theory End Semester Examination and 40 marks for project End semester Examination.

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC 8P1 | Project Work - Phase II | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 16 | 8 |

## Objectives

- To help the students apply their academic knowledge and technical skills in a specific domain
- Foster collaborative learning skills
- Habituated to critical thinking and use problem solving skills
- Develop self-directed inquiry and life-long skills
- To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Identify engineering problems in their domain of interest and carry out literature review in the chosen technical area | Understand |
| CO2 | Analyse and identify an appropriate technique to solve the problem. | Analyse |
| CO3 | Design engineering solution, do experimentation / simulation / programming / fabrication/ collect and interpret data utilizing a systems approach | Analyse |
| CO4 | Communicate effectively in oral and written forms | Apply |
| CO5 | Demonstrate the knowledge, skills and attitudes of a professional engineer as an individual and member of a team | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

**(Internal Assessment: 60 Marks + End Semester Examination: 40 Marks)**

| Internal Assessment (60) | | | | | End Semester (40) |
|---|---|---|---|---|---|
| Items | Review 1 | Review 2 | Review 3 | Publication* | |
| Marks | 5 | 10 | 15 | 30 | 40 |
| | Total internal marks 60 | | | | |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC 8P1 - Project Work - Phase II | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hrs** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VIII | 0 | 0 | 16 | 240 | 8 | 60 | 40 | 100 |

1. A committee is constituted with the project coordinator, project guide and HOD/Senior professor in the department.
2. Three reviews have to be conducted by the committee
3. Each review has to be evaluated for 100 marks.
4. Attendance is compulsory for all reviews. If a student fails to attend review for some valid reason, one or more chance may be given.
5. A senior professor from other departments may be included in the committee for final review.
6. The report should be submitted as per the format by the students.

*SDG 4 – Quality Education

**Course Designer(s)**


1. Dr.C.Rajasekaran - rajasekaran@ksrct.ac.in
2. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E31 | Medical Imaging Systems | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To study the ultrasound and photo acoustic imaging principles and methodologies used in medical imaging.
- To observe the functioning of X ray computed tomography for image scanning.
- To comprehend the principles of MRI in image acquisition and reconstruction.
- To study radio isotopic imaging equipment and safety measures.
- To study the imaging modalities in infrared and radiation safety.

## Pre-requisites

- Digital Image Processing

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the production, capture and applications of ultrasound in medicine. | Understand |
| CO2 | Illustrate the principles and reconstruction techniques of X ray in image scanning. | Understand |
| CO3 | Describe the MRI principles, acquisition and reconstruction in medical applications. | Apply |
| CO4 | Discuss the techniques involved in radiation therapy and principles involved in application of radiation in medical field. | Understand |
| CO5 | Demonstrate the concept of infrared and radio isotopic imaging in medical imaging systems. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 40 |
| Understand | 40 | 30 | 50 |
| Apply | - | 10 | 10 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E – Electronics and Communication Engineering | | | | | | | | |
| 60 EC E31- Medical Imaging Systems | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Ultrasound & Photo acoustic imaging *** <br> **Ultrasound Imaging:** Production of Ultrasound - Pulse Echo Imaging - Principles of A-mode, B-mode and M-mode Display - Steering and Focusing. <br> **Photo acoustic imaging:** principles - Case Study on Photo Acoustic Imaging in Oncology - Imaging procedure. <br> **Hands - on:** Develop a software based model to fit and map the moving image to the fixed image obtained from different imaging modalities | [9] |
| **X-Ray Computed Tomography *** <br> CT instrumentation: CT Generations and CT Detectors - Image Formation Principles - Image Reconstruction Techniques: Parallel Ray and Fan Beam - Noise Quality in CT Images: Measurement Statistics, Image Statistics, Image SNR. <br> **Hands - on:** Develop a software based model for removing noise from CT images. | [9] |
| **Magnetic Resonance Imaging *** <br> Principles - Image Acquisition: Encoding Spatial Position, Principle of Slice Selection - Reconstruction Techniques: Rectilinear and Polar Data - Image Quality in MRI Images: Sampling, Resolution, Noise, SNR, Artifacts. <br> **Hands - on:** Develop a software based model to load a stack of MRI images and view the same as volume slice-by-slice and as a 3D representation. | [9] |
| **Radiation Therapy and Radiation Safety *** <br> Radiation Therapy - Linear Accelerator - Tele Gamma Machine - Recent Techniques in Radiation Therapy - IGRT and Cyber Knife - Radiation Measuring Instruments: Thermo Luminescent Dosimeters & Electronic Dosimeter - Radiation Protection in Medicine - Radiation Protection Principles. <br> **Hands - on:** Develop a software based model for 3D dose calculation, comparing dose distributions, reconstructing treatment plans and their summations. | [9] |
| **Infra Red & Radio Isotopic Imaging*** <br> I**nfra Red Imaging:** Physics of Thermography - Infrared Detectors - Thermographic Equipment - Pyro Electric Vidicon Camera - Thermal Camera Based on IR Sensor. <br> **Radio Isotopic Imaging:** SPECT & PET Image Formation - Iterative Reconstruction. <br> **Hands - on:** Create a multi modeling image with use of CT and PET images. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Jerry L.Prince and Jonathan M.Links, “Medical Imaging Signals and Systems”, Pearson Education Inc. 2014. |
| 2. | Divyendu Sinha & Edward R.Dougherty, “Introduction to Computer Based Imaging Systems”, PHI, 2003. |
| **Reference(s):** | |
| 1. | Jacob Beutel (Editor), M. Sonka (Editor), “Handbook of Medical Imaging”, Volume 2. Medical Image Processing and Analysis, SPIE Press, 2019. |
| 2. | Khin Wee Lai, Dyah Ekashanti Octorina Dewi, “Medical Imaging Technology”, Springer Singapore, 2015. |
| 3. | Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata Mc Graw Hill, 2003. |
| 4. | William R. Hendee, “Medical Imaging Physics”, 4th Edition, A John Wiley & Sons, inc., Publication, 2002. |

*SDG 3 – Good Health and Well Being

**Assignment Activity:**

**Assignment 1:**

1. Case study on Photo Acoustic Imaging in Oncology.
2. Hands on noise removal in X ray and Ultrasound images.

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment 2:**

1. Poster presentation on Recent Techniques in Radiation Therapy.
2. Problems on frequency encoding & slice selection in MRI images.

**Assignment 3:**

1. Case studies on applications of MRI images in various medical fields.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Ultrasound & Photo acoustic imaging** | |
| 1.1 | Production of Ultrasound | 1 |
| 1.2 | Pulse Echo Imaging | 1 |
| 1.3 | Principles of A-mode | 1 |
| 1.4 | Principles of B-mode | 1 |
| 1.5 | Principles of M-mode | 1 |
| 1.6 | Transmit Steering and Focusing | 1 |
| 1.7 | Beam Forming and Dynamic Focusing | 1 |
| 1.8 | Case Study on Photo Acoustic Imaging in Oncology | 1 |
| **2.0** | Imaging Procedure | |
| 2.1 | **X-Ray Computed Tomography** | |
| 2.2 | CT Instrumentation | 1 |
| 2.3 | CT Generations | 1 |
| 2.4 | CT Detectors | 1 |
| 2.5 | Image Formation Principles: Line Integrals | 1 |
| 2.6 | CT Numbers | 1 |
| 2.7 | Image Reconstruction Techniques :Parallel Ray | 1 |
| 2.8 | Image Reconstruction Techniques : Fan Beam | 1 |
| 2.9 | Noise Quality in CT images: Measurement Statistics | 1 |
| **3.0** | Image Statistics, Image SNR. | |
| 3.1 | **Magnetic Resonance Imaging** | |
| 3.2 | Principles of MRI Pulse Sequence | 1 |
| 3.3 | Image Acquisition: Encoding Spatial Position | 1 |
| 3.4 | Principle of Slice Selection | 1 |
| 3.5 | Reconstruction Techniques: Rectilinear Data | 1 |
| 3.6 | Polar Data | 1 |
| 3.7 | Image Quality in MRI Images: Sampling | 1 |
| 3.8 | Resolution | 1 |
| **4.0** | Noise | |
| 4.1 | SNR, Artifacts | 1 |
| 4.2 | **Radiation Therapy And Radiation Safety** | |
| 4.3 | Radiation Therapy | 1 |
| 4.4 | Linear Accelerator | 1 |
| 4.5 | Tele Gamma Machine | 1 |
| 4.6 | Recent Techniques in Radiation Therapy | 1 |
| 4.7 | IGRT and Cyber Knife | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.8 | Radiation Measuring Instruments: Thermo Luminescent Dosimeters | 1 |
| 4.9 | Electronic Dosimeter | 1 |
| **5.0** | Radiation Protection in Medicine | |
| 5.1 | Radiation Protection Principles | 1 |
| 5.2 | **Infra Red & Radio Isotopic Imaging*** | |
| 5.3 | Physics of Thermography | 1 |
| 5.4 | Infrared Detectors | 1 |
| 5.5 | Thermographic Equipment | 1 |

**Course Designer(s)**


1. Dr. K.B.Jayanthi -jayanthikb@ksrct.ac.in
2. Mrs.K.Gogila Devi - gogiladevi@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E32 | Wireless Broadband Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To familiarize High Speed Networks
- To learn different wireless LAN network technologies and its application
- To study the various protocols in broadband networks
- To learn the basics of 5G and Beyond Wireless communication
- To understand about the layer level functionalities in interconnecting networks

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the concept of ISDN and frame relay in high speed networks. | Understand |
| CO2 | Describe the architecture of high-speed WLAN technologies. | Understand |
| CO3 | Illustrate the concepts of various protocols in wireless networks. | Understand |
| CO4 | Explore the current generation (5G and beyond) network architecture. | Understand |
| CO5 | Explain the interconnecting network functionalities by layer level functions. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 20 |
| Understand | 50 | 50 | 80 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | |
|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | |
| 60 EC E32 – Wireless Broadband Networks | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **High Speed Networks**<br>ISDN: Conceptual View - Standards - Transmission Structure - B-ISDN Standards and Services, Protocol Architecture - Frame Relay Networks, Call Control - LAPF - Frame Relay Congestion Control - Asynchronous Transfer Mode - ATM Protocol Architecture, ATM Logical Connection, ATM Cell - ATM Service Categories – AAL. | [9] |
| **Wireless Broadband***<br>Local Broad Band and Ad hoc Networks - Different Versions of IEEE 802.11 Standard, Protocol Architecture of WLAN - WLAN Technologies: Applications, Requirements - Hiper LAN: WATM, BRAN, HiperLAN2 - WiMAX Technology Protocol and Application of Technology - 6LoWPAN, Wireless HART. | [9] |
| **Wireless Protocols**<br>Mobile Network Layer - Fundamentals of Mobile IP, Data Forwarding Procedures in Mobile IP, IP Mobility Management - Mobile Transport Layer - TCP Congestion Control, Slow Start, Fast Recovery / Fast Retransmission, Classical TCP improvements - Indirect TCP, snooping TCP, Mobile TCP - Congestion Control in ATM, Mobile Ad-Hoc Network: Routing: Destination Sequence Distance Vector, IoT: CoAP. | [9] |
| **5G and Beyond***<br>5G Roadmap - 5G Architecture - IoT and Context Awareness - Networking Reconfiguration and Virtualization Support - Mobility QoS Control - Emerging Approach for Resource Over Provisioning, Small Cells for 5G Mobile Networks - Capacity Limits and Achievable Gains with Densification - Mobile Data Demand, Demand Vs Capacity, and 5G Future Directions with AI - 6G Key Enablers. | [9] |
| **Layer-Level Function and QoS**<br>Characteristics of Wireless Channels - Downlink Physical Layer, Uplink Physical Layer, MAC Scheme - Frame Structure, Resource Structure, Mapping, Synchronization, Reference Signals and Channel Estimation, Interference Cancellation - Comp, Carrier Aggregation, Services - Multimedia Broadcast/Multicast, Location-Based Services. QoS Issues in Broadband Communication - A Case Study of Broadband Service Regulations for Maintaining QoS by Telecom Regulatory Bodies Such as TRAI. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Vannithamby R and Talwar S, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, West Sussex, 2017. |
| 2. | Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015. |
| **Reference(s):** | |
| 1. | Sassan Ahmadi, "LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies", Elsevier, 2014. |
| 2. | William Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM', 4th Edition, PHI, 2004. |
| 3. | Vaei M, Ding Z, and Poor H.V, "Multiple Access techniques for 5G Wireless Networks and Beyond", Springer Nature, Switzerland, 2019. |
| 4. | Erik Dahlman, Stefan Parkvall, Johan Sko¨ld, "5G NR: The Next Generation Wireless Access Technology", 1st Edition, Elsevier, 2016. |

*SDG 9 - Sustainable industrialization and foster innovation

**Assignment Activity:**

**Assignment 1:**

1. Prepare a case study on wireless LAN
2. Poster Presentation on ATM

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment 2:**

1. Group discussion in wireless protocols

**Assignment 3:**

1. Video presentation on 5G

**Course Contents and Lecture Schedule**

| S.No. | Topic | No. of Hours |
|---|---|---|
| **1** | **High Speed Networks** | |
| 1.1 | ISDN: Conceptual View – Standards – Transmission Structure | 1 |
| 1.2 | B-ISDN Standards and Services, Protocol Architecture | 1 |
| 1.3 | Frame Relay Networks | 1 |
| 1.4 | Call Control – LAPF | 1 |
| 1.5 | Frame Relay Congestion Control | 1 |
| 1.6 | Asynchronous Transfer Mode | 1 |
| 1.7 | ATM Protocol Architecture | 1 |
| 1.8 | ATM Logical Connection, ATM Cell | 1 |
| 1.9 | ATM Service Categories – AAL | 1 |
| **2** | **Wireless Broadband** | |
| 2.1 | Local Broad Band and Ad hoc Networks | 1 |
| 2.2 | Different Versions of IEEE 802.11 Standard | 1 |
| 2.3 | Protocol Architecture of WLAN | 1 |
| 2.4 | WLAN Technologies: Applications, Requirements | 1 |
| 2.5 | Hiper LAN: WATM, BRAN | 1 |
| 2.6 | WiMAX Technology Protocol | 1 |
| 2.7 | WiMAX Application of Technology | 1 |
| 2.8 | 6LoWPAN | 1 |
| 2.9 | Wireless HART | 1 |
| **3** | **Wireless Protocols** | |
| 3.1 | Mobile Network Layer- Fundamentals of Mobile IP | 1 |
| 3.2 | Data Forwarding Procedures in Mobile IP | 1 |
| 3.3 | IPv6 | 1 |
| 3.4 | IP Mobility Management, IP Addressing | 1 |
| 3.5 | DHCP, Mobile Transport Layer | 1 |
| 3.6 | TCP Congestion Control, Slow Start, Fast Recovery/Fast Retransmission | 1 |
| 3.7 | Classical TCP Improvements-Indirect TCP, Snooping TCP | 1 |
| 3.8 | Mobile TCP. Mobile ad-hoc Network | 1 |
| 3.9 | Routing: Destination Sequence Distance Vector, IoT: CoAP | 1 |
| **4** | **5G and Beyond** | |
| 4.1 | 5G Roadmap – 5G Architecture | 1 |
| 4.2 | IoT and Context Awareness - Networking Reconfiguration and Virtualization Support | 1 |
| 4.3 | Mobility QoS control – Emerging Approach for Resource Over Provisioning | 1 |
| 4.4 | Small Cells for 5G Mobile Networks | 1 |
| 4.5 | Capacity Limits and Achievable Gains with Densification | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.6 | Mobile Data Demand | 1 |
| 4.7 | Demand Vs Capacity | 1 |
| 4.8 | Small Cell Challenges | 1 |
| 4.9 | 5G Future Directions with AI | 1 |
| **5** | **Layer-Level Function and QoS** | |
| 5.1 | Characteristics of Wireless Channels - Downlink Physical Layer | 1 |
| 5.2 | Uplink Physical Layer, MAC Scheme - Frame Structure | 1 |
| 5.3 | Resource Structure, Mapping | 1 |
| 5.4 | Synchronization | 1 |
| 5.5 | Reference Signals and Channel Estimation | 1 |
| 5.6 | CoMP, Carrier Aggregation | 1 |
| 5.7 | Services - Multimedia Broadcast/Multicast | 1 |
| 5.8 | Location-Based Services | 1 |
| 5.9 | QoS | 1 |

## Course Designers

1. Ms.R.Ramya – rramya@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E33 | Satellite Communication | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To learn the basic orbital mechanism in satellite communication
- To study the uplink/downlink link design
- To learn about the basic earth and space segments
- To study about the basic satellite access techniques
- To learn about the broadcast and their services

## Pre-requisites

- Digital Communication

## Course Outcomes

On the Successful Completion of the Course, Students will be able to

| | | |
|---|---|---|
| CO1 | Recognize the different orbital constellation mechanism in satellite communication. | Understand |
| CO2 | Build the uplink and downlink design in satellite communication. | Apply |
| CO3 | Construct the elements of earth and space segments. | Apply |
| CO4 | Summarize the basic CDMA, TDMA and FDMA access techniques | Understand |
| CO5 | Discuss the benefits of satellite broadcast and their services | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 2 | 2 | - | 2 | 3 | 2 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 2 | 2 | - | 2 | 3 | 2 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 2 | 2 | - | 2 | 3 | 2 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 2 | 2 | - | 2 | 3 | 2 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 2 | 2 | - | 2 | 3 | 2 | - | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 34 |
| Understand | 20 | 20 | 32 |
| Apply | 20 | 20 | 34 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DCE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E – Electronics and Communication Engineering | | | | | | | | |
| 60 EC E33 – Satellite Communication | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Satellite Orbit**<br>Satellite Orbits: Kepler's Laws - Earth Satellite Orbiting Satellite Terms - Orbital Elements - Orbital Perturbations - Inclined Orbits - Sun Synchronous Orbit - Constellation: Geo Stationary Satellites - NonGeostationary Constellation - Launching of Geostationary Satellites - Chandrayan - 3. | [9] |
| **Link Design**<br>EIRP - Transmission Losses - Power Budget Equation - System Noise Carrier to Noise Ratio - Uplink - Downlink - Effects of Rain - Inter Modulation Noise. | [9] |
| **Space and Earth Segment**<br>Space Segment: Power Supply - Altitude Control - Station Keeping - Thermal Control - TT& C Subsystems - Antenna Subsystem - Transponders - Wideband Receiver - Earth segment: Receive only Home TV System - Community Antenna TV system. | [9] |
| **Satellite Access**<br>Single Access - Pre assigned FDMA - Demand assigned FDMA - Spade System - TWT Amplifier Operation - Downlink Analysis - TDMA - Reference Bursts - Preamble - Postamble - Carrier Recovery - Network Synchronization - Preassigned TDMA assigned - CDMA. | [9] |
| **Broadcast and Services**<br>Broadcast: DBS - Orbital Spacings - Power Ratings - Frequency and Polarization - Transponder Capacity - Bit Rate - MPEG - Forward Error Correction - ODU - IDU - Downlink Analysis - Uplink - Satellite Mobile Services: VSAT - GPS. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Timothy Pratt, Charles Bostian & Jeremy Allmuti, "Satellite Communications", 3rd Edition, John Willy & Sons (Asia) Pvt. Ltd, 2019. |
| 2. | Dennis Roddy, "Satellite Communication", 4th Edition, McGraw Hill Publications, 2006. |
| **Reference(s):** | |
| 1. | M.Richharia, "Satellite Communication Systems (Design Principles)", 2nd Edition, Macmillan Press Ltd., 2017. |
| 2. | Agarwal D.C, "Satellite Communication", 5th Edition, Khanna Publications, Mc.Graw Hill, 2008. |
| 3. | Raja Rao K.N, "Fundamentals of Satellite Communications", PHI, 2004. |
| 4. | Wilbur L. Pritchars Henri G. SuyderHond Robert A.Nelson, "Satellite Communication Systems Engineering", 2nd Edition, Pearson Education Ltd., 2003. |

*SDG 3 – Good Health and Well Being
**SDG 7 – Affordable and Clean Energy

**Assignment Activity:**

**Assignment 1:**

1. Poster Presentation: Orbital Elements & Effects of Rain
2. Group Problem Solving: Power Budget Equation & Constellation: Geo Stationary Satellites
3. Case Studies: Chandrayan-3 & Latest launching Satellites

**Assignment 2:**

1. Poster Presentation: Transponders & TWT
2. Group Problem Solving: FDMA & TDMA

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment 3:**

1. Seminar Presentation: Thermal Control & Network Synchronization
2. Case Studies: Community Antenna TV system

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Satellite Orbit** | |
| 1.1 | Satellite Orbits: Kepler's laws | 1 |
| 1.2 | Earth Satellite Orbiting Satellite Terms | 1 |
| 1.3 | Orbital Elements | 1 |
| 1.4 | Orbital Perturbations | 1 |
| 1.5 | Inclined Orbits | 1 |
| 1.6 | Sun Synchronous Orbit | 1 |
| 1.7 | Constellation: Geo Stationary Satellites | 1 |
| 1.8 | Non Geostationary Constellation | 1 |
| 1.9 | Launching of Geostationary Satellites. | 1 |
| **2.0** | **Link Design** | |
| 2.1 | EIRP | 1 |
| 2.2 | Transmission Losses | 1 |
| 2.3 | Power Budget equation | 1 |
| 2.4 | System Noise Carrier to Noise | 1 |
| 2.5 | Uplink | 1 |
| 2.6 | Downlink | 1 |
| 2.7 | Effects of Rain | 1 |
| 2.8 | Inter Modulation Noise | 2 |
| **3.0** | **Space and Earth Segment** | |
| 3.1 | Space Segment: Power Supply | 1 |
| 3.2 | Altitude control- Station keeping | 1 |
| 3.3 | Thermal Control | 1 |
| 3.4 | TT& C Subsystems | 1 |
| 3.5 | Antenna Subsystem | 1 |
| 3.6 | Transponders | 1 |
| 3.7 | Wideband Receiver | 1 |
| 3.8 | Earth Segment: Receive only Home TV System | 1 |
| 3.9 | Community Antenna TV System | 1 |
| **4.0** | **Satellite Access** | |
| 4.1 | Single Access - Pre assigned FDMA | 1 |
| 4.2 | Demand Assigned FDMA | 1 |
| 4.3 | SPADE System | 1 |
| 4.4 | TWT Amplifier Operation Downlink Analysis | 1 |
| 4.5 | TDMA | 1 |
| 4.6 | Reference Bursts-Preamble | 1 |
| 4.7 | Postamble - Carrier Recovery | 1 |
| 4.8 | Network Synchronization Pre assigned TDMA assigned | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.9 | CDMA | 1 |
| **5.0** | **Broadcast and Services** | |
| 5.1 | Broadcast: DBS | 1 |
| 5.2 | Orbital Spacings- Power Ratings | 1 |
| 5.3 | Frequency and Polarization | 1 |
| 5.4 | Bit Rate | 1 |
| 5.5 | MPEG | 1 |
| 5.6 | Forward Error Correction | 1 |
| 5.7 | ODU, IDU | 1 |
| 5.8 | Downlink Analysis- Uplink | 1 |
| 5.9 | Satellite Mobile Services: VSAT, GPS | 1 |

**Course Designer(s)**


1. Dr P Babu- pbabu@ksrct.ac.in
2. Mr P Balamurugan - pbalamurugan@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E34 | 5G Communication Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To learn the evolution of wireless networks
- To understand the concepts of 5G networks
- To study the basics of network slicing and edge computing
- To understand the concepts of MM-wave communication
- To understand the security in 5G networks

## Pre-requisites

- Mobile communication and Networks

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Illustrate the principles of 2G,3G,4G and 5G networks | Remember |
| CO2 | Explain the 5G concepts and challenges | Understand |
| CO3 | Describe about network slicing and edge computing | Understand |
| CO4 | Apply the concepts of mm-wave communication | Apply |
| CO5 | Apply the security concepts in 5G networks | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 30 | 20 | 30 |
| Understand | 30 | 20 | 50 |
| Apply | - | 20 | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **B.E - Electronics and Communication Engineering** | | | | | | | |
| **60 EC E34 - 5G Communication Networks** | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Evolution of Wireless Networks*** <br> Networks Evolution: 2G, 3G, 4G, Evolution of Radio Access Networks, Need for 5G, 4G versus 5G, Next Generation Core (NG-core), Visualized Evolved Packet Core (vEPC) <br> **Hands - on:** Multiband OFDM Demodulation | [9] |
| **5G Concepts and Challenges**** <br> Fundamentals of 5G Technologies, Overview of 5G Core Network Architecture, New Radio and Cloud Technologies, Radio Access Technologies (RATs), EPC for 5G, Front haul and Backhaul in 5G. <br> **Hands - on:** Modelling of 5G Synchronization Signal Blocks and Bursts | [9] |
| **Network Slicing and Edge computing** **, <br> Network Slicing Architecture, Multi Access Edge Computing (MEC), Visualization of 5G Components, End-to-end System Architecture, Service Continuity, Relation to EPC and Edge Computing. <br> **Hands - on:** Perfect Channel Estimation | [9] |
| **Dynamic Spectrum Management and Mm-Waves** <br> Mobility Management, Command and Control, Spectrum Sharing and Spectrum Trading, Cognitive Radio based on 5G, Millimetre Waves, **Carrier Aggression****. <br> **Hands - on:** 5G-Compliant Waveform Generation and Testing | [9] |
| **Security in 5G Networks**** <br> Security Features in 5G networks, Network Domain security, User Domain Security, Flow Based QoS Framework, Mitigating the Threats in 5G. <br> **Hands - on:** Demonstration of Cryptographic Algorithms in 5G Applications | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Stephen Rommer, “5G Core Networks: Powering Digitalization”, 1st Edition, Academic Press, 2019. |
| 2. | Saro Velrajan, “An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases”, 1st Edition, Notion Press, 2020. |
| **Reference(s):** | |
| 1. | Afif osseiran, Jose .F. Monserrat, Patrick marsch, “5G Mobile and Wireless Communications Technology “, 1st Edition, Cambridge university, 2016. |
| 2. | Saad Z. Asif, “5G Mobile Communications Concepts and Technologies”, 1st Edition, CRC Press, 2019. |
| 3. | Guy Pujolle, “Software Networks: Virtualization, SDN, 5G and Security”, 2nd Edition, John Wiley & Sons, 2015. |
| 4. | Dr. William Stallings, “5G Wireless A Comprehensive Introduction”, Addison-wesley, 2021. |
| 5. | Ulrich Trick, “An Introduction to the 5th Generation Mobile Networks”, Walter de Gruyter, 2021. |

*SDG 9 – Industry Innovation and Infrastructure

**SDG 4 – Quality Education

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment Activity**

**Assignment 1:**

1. Chartwork and presentation on electromagnetic spectrum
2. Flipped class on 1G to 5G communication**.**

**Assignment 2:**

1. Case study on Millimetre waves

**Assignment 3:**

1. Flipped class on types of cryptography

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Evolution of Wireless Networks** | |
| 1.1 | Networks Evolution: 2G, 3G | 1 |
| 1.2 | Networks Evolution:4G | 1 |
| 1.3 | Evolution of Radio Access Networks | 1 |
| 1.4 | Need for 5G | 1 |
| 1.5 | 4G versus 5G | 1 |
| 1.6 | Next Generation Core (NG-core) | 1 |
| 1.7 | NG-core | 1 |
| 1.8 | EPC | 1 |
| 1.9 | Visualized Evolved Packet core (vEPC) | 1 |
| **2.0** | **5G Concepts and Challenges** | |
| 2.1 | Fundamentals of 5G Technologies | 1 |
| 2.2 | Features of 5G Technologies | 1 |
| 2.3 | Overview of 5G Core Network Architecture | 1 |
| 2.4 | 5G Core Network Architecture | 1 |
| 2.5 | New Radio | 1 |
| 2.6 | Cloud Technologies | 1 |
| 2.7 | Radio Access Technologies (RATs) | 1 |
| 2.8 | EPC for 5G | 1 |
| 2.9 | Fronthaul and Backhaul in 5G | 1 |
| **3.0** | **Network Slicing and Edge computing** | |
| 3.1 | Network Slicing Architecture | 1 |
| 3.2 | Network Slicing Architecture-Functions | 1 |
| 3.3 | Multi Access Edge Computing (MEC) | 1 |
| 3.4 | Visualization of 5G Components | 1 |
| 3.5 | End-to-end System Architecture | 1 |
| 3.6 | Service Continuity | 1 |
| 3.7 | Relation to EPC and Edge Computing | 1 |
| 3.8 | 5G protocols: 5G NAS, NGAP | 1 |
| 3.9 | GTP-U, IPSec and GRE | 1 |
| **4.0** | **Dynamic Spectrum Management and Mm-Waves** | |
| 4.1 | Mobility Management | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.2 | Command and Control | 1 |
| 4.3 | Spectrum Sharing | 1 |
| 4.4 | Spectrum Trading | 1 |
| 4.5 | Cognitive Radio Based on 5G | 1 |
| 4.6 | Cognitive Radio Based on 5G-Functions | 1 |
| 4.7 | Millimetre Waves | 1 |
| 4.8 | Carrier Aggression | 1 |
| 4.9 | Carrier Aggression-Functions | 1 |
| **5.0** | **Security in 5G Networks** | |
| 5.1 | Security Features in 5G networks | 1 |
| 5.2 | Security Features in 5G networks | 1 |
| 5.3 | Network Domain Security | 1 |
| 5.4 | Network Domain Security | 1 |
| 5.5 | User Domain Security | 1 |
| 5.6 | Flow Based QoS Framework | 1 |
| 5.7 | Flow Based QoS Framework | 1 |
| 5.8 | Mitigating the Threats in 5G | 1 |
| 5.9 | Mitigating the Threats in 5G | 1 |

**Course Designer(s)**

1. Mr.R.Satheesh kumar - satheeshkumar@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E35 | Artificial Intelligence | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

## Objectives

- To learn the concepts of the agents and environments in AI.
- To study the fundamentals of problem-solving.
- To explore the knowledge and reasoning in propositional logic and first-order logic.
- To understand the uncertain knowledge in solving AI problems.
- To discuss the different forms of learning.

## Pre-requisites

- Machine Learning Techniques

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the agents and environments in AI. | Understand |
| CO2 | Explain the concepts of intelligent agents and problem-solving aspects. | Apply |
| CO3 | Apply the knowledge of propositional logic and first order logic. | Apply |
| CO4 | Solve the uncertainty and probabilistic reasoning. | Apply |
| CO5 | Develop the types of learning methods and AI applications. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO4 | 3 | 2 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | - | 15 | - | - | 30 | - |
| Understand | 40 | 20 | 30 | 10 | 10 | 50 | 10 |
| Apply | - | 80 | 15 | 90 | 90 | 20 | 90 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E35 - Artificial Intelligence | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Agents and Environments in AI**<br>The Ethics and Risks of Developing Artificial Intelligence, AI: The Present and Future, Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents. | [6] |
| **Search Algorithms**<br>Solving Problems by Searching: Problem-Solving Agents, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Adversarial Search: Optimal Decisions in Game. | [6] |
| **Knowledge and Reasoning**<br>Logical Agents: Knowledge-based Agents, The Wumpus World, Agents based on Propositional Logic. First-Order Logic: Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic. | [6] |
| **Uncertain Knowledge and Reasoning**<br>Quantifying Uncertainty: Acting Under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Bayes' Rule and Its Use, Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Inference in Temporal Models, Hidden Markov Models. | [6] |
| **Learning and Applications***<br>Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Ensemble Learning, A Logical Formulation of Learning, Statistical Learning - Applications of Artificial Intelligence | [6] |
| **Practical:**<br>1. Simulate intelligent agents and analyze their behavior.<br>2. Simulate uninformed and informed search strategies.<br>3. Simulate the local search algorithms.<br>4. Simulate the behavior of local search algorithms and analyze its performance.<br>5. Write a program to generate the output for A* algorithm.<br>6. Write a program to show the tic tac toe game for 0 and X.<br>7. Simulate the various bayesian parameters<br>8. Simulate hidden markov models.<br>9. Simulate supervised learning for the selected problems-based regression.<br>10. Simulate supervised learning for the selected problems-based classification.<br>**Tools used: MATLAB / Open Source** | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |

| | |
|---|---|
| **Text Book(s):** | |
| 1. | Ethem Alpaydin, "Introduction to Machine Learning", 4th Edition, MIT Press, 2020. |
| 2. | Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2017. |
| **Reference(s):** | |
| 1. | Peter Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012. |
| 2. | Murphy K.P, "Machine Learning: A probabilistic perspective", MIT Press, 2012. |
| 3. | Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2014. |
| 4. | Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, 2014. |

*SDG 9 - Sustainable industrialization and foster innovation

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Agents and Environments in AI** | |
| 1.1 | The Ethics and Risks of Developing Artificial Intelligence | 1 |
| 1.2 | AI: The Present and Future, Intelligent Agents | 1 |
| 1.3 | Agents and Environments | 1 |
| 1.4 | Good Behaviour: The Concept of Rationality | 1 |
| 1.5 | The Nature of Environments | 1 |
| 1.6 | The Structure of Agents | 1 |
| **2** | **Search Algorithms** | |
| 2.1 | Solving Problems by Searching: Problem-Solving Agents | 1 |
| 2.2 | Uninformed Search Strategies, Informed (Heuristic) Search Strategies | 1 |
| 2.3 | Beyond Classical Search: Local Search Algorithms | 1 |
| 2.4 | Optimization Problems | 1 |
| 2.5 | Local Search in Continuous Spaces | 1 |
| 2.6 | Adversarial Search: Optimal Decisions in Game | 1 |
| **3** | **Knowledge, Reasoning** | |
| 3.1 | Logical Agents: Knowledge-Based Agents | 1 |
| 3.2 | The Wumpus World | 1 |
| 3.3 | Agents Based on Propositional Logic | 1 |
| 3.4 | First-Order Logic: Syntax and Semantics of First-Order Logic | 1 |
| 3.5 | Using First-Order Logic | 1 |
| 3.6 | Knowledge Engineering in First-Order Logic. | 1 |
| **4** | **Uncertain Knowledge and Reasoning** | |
| 4.1 | Quantifying Uncertainty: Acting Under Uncertainty | 1 |
| 4.2 | Basic Probability Notation, Inference Using Full Joint Distributions | 1 |
| 4.3 | Bayes' Rule and Its Use. Probabilistic Reasoning | 1 |
| 4.4 | Representing Knowledge in an Uncertain Domain, | 1 |
| 4.5 | The Semantics of Bayesian Networks, Inference in Temporal Models | 1 |
| 4.6 | Hidden Markov Models | 1 |
| **5** | **Learning and Applications** | |
| 5.1 | Forms of Learning, Supervised Learning | 1 |
| 5.2 | Learning Decision Trees, Evaluating and Choosing the Best Hypothesis | 1 |
| 5.3 | Regression and Classification with Linear Models | 1 |
| 5.4 | Artificial Neural Networks, Nonparametric Models | 1 |
| 5.5 | Ensemble Learning, A Logical Formulation of Learning | 1 |
| 5.6 | Statistical Learning - Applications of Artificial Intelligence | 1 |
| **Practical:** | | |
| 1. | Implement intelligent agents and analyze their behavior. | 2 |
| 2. | Implement uninformed and informed search strategies. | 2 |
| 3. | Simulate the local search algorithms. | 2 |
| 4. | Analyze the performance and behavior of local search algorithms. | 2 |
| 5. | Write a program to generate the output for A* algorithm. | 2 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 6. | Write a program to show the Tic Tac Toe game for 0 and X. | 4 |
| 7. | Simulate the various bayesian parameters. | 4 |
| 8. | Implementation of hidden markov models. | 4 |
| 9. | Simulate supervised learning for the selected problems-based regression. | 4 |
| 10. | Simulate supervised learning for the selected problems-based classification. | 4 |

**Course Designer(s)**


1. Dr. K.B.Jayanthi -jayanthikb@ksrct.ac.in
2. Ms.R.Ramya - rramya@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DCE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E36 | Ad hoc and Sensor Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To analyse the various design issues and challenges in the layered architecture of Ad hoc wireless networks
- To teach the students about various MAC and Routing protocols of Ad hoc and WSN.
- To compute the power consumption and Euclidean distance of a sensor network
- To identify appropriate layer protocols with the suitable routing algorithm
- To educate the students on introduction and application of LoWPAN

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Identify the necessity of Ad hoc and sensor networks | Understand |
| CO2 | Describe the operation of the routing and localization | Understand |
| CO3 | Compute the power consumption and Euclidean distance of a sensor network | Apply |
| CO4 | Identify appropriate layer protocols with the suitable routing algorithm based on the network and user requirement | Apply |
| CO5 | Illustrate the LoWPAN architecture with different protocols | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 2 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | 2 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 10 | 20 |
| Understand | 40 | 30 | 40 |
| Apply | - | 20 | 40 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K. S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E – Electronics and Communication Engineering | | | | | | | | |
| 60 EC E36 – Ad hoc and Sensor Networks | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Ad hoc Networks**<br>Characteristic - Features - Need for Ubiquitous Computing Network - Applications of Ad hoc, Mobility Models: Brownian Model - Column model - Random Walk Model - Random Waypoint model - Random Gauss Markov. | [9] |
| **Routing Protocols***<br>Need for Different routing Protocols - Proactive Vs Reactive Routing. Unicasting: Dynamic Source Routing - Ad hoc On-Demand Distance Vector Routing - Temporally Ordered Routing Algorithm - Signal Stability Based Routing - Associativity Based Routing - Zone Routing Protocol. | [9] |
| **Wireless Sensor Networks***<br>Challenges for Wireless Sensor Networks - Characteristics Requirements - Required mechanisms - Difference between Mobile Ad hoc and Sensor networks, Applications of Sensor Networks – Single - Node Architecture - Hardware Components - Energy Consumption of Sensor Nodes | [9] |
| **Networking of Sensors***<br>Physical Layer and Transceiver Design Considerations - MAC Protocols for Wireless Sensor Networks. The Mediation Device Protocol - Wakeup Radio Concepts - Address and Name Management - Assignment of MAC Addresses - Routing Protocols - Energy-Efficient Routing, Geographic Routing. | [9] |
| **LoWPAN**<br>Architecture, Protocol stack - Link layers - Addressing - Header format - Bootstrapping - Mesh topologies - Internet integration - Routing - Mesh-Under - Route-Over – ROLL, Common Protocols –WSP, MQTTS, CAP. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | C. Siva Ram Murthy, and B. S. Manoj, “Ad hoc Wireless Networks: Architectures and Protocols”, Prentice Hall Professional Technical Reference, 2008. |
| 2. | Tracy Camp, Jeff Boleng, Vanessa Davies, "A survey on Mobility Models for Ad hoc Network Research Wireless Communications and Mobile Computing", Special Issue on Mobile Ad hoc Networking: Research, Trends and Applications, Vol.2. No. 5. pp.483 502,2002. |
| **Reference(s):** | |
| 1 | Carlos De Morais Cordeiro, Dharma Prakash Agrawal, “Ad hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2006. |
| 2 | Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks, An Information Processing Approach", Elsevier, 2016. |
| 3 | Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley,2007. |
| 4 | Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks - Technology, Protocols, and Applications”, John Wiley, 2015. |
| 5 | Hongmei Deng, Wei Li and Dharma P. Agrawal, “Routing security in Wireless Ad hoc Networks”, IEEE Communication Magazine, 2002. |

*SDG 4 - Quality Education

**Assignment Activity**

**Assignment 1:**

1. Applications on Ad hoc network models - Video Presentation

**Assignment 2:**

1. Poster Presentation on Routing Protocol

**Assignment 3:**

1. Group Activity on Wireless Sensor Network

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S.No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Ad hoc Networks** | |
| 1.1 | Characteristic | 1 |
| 1.2 | Features | 1 |
| 1.3 | Need for Ubiquitous Computing Network | 1 |
| 1.4 | Applications of Ad hoc | 1 |
| 1.5 | Brownian Model | 1 |
| 1.6 | Column Model | 1 |
| 1.7 | Random Walk Model | 1 |
| 1.8 | Random Waypoint Model | 1 |
| 1.9 | Random Gauss Markov Model | 1 |
| **2.0** | **Routing Protocols** | |
| 2.1 | Need for Different Routing Protocols | 1 |
| 2.2 | Proactive Routing | 1 |
| 2.3 | Reactive Routing | 1 |
| 2.4 | Unicasting: Dynamic Source Routing | 1 |
| 2.5 | Ad hoc On-Demand Distance Vector Routing | 1 |
| 2.6 | Temporally Ordered Routing Algorithm | 1 |
| 2.7 | Signal Stability Based Routing | 1 |
| 2.8 | Associativity Based Routing | 1 |
| 2.9 | Zone Routing Protocol | 1 |
| **3.0** | **Wireless Sensor Networks** | |
| 3.1 | Challenges for Wireless Sensor Networks | 1 |
| 3.2 | Characteristics | 1 |
| 3.3 | Requirements | 1 |
| 3.4 | Required Mechanisms | 1 |
| 3.5 | Difference Between Mobile Ad hoc and Sensor Networks | 1 |
| 3.6 | Applications of Sensor Networks | 1 |
| 3.7 | Single-Node Architecture | 1 |
| 3.8 | Hardware Components | 1 |
| 3.9 | Energy Consumption of Sensor Nodes | 1 |
| **4.0** | **Networking of Sensors** | |
| 4.1 | Physical Layer and Transceiver Design Considerations | 1 |
| 4.2 | MAC Protocols for Wireless Sensor Networks | 1 |
| 4.3 | The Mediation Device Protocol | 1 |
| 4.4 | Wakeup Radio Concepts | 1 |
| 4.5 | Address and Name Management | 1 |
| 4.6 | Assignment of MAC Addresses | 1 |
| 4.7 | Routing Protocols | 1 |
| 4.8 | Energy-Efficient Routing | 1 |
| 4.9 | Geographic Routing. | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| **5.0** | **LoWPAN** | |
| 5.1 | Architecture, Protocol Stack, Link Layers, | 1 |
| 5.2 | Addressing - Header Format | 1 |
| 5.3 | Bootstrapping | 1 |
| 5.4 | Mesh Topologies | 1 |
| 5.5 | Internet Integration | 1 |
| 5.6 | Routing - Mesh-Under -Route-Over –Roll | 1 |
| 5.7 | Common Protocols – WSP | 1 |
| 5.8 | MQTTS, CAP | 1 |
| 5.9 | CAP | 1 |

**Course Designer(s)**

1. Mr S Jayamani - jayamani@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E37 | Fundamentals of Nanoelectronics | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To make students know the basic concept of nanoelectronics.
- To have knowledge about the quantum electronic devices.
- To understand the concepts of Nano electronic transistors, Semiconductor nanowire and memory cell.
- To understand the concepts of Nano electronic tunneling devices and superconducting devices
- To have knowledge about the Nanotubes and Nanostructure Devices.

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the basics of nano electronics including quantum wires, dots and wells | Understand |
| CO2 | Use the mechanism behind quantum electronic devices. | Understand |
| CO3 | Understand the basics of Nano Electronic Transistors | Understand |
| CO4 | Analyze the key performance aspects of tunneling and superconducting nano electronic devices | Analyze |
| CO5 | Apply the knowledge in the development of nanotubes and nanostructure devices | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO2 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO3 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO4 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO5 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 10 | 10 |
| Understand | 40 | 10 | 20 |
| Apply | - | 30 | 60 |
| Analyze | - | 10 | 10 |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E37 - Fundamentals of Nanoelectronics | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Fundamentals of Nano Electronics**<br>Scaling to nano - Light as a wave and particle- Electrons as waves and particles- Origin of quantum mechanics - General postulates of quantum mechanics - Time independent Schrodinger wave equation - Electron confinement - Quantum dots, wires and well -Spin and angular momentum. | [9] |
| **Quantum Electronics***<br>Quantum electronic devices - Short channel MOS transistor - Split gate transistor - Electron wave transistor - Electron wave transistor - Electron spin transistor - Quantum cellular automata - Quantum dot array, Quantum memory. | [9] |
| **Nano Electronic Transistors**<br>Coulomb blockade - Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions - Single electron transistors, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics - Memory cell. | [9] |
| **Nano Electronic Tunneling and Super Conducting Devices***<br>Tunnel effect -Tunneling element -Tunneling diode - Resonant tunneling diode - Three terminal resonant tunneling devices - Superconducting switching devices - Cryotron-Josephson tunneling device. | [9] |
| **Nanotubes and Nanostructure Devices***<br>Carbon Nanotube - Fullerenes - Types of nanotubes - Formation of nanotubes - Assemblies - Purification of carbon nanotubes - Electronic properties - Synthesis of carbon nanotubes - Carbon nanotube interconnects - Carbon nanotube FETs and SETs - Nanotube for memory applications - Nano structures and nano structured devices. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | George W.Hanson, “Fundamentals of Nanoelectronics”, 1st Edition, Pearson Education, 2009. |
| 2. | Jan Dienstuhl, Karl Goser, and Peter Glösekötter, “Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices”, Springer-Verlag, 2004. |
| **Reference(s):** | |
| 1. | Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, “Nanoelectronics: Materials, Devices, Applications”, Wiley, 2017. |
| 2. | Brajesh Kumar Kaushik, “Nanoelectronics: Devices, Circuits and Systems”, Elsevier science, 2018. |

* SDG 9 - Industry, Innovation and Infrastructure

**Assignment Activity:**

**Assignment 1:** Explanatory questions in Fundamentals of Nano Electronics & Quantum Electronics.

**Assignment 2:** Seminar presentation

**Assignment 3:** Explanatory questions in Module 5.

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1** | **Fundamentals of Nano Electronics** | |
| 1.1 | Scaling to nano | 1 |
| 1.2 | Light as a wave and particle | 1 |
| 1.3 | Electrons as waves and particles | 1 |
| 1.4 | origin of quantum mechanics | 1 |
| 1.5 | General postulates of quantum mechanics | 1 |
| 1.6 | Time independent Schrodinger wave equation | 1 |
| 1.7 | Electron confinement | 1 |
| 1.8 | Quantum dots, wires and well | 1 |
| 1.9 | Spin and angular momentum | 1 |
| **2** | **Quantum Electronics** | |
| 2.1 | Quantum electronic devices | 1 |
| 2.2 | MOS transistor | 1 |
| 2.3 | Short channel MOS transistor | 1 |
| 2.4 | Split gate transistor | 1 |
| 2.5 | Electron wave transistor | 1 |
| 2.6 | Electron spin transistor | 1 |
| 2.7 | Quantum cellular automata | 1 |
| 2.8 | Quantum dot array | 1 |
| 2.9 | Quantum memory | 1 |
| **3** | **Nano Electronic Transistors** | |
| 3.1 | Coulomb blockade | 1 |
| 3.2 | Coulomb blockade in Nano capacitors | 1 |
| 3.3 | Coulomb blockade in tunnel junctions | 1 |
| 3.4 | Single electron transistors | 1 |
| 3.5 | Semiconductor nanowire FETs | 1 |
| 3.6 | Semiconductor nanowire SETs | 1 |
| 3.7 | Molecular SETs | 1 |
| 3.8 | Molecular electronics | 1 |
| 3.9 | Memory cell | 1 |
| **4** | **Nano Electronic Tunneling and Super Conducting Devices** | |
| 4.1 | Tunnel effect | 1 |
| 4.2 | Tunneling element | 1 |
| 4.3 | Tunneling diode | 1 |
| 4.4 | Resonant tunneling diode | 1 |
| 4.5 | Three terminal resonant tunneling devices | 1 |
| 4.6 | Superconducting switching devices | 1 |
| 4.7 | Cryotron | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.8 | Tunneling device | 1 |
| 4.9 | Josephson tunneling device | 1 |
| **5** | **Nanotubes and Nanostructure Devices** | |
| 5.1 | Carbon Nanotube | 1 |
| 5.2 | Fullerenes- Types of nanotubes | 1 |
| 5.3 | Formation of nanotubes | 1 |
| 5.4 | Assemblies - Purification of carbon nanotubes | 1 |
| 5.5 | Electronic properties | 1 |
| 5.6 | Synthesis of carbon nanotubes - Carbon nanotube interconnects | 1 |
| 5.7 | Carbon nanotube FETs and SETs | 1 |
| 5.8 | Nanotube for memory applications | 1 |
| 5.9 | Nano structures and nano structured devices. | 1 |

**Course Designer(s)**

1. Dr.T.Baranidharan – baranidharan@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E41 | Brain Computer Interface and Applications | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To impart knowledge on types and structure of brain control interfaces.
- To impart knowledge on various potentials related to brain activation function.
- To impart knowledge on different methods of feature extraction from the signals.
- To impart knowledge on the machine learning methods for the brain control interface.
- To impart knowledge on various applications of BCI.

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the types and structure of brain control interfaces. | Understand |
| CO2 | Articulate the various potentials related to brain activation function. | Understand |
| CO3 | Discuss the different methods of feature extraction from the signals | Understand |
| CO4 | Describe the various machine learning methods for the brain control interface. | Understand |
| CO5 | Discuss the applications of the brain control interface. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 2 | 2 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | 3 | 2 | 2 | 3 |
| CO4 | 2 | 3 | 3 | - | 2 | 1 | - | 3 | 3 | 3 | - | 2 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 2 | - | 2 | 1 | - | 3 | 3 | 3 | - | 2 | 2 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 12 | 12 | 20 |
| Understand | 48 | 48 | 80 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPC
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E41 - Brain Computer Interface and Applications | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **BCI**<br>Brain Structure and Function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.<br>**Hands - on: Simulation of EEG Waveform** | [9] |
| **Brain Activation**<br>Brain Activation Patterns - Spikes, Oscillatory Potential and ERD, Slow Cortical Potentials, Movement Related Potentials-Mu Rhythms, Motor Imagery, Stimulus Related Potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials Related to Cognitive Tasks. | [9] |
| **Feature Extraction Methods**<br>Data Processing – Spike Sorting, Frequency Domain Analysis, Wavelet Analysis, Time Domain Analysis, Spatial Filtering – Principal Component Analysis (PCA) and Independent Component Analysis (ICA), Artifacts Reduction, Feature Extraction - Phase Synchronization and Coherence.<br>**Hands - on: EEG Signal Feature Extraction using Principal Component Analysis.** | [9] |
| **Machine Learning Methods for BCI**<br>Classification Techniques –Binary Classification, Ensemble Classification, Multiclass Classification. Regression - Linear, Polynomial - RBF's - Perceptron's - Multilayer Neural Networks -Support Vector Machine - Graph Theoretical Functional Connectivity Analysis.<br>**Hands - on: EEG Signal Classification using Support Vector Machine.** | [9] |
| **Applications of BCI**<br>Invasive BCIs: Decoding and Tracking Arm (hand) Position, Controlling Prosthetic Devices such as Orthotic Hands, Cursor and Robotic Control using Multi-Electrode Array Implant, Visual Cognitive BCI, Emotion Detection. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Rajesh.P.N.Rao, "Brain-Computer Interfacing: An Introduction", 1st Edition, Cambridge University Press, 2013. |
| 2. | Jonathan Wolpaw, Elizabeth Winter Wolpaw, "Brain Computer Interfaces: Principles and Practice", 1st Edition, Oxford University Press, USA, January 2012. |
| **Reference(s):** | |
| 1. | Ella Hassianien, A &Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", 2015, Springer. |
| 2. | Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010. |
| 3. | Ali Bashashati, Mehrdad Fatourechi, Rabab K Ward, Gary E Birch, "A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals", Journal of Neural Engineering, Vol.4, PP.32-57, 2007 |
| 4. | Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida. |

*SDG 4 - Quality Education

**Assignment Activity:**

**Assignment 1 – Covers Module 1 & 2**

1. Brain-Computer Interface Types.
2. Stimulus-related potentials, Visual Evoked Potentials, Auditory Evoked Potentials.

**Assignment 2 – Covers Modules 3, 4 & 5**

1. Principal Component Analysis (PCA), Independent Component Analysis (ICA).
2. Binary classification, Ensemble classification, Multiclass Classification.

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment 3 – Covers Modules 5**

1. Controlling prosthetic devices such as orthotic hands, Cursor, and robotic control using multi-electrode array implant.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **BCI** | |
| 1.1 | Brain Structure and Function | 1 |
| 1.2 | Brain Computer Interface Types | 1 |
| 1.3 | Synchronous and Asynchronous Types | 1 |
| 1.4 | Invasive BCI | 1 |
| 1.5 | Partially Invasive BCI | 1 |
| 1.6 | Non Invasive BCI | 1 |
| 1.7 | Structure of BCI System | 1 |
| 1.8 | BCI Monitoring Hardware | 1 |
| 1.9 | EEG, ECoG, MEG, fMRI. | 1 |
| **2.0** | **Brain Activation** | |
| 2.1 | Brain Activation Patterns | 1 |
| 2.2 | Spikes, Oscillatory Potential and ERD | 1 |
| 2.3 | Slow Cortical Potentials | 1 |
| 2.4 | Movement Related Potentials | 1 |
| 2.5 | Mu Rhythms, Motor Imagery | 1 |
| 2.6 | Stimulus Related Potentials | 1 |
| 2.7 | Visual Evoked Potentials – P300 | 1 |
| 2.8 | Auditory Evoked Potentials | 1 |
| 2.9 | Potentials Related to Cognitive Tasks | 1 |
| **3.0** | **Feature Extraction Methods** | |
| 3.1 | Data Processing – Spike Sorting | 1 |
| 3.2 | Frequency Domain Analysis | 1 |
| 3.3 | Wavelet Analysis | 1 |
| 3.4 | Time Domain Analysis | 1 |
| 3.5 | Spatial Filtering | 1 |
| 3.6 | Principal Component Analysis (PCA) | 1 |
| 3.7 | Independent Component Analysis (ICA) | 1 |
| 3.8 | Artifacts Reduction | 1 |
| 3.9 | Feature Extraction - Phase Synchronization and Coherence | 1 |
| **4.0** | **Machine Learning Methods for BCI** | |
| 4.1 | Binary, Ensemble Classification | 2 |
| 4.2 | Multiclass Classification | 1 |
| 4.3 | Regression - Linear, Polynomial | 1 |
| 4.4 | RBF's, Perceptron's | 1 |
| 4.5 | Multilayer Neural Networks | 1 |
| 4.6 | Support Vector Machine | 1 |
| 4.7 | Graph Theoretical Functional Connectivity Analysis | 2 |
| **5.0** | **Applications of BCI** | |
| 5.1 | Invasive BCIs: Decoding and Tracking Arm (Hand) Position | 2 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.2 | Controlling Prosthetic Devices such as Orthotic Hands | 2 |
| 5.3 | Cursor and Robotic Control using Multi Electrode Array Implant | 2 |
| 5.4 | Visual Cognitive BCI | 1 |
| 5.5 | Emotion Detection | 2 |

**Course Designer(s)**


1. Mr S.Pradeep – pradeeps@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E42 | Industrial IoT and Industry 4.0 | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- Gain knowledge of key concepts of Industry 4.0
- Examine cutting-edge technologies for Industry 4.0
- Acquire skills to identify, assess, and mitigate cybersecurity risks
- Delve into the layers of Industrial IoT (IIoT) architecture
- Develop the ability to apply Industry 4.0 principles and technologies

## Pre-requisites

- Internet of Things

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Assess the impact of Industry 4.0 on traditional production systems and identify opportunities for improvement. | Understand |
| CO2 | Discuss the strategies for integrating Industry 4.0 technologies into existing production systems to enhance efficiency and productivity. | Understand |
| CO3 | Assess the effectiveness of cybersecurity measures in protecting critical infrastructure and minimizing potential disruptions. | Analyze |
| CO4 | Implement end-to-end IIoT solutions tailored to specific application domains, considering factors such as data security, latency, and scalability. | Analyze |
| CO5 | Identify key application domains of Industry 4.0 technologies, including the oil, chemical, pharmaceutical, and manufacturing industries. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO2 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO3 | 3 | 3 | 2 | - | 3 | 3 | | 3 | 3 | - | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | - | - | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 10 | 10 |
| Understand | 40 | 10 | 20 |
| Apply | - | 30 | 60 |
| Analyse | - | 10 | 10 |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E. Electronics and Communication Engineering | | | | | | | | |
| 60 EC E42 - Industrial IoT and Industry 4.0 | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Industry 4.0 Essentials*** Sensing & actuation, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories | [9] |
| **Industry 4.0 Evolution*** Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis | [9] |
| **Cybersecurity*** Cybersecurity in Industry 4.0, Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems, Industrial IoT: Business Model and Reference Architecture | [9] |
| **IIoT Layers*** IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking, Big Data Analytics and Software Defined Networks: IIoT Analytics - Machine Learning and Data Science | [9] |
| **Application Domains**** Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Milk Processing and Packaging Industries, Manufacturing Industries | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Misra S, Mukherjee A, and Roy A, “Introduction to IoT”, Cambridge University Press, 2021. |
| 2. | Misra S, Roy C, and Mukherjee A, “Introduction to Industrial Internet of Things and Industry 4.0”, CRC Press, 2020. |
| 3. | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Cisco Press, 2017. |
| **Reference(s):** | |
| 1. | Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2021. |
| 2. | Alexander Manu, “Digital Transformation and Industry 4.0: A Guide for Executives and Decision Makers”, 2022. |

*SDG 9 – Industry Innovation and Infrastructure
**SDG 7 – Affordable and Clean Energy

**Assignment Activity**
**Assignment 1**- Explanatory questions in Industry 4.0 Essential, Evolution and cybersecurity.
**Assignment 2 -** Mini project on IIoT
**Assignment 3** - Case studies on Application Domains.

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| Course Contents and Lecture Schedule | | |
|---|---|---|
| **S. No.** | **Topics** | **No. of hours** |
| **1.0** | **Industry 4.0 Essentials** | |
| 1.1 | Sensing & Actuation | 1 |
| 1.2 | Industry 4.0: Globalization and Emerging Issues | 1 |
| 1.3 | Industry 4.0: Emerging Issues | 1 |
| 1.4 | The Fourth Revolution | 1 |
| 1.5 | LEAN Production Systems | 1 |
| 1.6 | LEAN Production Systems | 1 |
| 1.7 | Smart and Connected Business Perspective | 1 |
| 1.8 | Smart Factories | 1 |
| 1.9 | Smart Factories | 1 |
| **2.0** | **Industry 4.0 Evolution** | |
| 2.1 | Cyber Physical Systems | 1 |
| 2.2 | Next Generation Sensors | 1 |
| 2.3 | Collaborative Platform | 1 |
| 2.4 | Product Lifecycle Management | 1 |
| 2.5 | Product Lifecycle Management | 1 |
| 2.6 | Augmented Reality and Virtual Reality | 1 |
| 2.7 | Artificial Intelligence | 1 |
| 2.8 | Big Data | 1 |
| 2.9 | Advanced Analysis | 1 |
| **3.0** | **Cybersecurity** | |
| 3.1 | Cybersecurity in Industry 4.0 – Manufacturing | 1 |
| 3.2 | Cybersecurity in Industry 4.0 – Shipping and Cargo | 1 |
| 3.3 | Cybersecurity in Industry 4.0 – Medical | 1 |
| 3.4 | Industrial Processes | 1 |
| 3.5 | Industrial Sensing & Actuation | 1 |
| 3.6 | Industrial Internet Systems | 1 |
| 3.7 | Industrial Internet Systems | 1 |
| 3.8 | Business Model | 1 |
| 3.9 | Reference Architecture | |
| **4.0** | **IIoT Layers** | |
| 4.1 | IIoT Sensing | 1 |
| 4.2 | IIoT Processing | 1 |
| 4.3 | IIoT Communication | 1 |
| 4.4 | IIoT Networking | 1 |
| 4.5 | Big Data Analytics | 1 |
| 4.6 | Software Defined Networks | 1 |
| 4.7 | IIoT Analytics | 1 |
| 4.8 | Machine Learning | 1 |
| 4.9 | Data Science | 1 |
| **5.0** | **Application Domains** | |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.1 | Oil Industries | 1 |
| 5.2 | Chemical industry | 1 |
| 5.3 | Pharmaceutical industry | 1 |
| 5.4 | Applications of UAVs in Industries | 1 |
| 5.5 | Milk Processing Industries | 1 |
| 5.6 | Packaging Industries | 1 |
| 5.7 | Manufacturing Industries | 1 |
| 5.8 | Smart Energy Management | 1 |
| 5.9 | Environmental Monitoring | 1 |

**Course Designer(s)**


1. Dr.C.Rajasekaran – rajasekaran@ksrct.ac.in
2. Mr.K.Raguvaran – raguvaran@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E43 | Remote Sensing | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To familiarize about the principles of remote sensing.
- To acquire knowledge on data acquisition and analysis of satellite data.
- To learn the application of various type of remote sensing and its satellite data.
- To study the different techniques for information extraction in remote sensing.
- To comprehensive understanding of image analysis techniques in remote sensing

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the electromagnetic remote sensing process | Understand |
| CO2 | Select and list platforms used for data acquiring process | Understand |
| CO3 | Discuss the various remote sensing systems, the data they produce, and their resolution characteristics. | Understand |
| CO4 | Discuss satellite data acquisition and analysis. | Apply |
| CO5 | Apply image analysis for Satellite data. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 40 |
| Understand | 40 | 30 | 40 |
| Apply | - | 10 | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC E43 – Remote Sensing**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Fundamentals of Remote Sensing: Processes, Radiation Principles, and Spectral Reflectance**<br>Remote Sensing Process - Radiation Principles - Spectral Reflectance Curve - EMR Interactions with Atmosphere - Earth Surface Features - Resolution Types. | [9] |
| **Platforms**<br>Space Borne - Landsat Satellite Program - Thematic Mapper Spectral Bands - Landsat Image Interpretation - Spot Satellite Program - Spot Image Interpretation - IRS Satellite Program - IRS Image Interpretation - High Resolution Satellite System - Space Station Remote Sensing - Air borne. | [9] |
| **Types**<br>Multi Spectral Scanning – Infrared - Thermal Remote Sensing - Thermal Scanning - Radiation Principles - Hyper Spectral Scanning - Microwave Sensing - Side Looking Radar Systems - Synthetic Aperture Radar- Radar Image Characteristics - Radar Image Interpretation - LIDAR Remote Sensing-Microwave Radiometers - Microwave Scanners. | [9] |
| **Information Extraction**<br>Training Sets - Supervised, Unsupervised and Hybrid Classifiers - Baye's Theorem - Parametric Classification - Decision Tree – Non Parametric Classifiers - Sub-Pixel and Super-Pixel Classification – Hyper - Spectral Image Analysis - Accuracy Assessment. | [9] |
| **Image Analysis**<br>Pattern Recognition - Boundary Detection and Representation - Textural and Contextual Analysis - Decision Concepts - Fuzzy sets - Evidential Reasoning - Expert System - Artificial Neural Network - Case Studies. | [9] |
| **Total Hours:** | **45** |

| | |
|---|---|
| **Text Book(s):** | |
| 1. | Thomas M. Lilles, Ralph W. Kiefer, Jonathan W.Chipman, "Remote Sensing and Image interpretation",7th Edition , John Wiley and Sons, Inc., New York, 2015. |
| 2. | George Joseph, C Jeganathan, "Fundamentals of Remote Sensing", 3rd Edition, Universities Press (India) Private limited, Hyderabad, 2018. |
| **Reference(s):** | |
| 1. | John R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective" 4th Edition, Pearson , 2021. |
| 2. | Robert Shcowebgerdt, "Remote sensing models & methods for image processing", 3rd Edition, Academic Press, 2007. |
| 3. | John A.Richards, "Remote Sensing Digital Image Analysis" 6th Edition, Springer International Publisher, 2023. |
| 4. | John A. Richard, XiupingJia, "Remote Sensing Digital Image Analysis: An Introduction" 5th Edition, Springer Verlag, 2012 |

*SDG 9– Industry, Innovation, and Infrastructure
**SDG 13 – Climate Action
***SDG 15 – Life on Land

**Assignment Activity :**

**Assignment 1:**

1. Seminar in Earth Surface Feature
2. Poster Presentation in Spectral Reflectance Curve

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment 2:**

1. Prepare a case study on Remote sensing types and image analysis.
2. Simulation on Hyper and Multi Spectral Image Analysis and Accuracy Assessment.

.

**Assignment 3:**

1. Simulation on Thematic Mapper Spectral Bands
2. Video presentation on Pattern Recognition

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Fundamentals of Remote Sensing: Processes, Radiation Principles, and Spectral Reflectance** | |
| 1.1 | Remote Sensing Process | 2 |
| 1.2 | Radiation Principles | 1 |
| 1.3 | Spectral Reflectance Curve | 1 |
| 1.4 | Application of Spectral Reflectance Curve | 1 |
| 1.5 | EMR Interactions with Atmosphere | 1 |
| 1.6 | Earth Surface Features | 1 |
| 1.7 | Resolution Types | 1 |
| 1.8 | Impact of Resolution on Data Quality | 1 |
| **2.0** | **Platforms** | |
| 2.1 | Space Borne | 1 |
| 2.2 | Landsat Satellite Program | 1 |
| 2.3 | Thematic Mapper Spectral Bands | 1 |
| 2.4 | Landsat Image Interpretation | 1 |
| 2.5 | Spot Satellite Program | 1 |
| 2.6 | Spot Image Interpretation | 1 |
| 2.7 | IRS Satellite Program | 1 |
| 2.8 | IRS Image Interpretation - High Resolution Satellite System | 1 |
| 2.9 | Space Station Remote Sensing - Air Borne | 1 |
| **3.0** | **Types** | |
| 3.1 | Multi Spectral Scanning | 1 |
| 3.2 | Infrared - Thermal Remote Sensing | 1 |
| 3.3 | Thermal Scanning - Radiation Principles | 1 |
| 3.4 | Hyper Spectral Scanning | 1 |
| 3.5 | Microwave Sensing | 1 |
| 3.6 | Side Looking Radar Systems - Synthetic Aperture Radar | 1 |
| 3.7 | Radar Image Characteristics - Radar Image Interpretation | 1 |
| 3.8 | LIDAR Remote Sensing | 1 |
| 3.9 | Microwave Radiometers - Microwave Scanners | 1 |
| **4.0** | **Information Extraction** | |
| 4.1 | Training sets - Supervised | 1 |
| 4.2 | Unsupervised and Hybrid classifiers | 1 |
| 4.3 | Baye's Theorem | 1 |
| 4.4 | parametric Classification | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.5 | Decision tree | 1 |
| 4.6 | Non parametric classifiers | 1 |
| 4.7 | sub-pixel and super-pixel classification | 1 |
| 4.8 | Hyper spectral image analysis | 1 |
| 4.9 | Accuracy assessment | 1 |
| **5.0** | **Image Analysis** | |
| 5.1 | Pattern Recognition | 1 |
| 5.2 | Boundary Detection and Representation | 1 |
| 5.3 | Textural Analysis | 1 |
| 5.4 | Contextual Analysis | 1 |
| 5.5 | Decision Concepts Fuzzy Sets | 1 |
| 5.6 | Evidential Reasoning | 1 |
| 5.7 | Expert System | 1 |
| 5.8 | Artificial Neural Network | 1 |
| 5.9 | Case Studies | 1 |

**Course Designer(s)**


1. Dr. K.B.Jayanthi -jayanthikb@ksrct.ac.in
2. Mrs.M.Devaki - devaki@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E44 | Advanced Wireless Communication Techniques | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To understand the evolving paradigm of cooperative communication
- To understand concepts related to green wireless communication
- To enable the student to understand the different power saving strategies and energy efficient signal, system and network design.
- To expose the student to the energy saving techniques adopted in existing wireless components
- To provide understanding on protocols and networks related to green future wireless communication technologies

## Pre-requisites

- Wireless Communication

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Recall the necessity and the design aspects of cooperative communication. | Understand |
| CO2 | Illustrate the necessity and the design aspects of green wireless communication. | Understand |
| CO3 | Summarize the new techniques in wireless communication. | Understand |
| CO4 | Identify the feasibility of using mathematical models using simulation tools. | Apply |
| CO5 | Explain the impact of the green engineering solutions in a global, economic, environmental and societal context. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | 2 | 2 | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | 2 | 2 | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | 2 | 2 | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | 2 | 2 | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | 2 | 2 | 3 | 3 | 3 | - | | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 34 |
| Understand | 40 | 30 | 46 |
| Apply | - | 10 | 20 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPC
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E44 - Advanced Wireless Communication Techniques | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Cooperative Communications and Green Concepts*** Network Architectures and Research Issues in Cooperative Cellular Wireless Networks - Cooperative Communications in OFDM and MIMO Cellular Relay Networks: Issues and Approaches-Fundamental Trade-Offs on The Design of Green Radio Networks - Green Modulation and Coding Schemes - Cooperative Techniques for Energy Efficiency. | [9] |
| **Cooperative Base Station Techniques*** Cooperative Base Station Techniques for Cellular Wireless Networks - Turbo Base Stations- Antenna Architectures for Cooperation - Cooperative Communications In 3gpp LTE-Advanced - Partial Information Relaying and Coordinated Multi-Point Transmission In LTE-Advanced. | [9] |
| **Relay-Based Cooperative Cellular Networks*** Distributed Space - Time Block Codes, Collaborative Relaying in Downlink Cellular Systems-Radio Resource Optimization - Adaptive Resource Allocation-Cross-Layer Scheduling Design - Network Coding in Relay-Based Networks. | [9] |
| **Green Radio Networks***** Base Station Power-Management Techniques - Opportunistic Spectrum and Load Management - Energy Saving Techniques in Cellular Wireless Base Stations – Power - Management for Base Stations in Smart Grid Environment - Green Communications in Cellular Networks with Fixed Relay Nodes. | [9] |
| **Access Techniques for Green Radio Networks*** Cross-Layer Design of Adaptive Packet Scheduling for Green Radio Networks – Energy -Efficient Relaying for Cooperative Cellular Wireless Networks - Energy Performance in TDD - CDMA Multi Hop Cellular Networks - Resource Allocation for Green Communication in Relay - Based Cellular Networks - Green Radio Test-Beds and Standardization Activities. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Ekram Hossain, Dong in Kim, Vijay K. Bhargava, “Cooperative Cellular Wireless Networks”, Cambridge University Press, 2011. |
| 2. | Ekram Hossain, Vijay K. Bhargava (Editor), Gerhard P. Fettweis (Editor), “Green Radio Communication Networks”, Cambridge University Press, 2012. |
| **Reference(s):** | |
| 1. | Richard Yu F, Yu, Zhang and Victor C. M. Leung, “Green Communications and Networking”, CRC press, 2012. |
| 2. | Ramjee Prasad and Shingo Ohmori, Dina Simunic, “Towards Green ICT”, River Publishers, 2010. |
| 3. | insong Wu, Sundeep Rangan and Honggang Zhang, “Green Communications: Theoretical Fundamentals, Algorithms and Applications”, CRC Press, 2012. |
| 4. | Venkataraman H, Gabriel-miro Muntean, “Green Mobile Devices and Networks: Energy Optimization and Scavenging Techniques”, CRC Press, 2012. |

*SDG 9 – Industry Innovation and Infrastructure
**SDG 3 – Good Health and Well Being
***SDG 7 – Affordable and Clean Energy

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment Activity:**

**Assignment 1:**

1. Implementation of MIMO/OFDM system using MATLAB**.**
2. Poster Presentation- Fundamental Trade-Offs on The Design of Green Radio Networks.

**Assignment 2:**

1. Case Study-Energy Saving Techniques in Cellular Wireless Base Stations

**Assignment 3:**

1. Chart preparation of Network Coding in Relay-Based Networks.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Cooperative Communications and Green Concepts** | |
| 1.1 | Network Architectures | 1 |
| 1.2 | Research Issues in Cooperative Cellular Wireless Networks | 1 |
| 1.3 | Cooperative Communications in OFDM And MIMO Cellular Relay Networks | 1 |
| 1.4 | Issues And Approaches | 1 |
| 1.5 | Fundamental Trade-Offs on The Design of Green Radio Networks | 1 |
| 1.6 | Four Fundamental Trade-Offs | 1 |
| 1.7 | Green Modulation and Coding Schemes | 1 |
| 1.8 | Green Coding Schemes | 1 |
| 1.9 | Cooperative Techniques for Energy Efficiency | 1 |
| **2.0** | **Cooperative Base Station Techniques*** | |
| 2.1 | Cooperative Base Station Techniques for Cellular Wireless Networks | 1 |
| 2.2 | System Model | 1 |
| 2.3 | Turbo Base Stations | 1 |
| 2.4 | Antenna Architectures for Cooperation | 1 |
| 2.5 | Antenna Architectures for Network | 1 |
| 2.6 | Cooperative Communications in 3GPP LTE-Advanced | 1 |
| 2.7 | Partial Information Relaying and Coordinated | 1 |
| 2.8 | Multi-Point Transmission in LTE-Advanced | 1 |
| 2.9 | Cooperative Multipoint Transmission | 1 |
| **3.0** | **Relay-Based Cooperative Cellular Networks** | |
| 3.1 | Distributed Space-Time Block Codes | 1 |
| 3.2 | Collaborative Relaying in Downlink Cellular Systems | 1 |
| 3.3 | Radio Resource Optimization | 1 |
| 3.4 | Adaptive Resource Allocation | 1 |
| 3.5 | Network Optimization | 1 |
| 3.6 | Cross-Layer Scheduling Design | 1 |
| 3.7 | Cross-Layer Scheduling with Two Channel States | 1 |
| 3.8 | Network Coding in Relay-Based Networks | 1 |
| 3.9 | Physical-Layer Network Coding | 1 |
| **4.0** | **Green Radio Networks** | |
| 4.1 | Base Station Power | 1 |
| 4.2 | Management Techniques | 1 |

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.3 | Opportunistic Spectrum and Load Management | 1 |
| 4.4 | Energy Saving Techniques in Cellular Wireless Base Stations | 1 |
| 4.5 | Energy-Consumption Reference Model | 1 |
| 4.6 | Power-Management for Base Stations in Smart Grid Environment | 1 |
| 4.7 | Power Management for Wireless Base Station | 1 |
| 4.8 | Green Communications in Cellular Networks | 1 |
| 4.9 | fixed relay nodes | 1 |
| **5.0** | **Access Techniques for Green Radio Networks** | |
| 5.1 | Cross-Layer Design | 1 |
| 5.2 | Adaptive Packet Scheduling for Green Radio Networks | 1 |
| 5.3 | Energy-Efficient Relaying for Cooperative Cellular Wireless Networks | 1 |
| 5.4 | Energy Consumption for Single-Hop and Multi-Hop Transmission | 1 |
| 5.5 | Energy Performance In TDD-CDMA Multihop Cellular Networks | 1 |
| 5.6 | Resource Allocation for Green Communication in Relay-Based Cellular Networks | 1 |
| 5.7 | Design Of a Green Power Allocation Scheme | 1 |
| 5.8 | Green Radio Test-Beds | 1 |
| 5.9 | Green Radio Standardization Activities. | 1 |

**Course Designer(s)**

1. Mr.D.Dhanasekaran - dhanasekarand@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DCE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E45 | Computer Vision: Algorithms and Applications | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

## Objectives

- To impart knowledge on image formation and processing
- To understand the computer and human vision systems
- To explore image processing techniques for computer vision applications
- To study the various concepts of deep learning for computer vision applications
- To learn object recognition methods and their applications

## Pre-requisites

- Digital Image Processing

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Outline the various image interpolation techniques to enhance image quality during geometric transformations. | Understand |
| CO2 | Apply the principles of computer and human vision systems. | Apply |
| CO3 | Utilize the image processing techniques for computer vision. | Apply |
| CO4 | Solve the various techniques and algorithms used in computer vision for a specific problem. | Apply |
| CO5 | Apply object detection methods using the concept of computer vision. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 2 | - |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 2 | - |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | - | 15 | - | - | 30 | - |
| Understand | 40 | 20 | 30 | 10 | 10 | 60 | 10 |
| Apply | - | 80 | 15 | 90 | 90 | 10 | 90 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E45 - Computer Vision: Algorithms and Applications | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Image Formation and Processing**<br>Digital Image, Monochrome and Color Images, Image Brightness and Contrast, 2D, 3D, and 4D Images, Geometric Transformations - Image Interpolation, Nearest - Neighbor Interpolation, Bilinear Interpolation. | [6] |
| **Machine Vision**<br>Computer and Human Vision Systems, The Human Eye, Evolution of Computer Vision, Camera Models - Machine Vision Lighting - Machine Vision Software - Machine Vision Automation - Integration of Machine Vision Components. | [6] |
| **Image Processing for Computer Vision Applications**<br>Image Filtering - Bilateral Filter, Comparison of Filter Techniques - Image Segmentation - Motion Analysis: Differential Motion Analysis, Optical Flow, Analysis Based on Interest Points, Detection of Specific Motion Patterns, Video Tracking and Motion Estimation. | [6] |
| **Deep Learning for Computer Vision***<br>Deep Learning and Neural Networks for Vision - Convolutional Neural Networks (CNN) - Transfer Learning and FineTuning Pre - Trained Models - Performance Evaluation Metrics for Computer Vision Tasks. | [6] |
| **Emerging Trends in Machine Vision****:<br>Computer Vision and Industry 4.0 Applications: Object Detection and Semantic Segmentation - Variety of Approaches (YOLO) - Human Pose Estimation, Face ID, Face Detection and Recognition - Vehicle Vision System. | [6] |
| **Practical:**<br>1. Simulate the given images to adjust the brightness, contrast and display images.<br>2. Simulate the simple thresholding method to segment objects from the image.<br>3. Simulate the nearest-neighbor interpolation for image resizing.<br>4. Measure the camera calibration.<br>5. Simulate a bilateral filter.<br>6. Simulate the feature detection and extraction.<br>7. Simulate the loading, saving, and displaying the video for multiobject tracking.<br>8. Simulate the loading of the pre-trained model.<br>9. Classify a given image dataset using the pre-trained model.<br>10. Simulate the YOLO v8 architecture.<br>**Tools used: MATLAB / Open Source** | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |

| **Text Book(s):** | |
|---|---|
| 1. | Sheila Anand and L.Priya , “A Guide for Machine Vision in Quality Control”, Taylor & Francis Inc,Imprint CRC Press Inc, 2019. |
| 2. | Richard Szeliski, “Computer Vision: Algorithms and Applications”, 2nd Edition, Springer-Texts in Computer Science, 2022. |
| **Reference(s):** | |
| 1. | Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Limited, 2018. |
| 2. | Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing Analysis and Machine Vision”, 2nd Edition, Cengage learning, 2013. |
| 3. | Joe Minichino Joseph Howse, “Learning OpenCV 3 Computer Vision with Python”, 2nd Edition, Packt Publishing Ltd, , 2015. |
| 4. | Forsyth D.A, Ponce J, “Computer Vision: A Modern Approach”, 2nd Edition, Pearson Education, 2015. |

*SDG 9 - Sustainable industrialization and foster innovation

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| Course Contents and Lecture Schedule | | |
|---|---|---|
| **S. No.** | **Topics** | **No. of Hours** |
| **1** | **Image Formation and Processing** | |
| 1.1 | Digital Image, Monochrome and Color Images | 1 |
| 1.2 | Image Brightness and Contrast, 2D, 3D, and 4D Images | 1 |
| 1.3 | Geometric Transformations | 1 |
| 1.4 | Image Interpolation | 1 |
| 1.5 | Nearest-Neighbor Interpolation | 1 |
| 1.6 | Bilinear Interpolation. | 1 |
| **2** | **Machine Vision** | |
| 2.1 | Computer and Human Vision Systems | 1 |
| 2.2 | The Human Eye, Evolution of Computer Vision | 1 |
| 2.3 | Camera Models- Machine Vision Lighting | 1 |
| 2.4 | Machine Vision Software | 1 |
| 2.5 | Machine Vision Automation | 1 |
| 2.6 | Integration of Machine Vision Components | 1 |
| **3** | **Image Processing for Computer Vision Applications** | |
| 3.1 | Image Filtering-Bilateral Filter | 1 |
| 3.2 | Comparison of Filter Techniques, Image Segmentation | 1 |
| 3.3 | Motion Analysis: Differential Motion Analysis | 1 |
| 3.4 | Optical Flow, Analysis Based on Interest Points | 1 |
| 3.5 | Detection of Specific Motion Patterns | 1 |
| 3.6 | Video Tracking and Motion Estimation | 1 |
| **4** | **Deep Learning for Computer Vision** | |
| 4.1 | Deep Learning and Neural Networks for Vision | 1 |
| 4.2 | Convolutional Neural Networks (CNN) | 1 |
| 4.3 | CNN - Layers used to build ConvNets | 1 |
| 4.4 | Transfer Learning | 1 |
| 4.5 | Fine-Tuning Pre-Trained Models | 1 |
| 4.6 | Performance Evaluation Metrics for Computer Vision Tasks | 1 |
| **5** | **Emerging Trends in Machine Vision** | |
| 5.1 | Computer Vision and Industry 4.0, Applications: Object Detection | 1 |
| 5.2 | Semantic Segmentation, Variety of Approaches (YOLO) | 1 |
| 5.3 | Human Pose Estimation | 1 |
| 5.4 | Face ID, Face Detection | 1 |
| 5.5 | Face Recognition | 1 |
| 5.6 | Vehicle Vision System | 1 |
| **Practical:** | | |
| 1. | Simulate the given images to adjust the brightness, contrast and display images. | 2 |
| 2. | Simulate the simple thresholding method to segment objects from the image. | 2 |
| 3. | Simulate the nearest-neighbor interpolation for image resizing. | 2 |
| 4. | Measure the camera calibration. | 2 |
| 5. | Simulate a bilateral filter. | 2 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 6. | Simulate the feature detection and extraction. | 4 |
| 7. | Simulate the loading, saving, and displaying the video for multiobject tracking. | 4 |
| 8. | Simulate the loading of the pre-trained model. | 4 |
| 9. | Classify a given image dataset using the pre-trained model. | 4 |
| 10. | Simulate the YOLO v8 architecture. | 4 |

**Course Designer(s)**

1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Ms.R.Ramya - rramya@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E46 | VLSI Testing | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To understand the VLSI testing
- To learn the logic and fault simulation and testability measures
- To study the test generation techniques for combinational and sequential circuits
- To apply various design for testability
- To study the fault diagnosis

## Pre-requisites

- VLSI and Chip Design

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe VLSI testing process | Understand |
| CO2 | Explain logic simulation and fault simulation | Understand |
| CO3 | Develop test vector for combinational and sequential circuits | Apply |
| CO4 | Apply the various design for testability in testing | Apply |
| CO5 | Perform fault diagnosis | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 2 | - |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 10 | 20 |
| Understand | 40 | 30 | 40 |
| Apply | - | 20 | 30 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E46 - VLSI Testing | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Testing and Fault Modeling**<br>VLSI Testing Process and Test Equipment - Fault Modeling - Stuck-at-Fault - Fault Equivalence - Fault Collapsing - Fault Dominance. | [9] |
| **Logic & Fault Simulation and Testability Measures**<br>Design Verification and Test Evaluation - Modeling Circuits for Simulation - Algorithms for True Value and Fault Simulation - SCOAP Controllability and Observability. | [9] |
| **Test Generation for Combinational and Sequential Circuits**<br>Test Generation Algorithms - Boolean Difference - D-Algorithm – PODEM - Sequential ATPG Algorithms - Simulation Based ATPG - Genetic Algorithm Based ATPG. | [9] |
| **Design for Testability***<br>Testability Analysis - Scan Cell Designs - Boundary Scan Architecture - Built-In-Self-Test Architecture**-** Random Logic BIST - Test Algorithms for RAMs. | [9] |
| **Fault Diagnosis**<br>Fault Models for Diagnosis - Generation of Vectors for Diagnosis - Combinational Logic Diagnosis - Scan Chain Diagnosis - Logic BIST Diagnosis. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen, “VLSI Test Principles and Architectures”, Elsevier, 2017. |
| 2. | Michael L. Bushnell and Vishwani D. Agrawal, “Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2017. |
| **Reference(s):** | |
| 1. | Abramovici M, Breuer M A and Friedman A D, "Digital Systems and Testable Design", Jaico Publishing House, 2009. |
| 2. | Lala P.K, “Digital Circuit Testing and Testability”, Academic Press, 2012. |
| 3. | Crouch A.L, “Design-For-Test For Digital IC’s And Embedded Core System”, Pearson Education, 2012. |
| 4. | Niraj K. Jha and Sandeep Gupta, “Testing of Digital Systems”, Cambridge University Press, 2017. |

*SDG 9 - Industry Innovation and Infrastructure

**Assignment Activity:**

**Assignment 1:**

1. Poster Presentation on Various Test Equipment
2. Simulation of Various Fault Modeling Using EDA Tool

**Assignment 2:**

1. Simulation of ATPG Using EDA Tool

**Assignment 3:**

1. Seminar Presentation on SCOAP Controllability and Observability
2. Prepare a Case Study on Test Algorithms for RAMs.

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Testing and Fault Modeling** | |
| 1.1 | VLSI Development Process | 1 |
| 1.2 | Levels of Abstraction in VLSI Testing | 1 |
| 1.3 | Test Equipment- Automatic Test Equipment | 1 |
| 1.4 | Fault Modelling - Stuck-at-Faults | 1 |
| 1.5 | Transistor Faults, Open and Short Faults, Delay Faults and Crosstalk | 1 |
| 1.6 | Pattern Sensitivity and Coupling Faults, Analog Fault Models | 1 |
| 1.7 | Fault Equivalence | 1 |
| 1.8 | Fault Collapsing | 1 |
| 1.9 | Fault Dominance | 1 |
| **2.0** | **Logic & Fault Simulation and Testability Measures** | |
| 2.1 | Logic Simulation for Design Verification | 1 |
| 2.2 | Fault Simulation for Test and Diagnosis | 1 |
| 2.3 | Test Evaluation | 1 |
| 2.4 | Simulation Models | 1 |
| 2.5 | Algorithms for True Value Simulation- Compiled-Code and Event Driven Simulation | 1 |
| 2.6 | Serial Fault Simulation | 1 |
| 2.7 | Parallel Fault Simulation | 1 |
| 2.8 | SCOAP Controllability | 1 |
| 2.9 | Observability | 1 |
| **3.0** | **Test Generation for Combinational and Sequential Circuits** | |
| 3.1 | Test Generation Algorithms - Random Test Generation | 1 |
| 3.2 | Boolean Difference | 1 |
| 3.3 | D-Algorithm | 1 |
| 3.4 | Pseudocode for D-Algorithm | 1 |
| 3.5 | PODEM | 1 |
| 3.6 | Sequential ATPG Algorithms – Time Frame Expansion | 1 |
| 3.7 | Gated Clocks and Multiple Clocks | 1 |
| 3.8 | Simulation Based ATPG | 1 |
| 3.9 | Genetic Algorithm Based ATPG | 1 |
| **4.0** | **Design for Testability** | |
| 4.1 | SCOAP Testability Analysis | 1 |
| 4.2 | Probability and Simulation-Based Testability Analysis | 1 |
| 4.3 | Scan Cell Designs - Muxed-D Scan Cell | 1 |
| 4.4 | Clocked-Scan Cell and LSSD Scan Cell | 1 |
| 4.5 | Boundary Scan-Architecture, TAP and Bus Protocols | 1 |
| 4.6 | Tap Controller, Instruction Register & Set, On-Chip Test Support | 1 |
| 4.7 | Logic BIST Architecture | 1 |
| 4.8 | Random Logic BIST | 1 |
| 4.9 | Test Algorithms for RAMs – Functional Fault Models and Test Algorithms | 1 |
| **5.0** | **Fault Diagnosis** | |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.1 | Fault Models for Diagnosis | 1 |
| 5.2 | Generation of Vectors for Diagnosis | 1 |
| 5.3 | Combinational Logic Diagnosis - Cause-Effect Analysis | 1 |
| 5.4 | Effect - Cause Analysis, Chip-Level Strategy | 1 |
| 5.5 | Preliminaries for Scan Chain Diagnosis, Hardware-Assisted Method | 1 |
| 5.6 | Modified Inject-and-Evaluate Paradigm, Signal-Profiling-Based Method | 1 |
| 5.7 | Logic BIST Diagnosis | 1 |
| 5.8 | Interval-Based Methods | 1 |
| 5.9 | Masking-Based Methods | 1 |

**Course Designer(s)**

1. Saravanan S – saravanan.s@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E47 | Positioning and Navigation Systems | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To explain the fundamentals of navigation systems.
- To understand the inertial navigation systems.
- To acquire knowledge on radio navigation.
- To have an overview of global positioning systems
- To learn the hybrid navigation systems.

## Pre-requisites

- Digital Communication

## Course Outcomes

On the Successful Completion of the Course, Students will be able to

| | | |
|---|---|---|
| CO1 | Discuss the advanced concepts of positioning and navigation systems and exposure on various navigation systems | Remember |
| CO2 | Illustrate about gyroscopes and accelerometers and inertial navigation systems and its types and mechanisation | Apply |
| CO3 | Explain the different radio navigation aids and its usage for civil and military aircrafts and satellites | Understand |
| CO4 | Interpret the satellite navigation – GPS and its usage in aircraft and spacecraft applications | Apply |
| CO5 | Deploy these skills effectively in the analysis and understanding of hybrid navigation systems and relative navigation in a spacecraft. | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 | 2 | 2 | 2 |
| | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 34 |
| Understand | 20 | 20 | 32 |
| Apply | 20 | 20 | 34 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E – Electronics and Communication Engineering | | | | | | | | |
| 60 EC E47– Positioning and Navigation Systems | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Navigation Concepts**<br>Fundamentals of Navigation Systems and Position Fixing - Categories of Navigation - Geometric Concepts of Navigation - The Earth in Inertial Space - Different Coordinate Systems - Coordinate Transformation - Euler Angle Formulations - Direction Cosine Matrices Formulation - Quaternion Formulation. | [9] |
| **Inertial Navigation Systems**<br>Inertial Sensors - Gyroscopes -Types - Mechanical – Electromechanical - Optical Gyro - Ring Laser Gyro - Fiber Optic Gyro - Accelerometers - Pendulous Type - Force Balance Type - MEMs - Basic Principles of Inertial Navigation - Types - Platform and Strap Down - Mechanization INS System - Rate Corrections - Acceleration Errors - Schuler Tuning. | [9] |
| **Radio Navigation & Air Traffic Management**<br>Different Types of Radio Navigation - ADF, VOR, DME, TACAN, VORTAC - Doppler - Hyperbolic Navigations - Air Traffic Management - RADAR Surveillance - Airborne Collision Avoidance Systems. | [9] |
| **Global Positioning System ***<br>Overview of GPS: Basic Concept, System Architecture, GPS Signals Signal Structure, Anti-Spoofing (AS), Selective Availability - GPS for Position and Velocity Determination - GPS Aided Geo - Augmented Navigation (GAGAN) Architecture - GPS Error Sources - Clock Error, Ionospheric Error, Tropospheric Error - Multipath, Ionospheric Error Estimation using Dual Frequency GPS Receiver. | [9] |
| **Hybrid Navigation & Relative Navigation Systems ****<br>Hybrid Navigation - Introduction to Kalman Filtering - Case Studies - Integration of GPS and INS using Kalman Filter - Relative Navigation - Fundamentals - Equations of Relative Motion for Circular Orbits Clohessy Wiltshire Equations - Sensors for Rendezvous Navigation - Relative Positioning - Point Positioning and Differential Positioning - Differential GPS and Space Based Augmentation System - Concepts - Relative GPS - Formation Flying - Figure of Merit. | [9] |
| **Total Hours:** | 45 |

| **Text Book(s):** | |
|---|---|
| 1. | Paul. D. Groves, “Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems”, Artech House, 2013. |
| 2. | Myron Kyton, Walfred Fried, “Avionics Navigation Systems”, 2nd Edition, John Wiley & Sons, 1997. |
| **Reference(s):** | |
| 1. | Nagaraja, “Elements of Electronic Navigation”, 2nd Edition, Tata McGraw Hill, 2000. |
| 2. | Maxwell Noton, “Spacecraft Navigation and Guidance”, Springer (London, New York), 1998**.** |
| 3. | Albert Helfrick, “Practical Aircraft Electronic Systems”, Prentice Hall Education, Career & Technology, 1995. |
| 4. | Albert D. Helfrick, “Modern Aviation Electronics”, 2nd Edition, Prentice Hall Career & Technology, 1994. |

*SDG 9 – Industry, Innovation and Infrastructure

**SDG 13 – Climate Action

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment Activity:**

**Assignment 1:**

1. Poster Presentation - Different Coordinate Systems, Mechanization INS System
2. Group Problem Solving - Direction Cosine Matrices Formulation, Schuler Tuning

**Assignment 2:**

1. Poster Presentation - RADAR Surveillance,
2. Group Problem Solving - GPS for Position and Velocity Determination, - GPS Aided Geo - Augmented Navigation (GAGAN) Architecture

**Assignment 3:**

1. Case Studies **-** Integration of GPS and INS using Kalman Filter
2. Poster Presentation - Sensors for Rendezvous Navigation, Relative GPS

| **Course Contents and Lecture Schedule** | | |
|---|---|---|
| **S. No.** | **Topics** | **No. of hours** |
| **1.0** | **Navigation Concepts** | |
| 1.1 | Fundamentals of Navigation Systems and Position Fixing | 1 |
| 1.2 | Categories of Navigation | 1 |
| 1.3 | Geometric Concepts of Navigation | 1 |
| 1.4 | The Earth in Inertial Space | 1 |
| 1.5 | Different Coordinate Systems | 1 |
| 1.6 | Coordinate Transformation | 1 |
| 1.7 | Euler Angle Formulations | 1 |
| 1.8 | Direction Cosine Matrices Formulation | 1 |
| 1.9 | Quaternion Formulation | 1 |
| **2.0** | **Inertial Navigation Systems** | |
| 2.1 | Inertial Sensors | 1 |
| 2.2 | Gyroscopes, Types, Mechanical | 1 |
| 2.3 | Electromechanical | 1 |
| 2.4 | Optical Gyro, Ring Laser Gyro | 1 |
| 2.5 | Fiber Optic Gyro | 1 |
| 2.6 | Accelerometers, Pendulous Type | 1 |
| 2.7 | Force Balance Type, MEMs | 1 |
| 2.8 | Basic Principles of Inertial Navigation Types, Platform and Strap Down, Mechanization INS System | 1 |
| 2.9 | Rate Corrections, Acceleration Errors, Schuler Tuning. | 1 |
| **3.0** | **Radio Navigation & Air Traffic Management** | |
| 3.1 | Different Types of Radio Navigation- ADF | 1 |
| 3.2 | VOR | 1 |
| 3.3 | DME | 1 |
| 3.4 | TACAN | 1 |
| 3.5 | VORTAC | 1 |
| 3.6 | Doppler - Hyperbolic Navigations | 1 |
| 3.7 | Air Traffic Management | 1 |
| 3.8 | RADAR Surveillance | 1 |
| 3.9 | Airborne Collision Avoidance Systems | 1 |
| **4.0** | **Global Positioning System** | |
| 4.1 | Overview of GPS: Basic Concept, System Architecture | 1 |
| 4.2 | GPS Signals Signal Structure | 1 |
| 4.3 | Anti-Spoofing (AS), Selective Availability | 1 |
| 4.4 | GPS for Position and Velocity Determination | 1 |
| 4.5 | GPS Aided Geo | 1 |
| 4.6 | Augmented Navigation (GAGAN) Architecture | 1 |
| 4.7 | GPS Error Sources | 1 |
| 4.8 | Clock Error, Ionospheric Error, Tropospheric Error | 1 |

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.9 | Multipath, Ionospheric Error Estimation using Dual Frequency GPS Receiver | 1 |
| **5.0** | **Hybrid Navigation & Relative Navigation Systems** | |
| 5.1 | Introduction to Kalman Filtering, Case Studies | 1 |
| 5.2 | Integration of GPS and INS using Kalman Filter | 1 |
| 5.3 | Relative Navigation, Fundamentals, | 1 |
| 5.4 | Equations of Relative Motion for Circular Orbits Clohessy Wiltshire Equations | 1 |
| 5.5 | Sensors for Rendezvous Navigation, Relative Positioning | 1 |
| 5.6 | Point Positioning and Differential Positioning | 1 |
| 5.7 | Differential GPS and Space Based Augmentation System | 1 |
| 5.8 | Concepts, Relative GPS | 1 |
| 5.9 | Formation Flying, Figure of Merit. | 1 |

**Course Designer(s)**

1. Mr P Balamurugan - pbalamurugan@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E51 | Wireless Body Area Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To learn the basics of body area network
- To learn the hardware requirement of BAN
- To learn the various network architecture
- To understand the communication and security aspects in the BAN
- To learn the applications of BAN in the field of medicine

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Summarize the significance and role of BAN in the present contemporary world. | Understand |
| CO2 | Discuss the hardware requirements for BAN and their applications in medicine. | Understand |
| CO3 | Assess the efficiency of communication and the security parameters. | Understand |
| CO4 | Describe the need for medical device regulation and regulations followed in various regions | Understand |
| CO5 | Discuss the concepts of BAN for medical applications. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |

3 - Strong; 2 - Medium; 1 - Some

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 30 |
| Understand | 40 | 40 | 70 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | |
|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | |
| 60 EC E51 - Wireless Body Area Networks | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | |
| | L | T | P | | C | CA | ES | Total |
| VIII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **BAN**<br>BAN and Healthcare - Pervasive Patient Monitoring using BAN - Technical Challenges- Sensor Design, Biocompatibility, Energy Supply, System Security and Reliability, Context Awareness, Integrated Therapeutic Systems - Ideal BSN Architecture. | [9] |
| **Hardware for BAN*** <br>Wireless Communication - RF Communication in Body, Antenna Design and Testing, Matching Network, Propagation, Materials, Base Station, Power Considerations, Wireless Communications for Wearable Systems, Body Area Network – Human Applications. | [9] |
| **Network Topologies, Protocols and Standards**<br>Network Topologies - Stand – Alone BAN - Wireless Personal Area Network Technologies. Standards - IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee - Healthcare System Standards. | [9] |
| **Coexistence Issues with BAN**<br>Analysis of Interferers – Intrinsic, Extrinsic - Effect on transmission - Regulatory Issues - Medical Device Regulation in Asia, Security and Self-Protection - Bacterial Attacks, Virus Infection, Secured Protocols, Self-Protection. | [9] |
| **Applications of BAN****<br>Monitoring Patients with Chronic Disease, Hospital Patients, and Elderly Patients - Cardiac Arrhymias Monitoring - Multi Patient Monitoring Systems - Multichannel Neural Recording- Gait Analysis - Smart Garments Electronic Pill. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2013. |
| 2. | Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pvt. Ltd., Singapore, 2012. |
| **Reference(s):** | |
| 1. | Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013. |
| 2. | Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006. |
| 3. | Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011. |
| 4. | Huan-Bang Li, Kamya Yekeh Yazdandoost, Bin Zhen, “Wireless Body Area Networks”, River Publishers Series in Computing and Information Science and Technology, 2010. |

*****SDG 9 – Industry Innovation and Infrastructure

******SDG 3 – Good Health and Well Being

**Assignment activity:**

**Assignment 1:**

1. Poster presentation on BSN Architecture for various applications.
2. Case study on Antenna Design and testing.

**Assignment 2:**

1. Case study on various protocol standards for BAN.

**Assignment 3:**

1. Case study on Body Area Network – Human Applications**.**
2. Poster presentation on Security for BAN

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
Reg. Dept.
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **BAN** | |
| 1.1 | Definition, BAN and Healthcare | 1 |
| 1.2 | Pervasive Patient Monitoring using BAN | 1 |
| 1.3 | Technical Challenges-Sensor design | 1 |
| 1.4 | Biocompatibility | 1 |
| 1.5 | Energy Supply | 1 |
| 1.6 | System Security and Reliability | 1 |
| 1.7 | Context Awareness | 1 |
| 1.8 | Integrated Therapeutic Systems | 1 |
| 1.9 | Ideal BSN Architecture | 1 |
| **2.0** | **Hardware for BAN** | |
| 2.1 | Wireless Communication - RF Communication in Body | 1 |
| 2.2 | Antenna Design | 1 |
| 2.3 | Antenna Testing | 1 |
| 2.4 | Matching Network | 1 |
| 2.5 | Propagation | 1 |
| 2.6 | Materials, Base Station | 1 |
| 2.7 | Power Considerations | 1 |
| 2.8 | Wireless Communications for Wearable Systems | 1 |
| 2.9 | Body Area Network – Human Applications | 1 |
| **3.0** | **Network Topologies, Protocols and Standards** | |
| 3.1 | Network Topologies | 1 |
| 3.2 | Stand – Alone BAN | 1 |
| 3.3 | Wireless Personal Area Network Technologies - Star | 1 |
| 3.4 | Mesh and Hybrid topology | 1 |
| 3.5 | Standards - IEEE 802.15.1 | 1 |
| 3.6 | IEEE P802.15.13 | 1 |
| 3.7 | IEEE 802.15.14 | 1 |
| 3.8 | Zigbee | 1 |
| 3.9 | Healthcare System Standards | 1 |
| **4.0** | **Coexistence Issues with BAN** | |
| 4.1 | Analysis of Interferers – Intrinsic, Extrinsic | 1 |
| 4.2 | Effect on Transmission | 1 |
| 4.3 | Regulatory Issues - Medical Device Regulation in Asia | 1 |
| 4.4 | Security | 1 |
| 4.5 | Self-Protection | 1 |
| 4.6 | Bacterial attacks | 1 |
| 4.7 | Virus Infection | 1 |
| 4.8 | Secured Protocols | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.9 | Self-Protection | 1 |
| **5.0** | **Applications of BAN** | |
| 5.1 | Monitoring Patients with Chronic Disease | 1 |
| 5.2 | Hospital Patients | 1 |
| 5.3 | Elderly Patients | 1 |
| 5.4 | Cardiac Arrhymias Monitoring | 1 |
| 5.5 | Multi Patient Monitoring Systems | 1 |
| 5.6 | Multichannel Neural Recording | 1 |
| 5.7 | Gait Analysis | 1 |
| 5.8 | Smart Garments | 1 |
| 5.9 | Electronic Pill | 1 |

**Course Designer(s)**

1. Mr. A. Balachandran - abalachandran@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E52 | Micro Electro Mechanical Systems | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To introduce and provide a broad view of MEMS and micro systems
- To familiarize with the fundamentals of MEMS products, materials for microsystems
- To learn the microsystem fabrication process
- To know the various MEMS-specific design issues and constraints
- To familiarize with the application of MEMS sensors

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the basic principles of MEMS sensors and actuators. | Understand |
| CO2 | Explain the various materials used for MEMS products. | Understand |
| CO3 | Explain the fabrication process of MEMS devices. | Understand |
| CO4 | Illustrate the design consideration, issues and constraints of basic MEMS sensors and actuators. | Understand |
| CO5 | Extend the concepts of MEMS sensors in the diverse applications. | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 30 | 30 | 40 |
| Understand | 30 | 30 | 60 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E. Electronics and Communication Engineering | | | | | | | | |
| 60 EC E52 - Micro Electro Mechanical Systems | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VIII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **MEMS**<br>Scaling law – MEMS and Micro System Products – Microsystems and Microelectronics – Working Principle of Microsystems – Micro Actuation Techniques. | [9] |
| **Materials for Microsystems**<br>Substrate and Wafer – Single Crystal Silicon Wafer Formation – Ideal Substrates – Mechanical Properties – Silicon Compounds – $Si0_2$, SiC, $Si_3N_4$ and Polycrystalline Silicon – Silicon Piezo Resistors – Gallium Arsenide – Quartz – Piezoelectric Crystals – Polymers. | [9] |
| **Micro System Fabrication Process**<br>Photolithography – Doping Process – Ion Implantation – Diffusion – Oxidation – CVD – Physical Vapor Deposition – Deposition by Epitaxy – Etching Process – Wet and Dry Etching – Bulk Micromachining – Surface Micromachining. | [9] |
| **Micro System Design***<br>Design Considerations – Process Design – Mask Layout Design – Design Constraints – Selection of Materials – Manufacturing Process – Signal Transduction – Packaging Fundamentals – Packaging Techniques – Application of Micro System in Automotive Industry – Biomedical – Telecommunication – Carbon Nano Tubes. | [9] |
| **Micro Sensors**<br>Micro Sensors – Biomedical Sensors – Piezoresistive Sensors – Pressure Sensors – Thermal Sensors – Chemical Sensors – Optical Sensors – Micro Actuation – MEMS with Actuators. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Tai-Ran Hus, "MEMS & Microsystems Design, Manufacture and Nano scale engineering", 2nd Edition, John Wiley & Sons, 2020. |
| 2. | Julian W.Gardner, Vijay K.Varadan, Osama O.Awadel Karim, "Micro sensors MEMS and Smart Devices", John Wiley & Sons, 2013. |
| **Reference(s):** | |
| 1. | Chang Liu, "Foundations of MEMS", 2nd Edition, Pearson Education Inc., 2012. |
| 2. | Stephen D Senturia, "Microsystem Design"', Springer Publication, 2000. |
| 3. | James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2005. |
| 4. | Thomas M.Adams and Richard A.Layton, "Introductory MEMS: Fabrication and Application", Springer, 2010. |

*SDG 9 – Industry Innovation and Infrastructure

**Assignment Activity**

**Assignment 1** - Covers Module 1 & 2
1. Questions on MEMS and Microsystems
2. Seminar /poster presentation

**Assignment 2** - Covers Module 3, 4
1. Explanatory questions on design and fabrication Process

**Assignment 3** - Covers Module 5
1. Seminar /poster presentation

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **MEMS** | |
| 1.1 | Scaling Law | 1 |
| 1.2 | MEMS | 1 |
| 1.3 | MEMS Products | 1 |
| 1.4 | Micro System Products | 1 |
| 1.5 | Microsystems | 1 |
| 1.6 | Microelectronics | 1 |
| 1.7 | Working Principle of Microsystems | 1 |
| 1.8 | Micro Actuation | 1 |
| 1.9 | Micro Actuation Techniques | 1 |
| **2.0** | **Materials for Microsystems** | |
| 2.1 | Substrate and Wafer | 1 |
| 2.2 | Single Crystal Silicon Wafer Formation | 1 |
| 2.3 | Ideal Substrates | 1 |
| 2.4 | Mechanical Properties | 1 |
| 2.5 | Silicon Compounds | 1 |
| 2.6 | $Si0_2$, SiC, $Si_3N_4$ and Polycrystalline Silicon | 1 |
| 2.7 | Silicon Piezo Resistors – Gallium Arsenide | 1 |
| 2.8 | Quartz – Piezoelectric Crystals | 1 |
| 2.9 | Polymers | 1 |
| **3.0** | **Micro System Fabrication Process** | |
| 3.1 | Photolithography | 1 |
| 3.2 | Doping Process-Ion Implantation | 1 |
| 3.3 | Diffusion | 1 |
| 3.4 | Oxidation | 1 |
| 3.5 | CVD – Physical Vapor Deposition | 1 |
| 3.6 | Deposition by Epitaxy | 1 |
| 3.7 | Etching Process-Wet & Dry Etching | 1 |
| 3.8 | Bulk Micromachining | 1 |
| 3.9 | Surface Micromachining | 1 |
| **4.0** | **Micro System Design** | |
| 4.1 | Design Considerations- Process Design | 1 |
| 4.2 | Mask Layout Design – Design Constraints | 1 |
| 4.3 | Selection of Materials | 1 |
| 4.4 | Manufacturing Process - Signal Transduction | 1 |
| 4.5 | Packaging Fundamentals – Packaging Techniques | 1 |
| 4.6 | Application of Micro System In Automotive Industry | 1 |
| 4.7 | Biomedical – Aerospace | 1 |
| 4.8 | Telecommunication | 1 |
| 4.9 | Carbon Nano Tubes. | 1 |
| **5.0** | **Micro Sensors** | |
| 5.1 | Micro Sensors | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.2 | Biomedical Sensors | 1 |
| 5.3 | Piezoresistive Sensors | 1 |
| 5.4 | Pressure Sensors | 1 |
| 5.5 | Thermal Sensors | 1 |
| 5.6 | Chemical Sensors | 1 |
| 5.7 | Optical Sensors | 1 |
| 5.8 | Micro Actuation | 1 |
| 5.9 | MEMS with Actuators | 1 |

**Course Designer(s)**

1. Dr.T.Baranidharan - baranidharan@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DCE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E53 | Rocketry and Space Mechanics | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To study the basic functions of rocket system
- To learn the basic concepts of aerodynamics of rockets and missiles
- To learn about the basic motion in space and gravitational field
- To study the concept of staging and control methods of rockets
- To learn about the space dynamics

## Pre-requisite

- Satellite Communication

## Course Outcomes

On the Successful Completion of the Course, Students will be able to

| | | |
|---|---|---|
| CO1 | Recognize the basic functions of rocket system | Understand |
| CO2 | Build the methods of aerodynamic forces and moments | Apply |
| CO3 | Develop the motions and forces in free space and gravitational field | Apply |
| CO4 | Summarize the rocket control and methods of staging of rockets | Understand |
| CO5 | Discuss the solar systems in space dynamics | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | 2 | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | 2 | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | 2 | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | 2 | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3` | 3 | - | 3 | 2 | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 34 |
| Understand | 20 | 20 | 32 |
| Apply | 20 | 20 | 34 |
| Analyse | | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DCE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **B.E – Electronics and Communication Engineering** | | | | | | | | |
| **60 EC E53 – Rocketry and Space Mechanics** | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VIII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Rockets System**<br>Ignition System in Rockets - Types of Igniters - Igniter Design Considerations - Design Consideration of Liquid Rocket Combustion Chamber - Injector Propellant Feed Lines, Valves - Propellant Tanks Outlet and Helium Pressurized - Turbine Feed Systems - Propellant Slosh and Propellant Hammer - Elimination of Geysering Effect in Missiles - Combustion System of Solid Rockets. | [9] |
| **Aerodynamics of Rockets and Missiles**<br>Airframe Components of Rockets and Missiles - Classification of Rockets and Missiles - Methods of Describing Aerodynamic Forces and Moments - Lateral Aerodynamic Moment - Lateral Damping Moment and Longitudinal Moment of a Rocket - Lift and Drag Forces - Drag Estimation - Rocket Dispersion - Numerical Problems. | [9] |
| **Motion in Space and Gravitational Field**<br>One Dimensional and Two Dimensional Rocket Motions in Free Space and Homogeneous Gravitational Fields - Forces Acting on a Rocket while Passing Through Atmosphere - Description of vertical, inclined and gravity turn trajectories - Approximations to burnout velocity. | [9] |
| **Staging and Control**<br>Rocket Vector Control - Methods - Thrust Determination - SITVC - Multi Staging of Rockets - Vehicle Optimization - Stage Separation Dynamics - Separation Techniques - Selection of Materials | [9] |
| **Space Dynamics**<br>The Solar System - References Frames and Coordinate Systems - The Celestial Sphere - The Ecliptic - Motion of Vernal Equinox - Sidereal Time - Solar Time - Standard Time - The Earth's Atmosphere - Two Body Problem - Libration Points - R Satellite Orbits - Relations between Position and Time - Orbital Elements - Time and Keplerian Orbits, Keplerian Orbits in Space, Perturbed Orbits. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Stephen Corda, "Introduction to Aerospace Engineering with a Flight Test Perspective",1st Edition, Wiley, 2017. |
| 2. | Wakker K.F, "Rocket Propulsion and Spaceflight Dynamics, Pitman Publication", United Kingdom, 2016. |
| **References:** | |
| 1. | Martin J.L. Turner, "Rocket and Spacecraft Propulsion: Principles, Practice and New Developments", 3rd Edition, Springer Publication, 2009. |
| 2. | Sutton G.P, "Rocket Propulsion Elements", Wiley, New York, 2006. |
| 3. | Marcel J. Sidi, "Spacecraft Dynamics and Control: An Introduction ", Cambridge University Press, 2002. |
| 4. | Brown C.D, "Spacecraft Propulsion", AIAA Education Series, AIAA Inc., Washington DC, 1996. |

**Assignment Activity:**

**Assignment 1:**

1. Poster Presentation: Types of Igniters, Classification of Rockets and Missiles
2. Group Problem Solving: Lateral Damping Moment and Longitudinal Moment of a Rocket, Numerical Problems
3. Case Studies: Latest Rockets and Missiles

**Assignment 2:**

1. Poster Presentation: Multi Staging of Rockets
2. Group Problem Solving: Forces Acting on a Rocket while Passing Through Atmosphere

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment 3:**

1. Seminar Presentation: Stage Separation Dynamics
2. Case Studies: Rocket Vector Control

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Rockets System** | |
| 1.1 | Ignition System in Rockets – Types of Igniters | 1 |
| 1.2 | Igniter Design Considerations | 1 |
| 1.3 | Design Consideration of Liquid Rocket Combustion Chamber | 1 |
| 1.4 | Injector Propellant Feed Lines, Valves | 1 |
| 1.5 | Propellant Tanks Outlet and Helium Pressurized | 1 |
| 1.6 | Turbine Feed Systems | 1 |
| 1.7 | Propellant Slosh and Propellant Hammer | 1 |
| 1.8 | Elimination of Geysering Effect in Missiles | 1 |
| 1.9 | Combustion System of Solid Rockets | 1 |
| **2.0** | **Aerodynamics of Rockets and Missiles** | |
| 2.1 | Airframe Components of Rockets and Missiles | 1 |
| 2.2 | Classification of Rockets and Missiles | 1 |
| 2.3 | Methods of Describing Aerodynamic Forces and Moments | 1 |
| 2.4 | Lateral Aerodynamic Moment | 1 |
| 2.5 | Lateral Damping Moment | 1 |
| 2.6 | Longitudinal Moment of a Rocket | 1 |
| 2.7 | Lift and Drag Forces | 1 |
| 2.8 | Drag Estimation | 1 |
| 2.9 | Rocket Dispersion, Numerical Problems | 1 |
| **3.0** | **Motion in Space and Gravitational Field** | |
| 3.1 | One Dimensional and Two Dimensional Rocket Motions in Free Space | 2 |
| 3.2 | One Dimensional and Two Dimensional Rocket Motions in Homogeneous Gravitational Fields | 2 |
| 3.3 | Forces Acting on a Rocket while Passing Through Atmosphere | 1 |
| 3.4 | Description of Vertical | 1 |
| 3.5 | Inclined Trajectories | 1 |
| 3.6 | Description of Gravity Turn Trajectories | 1 |
| 3.7 | Approximations to Burnout Velocity. | 1 |
| **4.0** | **Staging and Control** | |
| 4.1 | Rocket Vector Control | 1 |
| 4.2 | Rocket Control Methods | 1 |
| 4.3 | Thrust Determination | 1 |
| 4.4 | SITVC | 1 |
| 4.5 | Multi Staging of Rockets | 1 |
| 4.6 | Vehicle Optimization | 1 |
| 4.7 | Stage Separation Dynamics | 1 |
| 4.8 | Separation Techniques | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.9 | Selection of Materials | 1 |
| **5.0** | **Space Dynamics** | |
| 5.1 | The Solar System, References Frames and Coordinate Systems | 1 |
| 5.2 | The Celestial Sphere, The Ecliptic | 1 |
| 5.3 | Motion of Vernal Equinox, Sidereal Time | 1 |
| 5.4 | Solar Time, Standard Time | 1 |
| 5.5 | The Earth's Atmosphere. Two Body Problem | 1 |
| 5.6 | Libration Points, R Satellite Orbits | 1 |
| 5.7 | Relations Between Position and Time , Orbital Elements | 1 |
| 5.8 | Time and Keplerian Orbits | 1 |
| 5.9 | Keplerian Orbits in Space, Perturbed Orbits | 1 |

**Course Designer(s)**


1. Dr P Babu - pbabu@ksrct.ac.in
2. Mr P Balamurugan - pbalamurugan@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E54 | Software Defined Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane to comprehend the migration of networking functions to SDN environment
- To study SDN applications
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

## Pre-requisites

- Mobile Communication and Networks

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the basics of SDN and its data plane | Understand |
| CO2 | Describe the functions of control plane | Understand |
| CO3 | Apply the concepts of SDN in applications | Apply |
| CO4 | Explain the operations of network function virtualization | Understand |
| CO5 | Apply various use cases of SDN | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 25 | 25 | 40 |
| Understand | 35 | 25 | 50 |
| Apply | - | 10 | 10 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E54 - Software Defined Networks | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VIII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **SDN Data Plane****<br>Evolving Network Requirements – The SDN Approach - SDN Architecture – SDN and NFV - Related Standards – SDN Data Plane – OpenFlow Logical Network Device – OpenFlow Protocol. | [9] |
| **SDN Control Plane****<br>SDN Control Plane Architecture: Southbound Interface, Northbound Interface – Control Plane Functions – ITU-T Model – OpenDaylight – REST – Cooperation and Coordination among Controllers. | [9] |
| **SDN applications****<br>SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking -- Mobility and Wireless – Information-Centric Networking. | [9] |
| **Network Function Virtualization****<br>Network Slicing-NFV Concepts – Benefits and Requirements – Reference Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use Cases – SDN and NFV. | [9] |
| **Network Virtualization**<br>**C-RAN*, V-RAN***, Virtual LANs – OpenFlow VLAN Support – Virtual Private Networks – Network Virtualization – OpenDaylight's Virtual Tenant Network – CoSoftware - Defined Infrastructure. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", 1st Edition, Pearson Education, 2015. |
| 2. | Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", 1st Edition, O'Reilly Media, 2013. |
| **Reference(s):** | |
| 1. | Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014. |
| 2. | Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016 |
| 3. | Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017. |
| 4. | Nunes, Bruno AA, et al. "A survey of Software-Defined Networking: Past, Present, and Future of Programmable Networks." Communications Surveys & Tutorials, IEEE 16.3 (2014): 1617-1634. |

*SDG 9 – Industry Innovation and Infrastructure

**SDG 4 – Quality Education

**Assignment Activity:**

**Assignment 1** - Case Study, Poster Presentation on SDN Data Plane

**Assignment 2** - Group Discussion on SDN Control Plane

**Assignment 3 -** Simulation on SDN Control Plane

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **SDN Data plane** | |
| 1.1 | Evolving Network Requirements | 1 |
| 1.2 | The SDN Approach | 1 |
| 1.3 | SDN Architecture | 1 |
| 1.4 | SDN Architecture | 1 |
| 1.5 | SDN -Related Standards | 1 |
| 1.6 | NFV-Related Standards | 1 |
| 1.7 | SDN Data Plane | 1 |
| 1.8 | OpenFlow Logical Network Device | 1 |
| 1.9 | OpenFlow Protocol | 1 |
| **2.0** | **SDN control plane** | |
| 2.1 | SDN Control Plane Architecture | 1 |
| 2.2 | SDN Control Plane Architecture | 1 |
| 2.3 | Southbound Interface | 1 |
| 2.4 | Northbound Interface | 1 |
| 2.5 | Control Plane Functions | 1 |
| 2.6 | ITU-T Model | 1 |
| 2.7 | OpenDaylight | 1 |
| 2.8 | REST | 1 |
| 2.9 | Cooperation and Coordination Among Controllers | 1 |
| **3.0** | **SDN applications** | |
| 3.1 | SDN Application Plane Architecture | 1 |
| 3.2 | SDN Application Plane Architecture | 1 |
| 3.3 | Network Services Abstraction Layer | 1 |
| 3.4 | Traffic Engineering | 1 |
| 3.5 | Measurement and Monitoring | 1 |
| 3.6 | Security | 1 |
| 3.7 | Data Center Networking | 1 |
| 3.8 | Mobility and Wireless | 1 |
| 3.9 | Information-Centric Networking | 1 |
| **4.0** | **Network Function Virtualization** | |
| 4.1 | Network Slicing | 1 |
| 4.2 | NFV Concepts – Benefits | 1 |
| 4.3 | NFV Concepts – Requirements | 1 |
| 4.4 | Reference Architecture | 1 |
| 4.5 | NFV Infrastructure | 1 |
| 4.6 | Virtualized Network Functions | 1 |
| 4.7 | NFV Management | 1 |
| 4.8 | NFV Orchestration | 1 |
| 4.9 | NFV Use Cases – SDN and NFV | 1 |
| **5.0** | **Network Virtualization** | |
| 5.1 | C-RAN | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DCE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 5.2 | V-RAN | 1 |
| 5.3 | Virtual LANs | 1 |
| 5.4 | OpenFlow VLAN Support | 1 |
| 5.5 | Virtual Private Networks | 1 |
| 5.6 | Network Virtualization | 1 |
| 5.7 | OpenDaylight's Virtual Tenant Network | 1 |
| 5.8 | CoSoftware-Defined Infrastructure | 1 |
| 5.9 | CoSoftware-Defined Infrastructure | 1 |

**Course Designer(s)**

1. Mr.R.Satheesh kumar - satheeshkumar@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E55 | Deep Learning | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 2 | 0 | 2 | 3 |

## Objectives

- To experiment the Convolutional Networks
- To utilize the Autoencoders
- To model the Deep Generative Models
- To model the Generative Adversarial Networks (GANs)
- To experiment with the Transformers architectures

## Pre-requisites

- Machine Learning Techniques

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Apply the Convolutional Networks in computer vision applications | Apply |
| CO2 | Construct the different types of Autoencoders | Apply |
| CO3 | Build the different boltzmann machines of the Deep Generative Models | Apply |
| CO4 | Develop the different Generative Adversarial Networks (GANs) to increase the efficiency | Apply |
| CO5 | Make use of various transformer architectures for text based applications | Apply |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | - | 2 | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 - Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | - | 20 | - | - | 34 | - |
| Understand | 20 | 20 | 20 | 20 | 20 | 33 | 20 |
| Apply | 20 | 80 | 20 | 80 | 80 | 33 | 80 |
| Analyse | - | - | - | - | - | - | - |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E – Electronics and Communication Engineering**

**60 EC E55 – Deep Learning**

| Semester | Hours / Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VIII | 2 | 0 | 2 | 60 | 3 | 50 | 50 | 100 |

| | |
|---|---|
| **Convolutional Networks*** <br> The Convolution Operation - Motivation, Pooling - Convolution and Pooling as an Infinitely Strong Prior - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features - Applications of DL in Computer Vision. | [6] |
| **Autoencoders*** <br> Undercomplete Autoencoders - Stochastic Encoders and Decoders - Denoising Autoencoders - Learning Manifolds with Autoencoders - Contractive Autoencoders - Applications of Autoencoders | [6] |
| **Deep Generative Models*** <br> Boltzmann Machines - Restricted Boltzmann Machines - Deep Belief Networks - Deep Boltzmann Machines - Boltzmann Machines for Real - Valued Data - Boltzmann Machines for Structured or Sequential Outputs - Directed Generative Nets | [6] |
| **Generative Adversarial Networks (GANs)*** <br> Vanilla GAN - CycleGAN - StyleGAN - pixelRNN - DiscoGAN - lsGAN - EfficientNet-Compound Scaling - Focus on Efficiency - EfficientNet with Transformers - Pruning and Quantization Techniques | [6] |
| **Transformers*** <br> Bidirectional Encoder Representations from Transformers (BERT - Generative Pre-trained Transformer 3 (GPT-3) - Text-to-Text Transfer Transformer (T5) - Generalized Autoregressive Pretraining for Language Understanding (XLNet) | [6] |
| **Practical:** <br> 1. Implement a basic ResNet architecture and compare its training behavior to a plain CNN. <br> 2. Explore the use of dropout layers in CNN architectures to prevent overfitting. Experiment with different dropout rates at various locations in the network and observe their impact on training. <br> 3. Demonstrate an undercomplete autoencoder to compress images for storage or transmission with minimal loss of quality compared to standard compression techniques (e.g., JPEG) <br> 4. Perform an autoencoder with and without stochastic encoders/decoders on noisy data. How does noise injection during training affect the model's ability to reconstruct clean data and generalize to unseen noisy examples? <br> 5. Implement a binary RBM in Python using libraries like TensorFlow or PyTorch. Train it on a simple dataset like MNIST digits and visualize the learned hidden units. <br> 6. Implement a DBN using stacked RBMs. Train each RBM layer-wise and then fine-tune the entire network on a classification task (e.g., classifying handwritten digits). <br> 7. Implement a vanilla GAN in Python using TensorFlow or PyTorch. Train it on a simple dataset like MNIST digits and visualize the generated images. <br> 8. Execute the CycleGAN architecture and implement a basic version for image-to-image translation (e.g., translating horses to zebras). <br> 9. Implement a single-layer Transformer encoder in Python using libraries like TensorFlow or PyTorch. Train it on a small dataset of sentences to predict the next word in a sequence. <br> 10. Perform a Transformer model and visualize the attention weights learned by the model to understand how it focuses on specific parts of the input sequence. <br> **Tools used: MATLAB / Open Source – Deep Learning Platforms** | [30] |
| **Total Hours: (Lecture - 30; Practical - 30)** | **60** |
| **Text Book(s):** | |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | |
|---|---|
| 1. | Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, 2nd Edition, MIT Press, 2023. |
| 2. | Nithin Buduma, Nikhil Buduma, Joe Papa, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithm”, 2nd Edition, O'Reilly Media, Inc., 2022. |
| **Reference(s):** | |
| 1. | Rajalingappaa Shanmugamani , “Deep Learning for Computer Vision”, Packt Publishing, 2018 |
| 2. | Nikhil Ketkar, “Deep Learning with Python: A Hands-on Introduction”, Apress, 2017. |
| 3. | https://deepmind.google/ |
| 4. | https://www.deeplearning.ai/ |
| 5. | https://blog.research.google/2017/08/transformer-novel-neural-network.html |
| 6. | https://www.tensorflow.org/hub |
| 7. | https://towardsdatascience.com/transformer-models-101-getting-started-part-1-b3a77ccfa14d |
| 8. | https://roboflow.com/model/yolov5 |
| 9. | https://medium.com/swlh/resnet-with-tensorflow-transfer-learning-13ff0773cf0c |
| 10. | https://keras.io/api/layers/regularization_layers/dropout/ |

*SDG 9 – Industry Innovation and Infrastructure

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1** | **Convolutional Networks** | |
| 1.1 | The Convolution Operation | 1 |
| 1.2 | Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior | 1 |
| 1.3 | Variants of the Basic Convolution Function, Structured Outputs | 1 |
| 1.4 | Data Types, Efficient Convolution Algorithms | 1 |
| 1.5 | Random or Unsupervised Features | 1 |
| 1.6 | Applications of DL in Computer Vision | 1 |
| **2** | **Autoencoders** | |
| 2.1 | Undercomplete Autoencoders | 1 |
| 2.2 | Stochastic Encoders and Decoders | 1 |
| 2.3 | Denoising Autoencoders | 1 |
| 2.4 | Learning Manifolds with Autoencoders | 1 |
| 2.5 | Contractive Autoencoders | 1 |
| 2.6 | Applications of Autoencoder | 1 |
| **3** | **Deep Generative Models** | |
| 3.1 | Boltzmann Machines, Restricted Boltzmann Machines | 1 |
| 3.2 | Deep Belief Networks | 1 |
| 3.3 | Deep Boltzmann Machines | 1 |
| 3.4 | Boltzmann Machines for Real-Valued Data | 1 |
| 3.5 | Boltzmann Machines for Structured or Sequential Outputs | 1 |
| 3.6 | Directed Generative Nets | 1 |
| **4** | **Generative Adversarial Networks (GANs)** | |
| 4.1 | Vanilla GAN, | 1 |
| 4.2 | CycleGAN, StyleGAN | 1 |
| 4.3 | PixelRNN, DiscoGAN, | 1 |
| 4.4 | lsGAN, EfficientNet - Compound Scaling, Focus | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.5 | Efficiency, EfficientNet with Transformers | 1 |
| 4.6 | Pruning and Quantization Techniques | 1 |
| **5** | **Transformers** | |
| 5.1 | Bidirectional Encoder | 1 |
| 5.2 | Representations from Transformers (BERT) | 1 |
| 5.3 | Generative Pre-trained Transformer 3 (GPT-3) | 1 |
| 5.4 | Text-to-Text Transfer Transformer (T5) | 1 |
| 5.5 | Generalized Autoregressive Pretraining for Language Understanding (XLNet) | 2 |
| **Practical:** | | |
| 1. | Implement a basic ResNet architecture and compare its training behavior to a plain CNN. | 4 |
| 2. | Explore the use of dropout layers in CNN architectures to prevent overfitting. Experiment with different dropout rates at various locations in the network and observe their impact on training. | 2 |
| 3. | Demonstrate an undercomplete autoencoder to compress images for storage or transmission with minimal loss of quality compared to standard compression techniques (e.g., JPEG) | 4 |
| 4. | Perform an autoencoder with and without stochastic encoders/decoders on noisy data. How does noise injection during training affect the model's ability to reconstruct clean data and generalize to unseen noisy examples? | 4 |
| 5. | Implement a binary RBM in Python using libraries like TensorFlow or PyTorch. Train it on a simple dataset like MNIST digits and visualize the learned hidden units. | 2 |
| 6. | Implement a DBN using stacked RBMs. Train each RBM layer-wise and then fine-tune the entire network on a classification task (e.g., classifying handwritten digits). | 2 |
| 7. | Implement a vanilla GAN in Python using TensorFlow or PyTorch. Train it on a simple dataset like MNIST digits and visualize the generated images. | 4 |
| 8. | Execute the CycleGAN architecture and implement a basic version for image-to-image translation (e.g., translating horses to zebras). | 2 |
| 9. | Implement a single-layer Transformer encoder in Python using libraries like TensorFlow or PyTorch. Train it on a small dataset of sentences to predict the next word in a sequence. | 4 |
| 10. | Perform a Transformer model and visualize the attention weights learned by the model to understand how it focuses on specific parts of the input sequence. | 2 |

**Course Designer(s)**


1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Dr.D. Mugilan - mugilan@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E56 | Biomedical Instrumentation | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To introduce the various biological sensors and signal conditioning devices used in bio-medical field
- To familiarize with the measurements and modern methods of imaging techniques
- To learn the various methods of non-electrical parameter measurement in bio- medical applications
- To Provide latest knowledge of medical assistance / techniques and therapeutic equipment
- To learn the latest trends in biomedical instrumentation

## Pre-requisites

- Nil

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Familiarize the role of instrumentation system and its components in biological field | Remember |
| CO2 | Outline the procedure involved in the measurement of medical imaging techniques | Understand |
| CO3 | Explain the working principle of non-electrical parameter measurements | Understand |
| CO4 | Demonstrate the usage of assisting and therapeutic equipment | Understand |
| CO5 | Explain the recent trends in medical instrumentation | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | - | - | 2 | - | 3 | 3 | 3 | - | - | 3 | 2 | 3 |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 20 | 20 | 40 |
| Understand | 40 | 40 | 60 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

| K.S. Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E - Electronics and Communication Engineering | | | | | | | | |
| 60 EC E56 – Biomedical Instrumentation | | | | | | | | |
| **Semester** | **Hours/Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| VIII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Electro – Physiology and Bio Sensors**<br>Origin of Bio Potentials, Bio Potential Electrodes, ECG – EEG – EMG – Lead Systems and Recording Methods – Typical Waveforms and Signal Characteristics, Bio Sensors – Need of Sensors, Working Principle of Bio Sensor, Types of Biosensors and their Applications | [9] |
| **Medical Imaging Equipments**<br>X-Ray Machine – Radio Graphic and Fluoroscopic Techniques – Computer Tomography – MRI – Ultrasonography – Endoscopy – Thermography – Bio-Telemetry – Different types of Biotelemetry System and Patient Monitoring. | [9] |
| **Non-Electrical Parameter Measurements**<br>Measurement of Blood Pressure – Cardiac Output – Heart Rate, Heart Sound Pulmonary Function Measurements – Spirometer – Photo Plethysmography – Body Plethysmography, Blood Gas Analyzers: pH of Blood, Measurement of Blood $PCO_2$, $PO_2$. | [9] |
| **Assisting and Therapeutic Equipments**<br>Pacemakers – Defibrillators – Ventilators – Diathermy – Heart – Lung machine – Audio Meters – Dialyzers – Lithotripsy – Electrical Safety in Medical Environment: Shock Hazards – Instruments for Checking Safety Parameters of Biomedical Equipments. | [9] |
| **Recent Trends in Medical Instrumentation***<br>Laser in Medicine – Cryogenic Application – Telemedicine, Case Study: Handheld Devices Such as Infrared Thermometer – Pulse Oximeter – Blood Glucose Meter – Surgical Robotics – Telesurgery – Artificial Intelligence in Medical Imaging. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Leslie Cromwell, “Biomedical Instrumentation and Measurement”, 2nd Edition, Pearson Education, New Delhi, 2016. |
| 2. | John G. Webster, “Medical Instrumentation Application and Design”, 5th Edition, John Wiley and Sons, New York, 2020. |
| **Reference(s):** | |
| 1. | Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2014. |
| 2. | Arumugam A, ‘Bio-Medical Instrumentation”, 3rd Edition, Anuradha Publications, Chennai, 2017. |
| 3. | Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th Edition, Pearson Education, 2019. |

***** SDG 3 - Good health and well-being

**Assignment Activity**

**Assignment 1**- Covers Module 1 & 2

1. Seminar / Poster presentation

**Assignment 2**- Covers Module 3, 4

1. Seminar / Poster presentation

**Assignment 3**- Covers Module 5

1. Case Studies on Recent Trends in Medical Devices

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DCE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Electro – Physiology and Bio Sensors** | |
| 1.1 | Origin of Bio Potentials, Bio Potential Electrodes | 1 |
| 1.2 | ECG – EEG | 1 |
| 1.3 | EMG | 1 |
| 1.4 | Lead Systems and Recording Methods | 1 |
| 1.5 | Typical Waveforms and Signal Characteristics | 1 |
| 1.6 | Bio Sensors – Need of Sensors | 1 |
| 1.7 | Working Principle of Bio Sensor | 1 |
| 1.8 | Types of Biosensors and their Applications | 1 |
| 1.9 | Applications of Biosensors | 1 |
| **2.0** | **Medical Imaging Equipments** | |
| 2.1 | X-Ray Machine | 1 |
| 2.2 | Radio Graphic and Fluoroscopic Techniques | 1 |
| 2.3 | Computer Tomography | 1 |
| 2.4 | MRI – Ultrasonography | 1 |
| 2.5 | Endoscopy | 1 |
| 2.6 | Thermography | 1 |
| 2.7 | Bio-Telemetry | 1 |
| 2.8 | Different types of Biotelemetry System | 1 |
| 2.9 | Patient Monitoring System | 1 |
| **3.0** | **Non-Electrical Parameter Measurements** | |
| 3.1 | Measurement of Blood Pressure | 1 |
| 3.2 | Cardiac Output | 1 |
| 3.3 | Heart Rate, Heart Sound Pulmonary Function Measurements | 1 |
| 3.4 | Spirometer | 1 |
| 3.5 | Photo Plethysmography | 1 |
| 3.6 | Body Plethysmography | 1 |
| 3.7 | Blood Gas Analysers | 1 |
| 3.8 | pH of Blood | 1 |
| 3.9 | Measurement of Blood $PCO_2$, $PO_2$ | 1 |
| **4.0** | **Assisting and Therapeutic Equipments** | |
| 4.1 | Pacemakers | 1 |
| 4.2 | Defibrillators, Ventilators | 1 |
| 4.3 | Diathermy | 1 |
| 4.4 | Heart–Lung Machine | 1 |
| 4.5 | Audio Meters | 1 |
| 4.6 | Dialyzers | 1 |
| 4.7 | Lithotripsy | 1 |
| 4.8 | Electrical Safety In Medical Environment: Shock Hazards | 1 |
| 4.9 | Instruments for Checking Safety Parameters of Biomedical Equipment's. | 1 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| **5.0** | **Recent Trends In Medical Instrumentation** | |
| 5.1 | Laser In Medicine | 1 |
| 5.2 | Cryogenic Application | 1 |
| 5.3 | Introduction to Telemedicine | 1 |
| 5.4 | Case Study: Handheld Devices Such as Infrared Thermometer | 1 |
| 5.5 | Pulse Oximeter | 1 |
| 5.6 | Blood Glucose Meter | 1 |
| 5.7 | Surgical Robotics | 1 |
| 5.8 | Telesurgery | 1 |
| 5.9 | Artificial Intelligence in Medical Imaging | 1 |

**Course Designer(s)**


1. Dr. K.B.Jayanthi - jayanthikb@ksrct.ac.in
2. Dr.T.Baranidharan - baranidharan@ksrct.ac.in


Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| 60 EC E57 | Massive MIMO Networks | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell massive MIMO systems.
- To learn about channel estimation in multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.

## Pre-requisites

- Mobile communication and Networks

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss about massive MIMO networks. | Understand |
| CO2 | Describe the massive MIMO propagation channels. | Understand |
| CO3 | Find the channel estimation in single cell and multicell massive MIMO systems. | Understand |
| CO4 | Extend the concepts of massive MIMO deployment in the context of single cell and multicell deployment. | Understand |
| CO5 | Infer the case studies in single-cell deployment and multi-cell deployment | Understand |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO2 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | - |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 12 | 12 | 20 |
| Understand | 48 | 48 | 80 |
| Apply | - | - | - |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |
| Total | 60 | 60 | 100 |

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / DPG
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**B.E - Electronics and Communication Engineering**

**60 EC E57 - Massive MIMO Networks**

| Semester | Hours/Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| VIII | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Massive MIMO Networks**<br>Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model | [9] |
| **The Massive MIMO Propagation Channel**<br>Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels | [9] |
| **Single-Cell Systems**<br>Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility | [9] |
| **Multi-Cell Systems**<br>Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference | [9] |
| **Case Studies ****<br>Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies | [9] |
| **Total Hours:** | **45** |

| | |
|---|---|
| **Text Book(s):** | |
| 1. | Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press 2016. (UNITS II-V) |
| 2. | Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends, Now, 2017. (UNIT I) |
| **Reference(s):** | |
| 1. | Long Zhao, Hui Zhao, Kan Zheng, “Wei Xiang Massive MIMO in 5G Networks: Selected Applications”, Springer 2018 |
| 2. | Leibo Liu, Guiqiang Peng, Shaojun Wei, “Massive MIMO Detection Algorithm and VLSI Architecture”, Springer 2019 |
| 3. | Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, “mmWave Massive MIMO A Paradigm for 5G”, Elsevier, 2017 |

**SDG 9 – Industry Innovation and Infrastructure

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

**Assignment Activity:**

**Assignment 1**

Massive MIMO hybrid beam forming using MATLAB.

**Assignment 2**

1. Single cell massive MIMO downlink communications using MATLAB.
2. Multicell massive MIMO downlink communications using MATLAB.

**Assignment 3**

Channel estimation in massive MIMO system using MATLAB.

**Course Contents and Lecture Schedule**

| S. No. | Topics | No. of hours |
|---|---|---|
| **1.0** | **Massive MIMO Networks** | |
| 1.1 | Definition of Massive MIMO | 1 |
| 1.2 | Correlated Rayleigh Fading, | 1 |
| 1.3 | System Model for Uplink and Downlink | 1 |
| 1.4 | Basic Impact of Spatial Channel Correlation | 1 |
| 1.5 | Basic Impact of Spatial Channel Correlation | 1 |
| 1.6 | Channel Hardening and Favourable Propagation | 1 |
| 1.7 | Channel Hardening and Favourable Propagation | 1 |
| 1.8 | Local Scattering Spatial Correlation Model | 1 |
| 1.9 | Local Scattering Spatial Correlation Model | 1 |
| **2.0** | **The Massive MIMO Propagation Channel** | |
| 2.1 | Favorable Propagation and Deterministic Channels | 1 |
| 2.2 | Capacity Upper Bound | 1 |
| 2.3 | Distance from Favorable Propagation | 1 |
| 2.4 | Favorable Propagation and Linear Processing | 1 |
| 2.5 | Singular Values and Favorable Propagation | 1 |
| 2.6 | Favorable Propagation and Random Channels- | 1 |
| 2.7 | Independent Rayleigh Fading- | 1 |
| 2.8 | Uniformly Random Line-of-Sight (UR-LoS) | 1 |
| 2.9 | Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels | 1 |
| **3.0** | **Single-Cell Systems** | |
| 3.1 | Uplink Pilots and Channel Estimation | 1 |
| 3.2 | Orthogonal Pilots- De-Spreading of the Received Pilot Signal | 1 |
| 3.3 | -MMSE Channel Estimation, Uplink Data Transmission | 1 |
| 3.4 | Zero-Forcing -Maximum-Ratio. Downlink Data Transmission | 1 |
| 3.5 | -Linear Precoding-Zero-Forcing-Maximum-Ratio | 1 |
| 3.6 | Discussion Interpretation of the Effective SINR Expressions- | 1 |
| 3.7 | Implications for Power Control-Scaling Laws and Upper Bounds on the SINR | 1 |
| 3.8 | Near-Optimality of Linear Processing when M >> K | 1 |
| 3.9 | Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility | 1 |
| **4.0** | **Multi-Cell Systems** | |
| 4.1 | Uplink Pilots and Channel Estimation | 1 |
| 4.2 | Uplink Data Transmission | 1 |
| 4.3 | Zero-Forcing -Maximum-Ratio | 1 |

Passed in BoS Meeting held on 18/05/2024

Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.

| | | |
|---|---|---|
| 4.4 | Downlink Data Transmission -Zero-Forcing | 1 |
| 4.5 | Maximum-Ratio, Discussion | 1 |
| 4.6 | Asymptotic Limits with Infinite Numbers of Base Station Antennas | 1 |
| 4.7 | Asymptotic Limits with Infinite Numbers of Base Station Antennas | 1 |
| 4.8 | The Effects of Pilot Contamination | 1 |
| 4.9 | Non-Synchronous Pilot Interference | 1 |
| **5.0** | **Case Studies** | |
| 5.1 | Single-Cell Deployment | 1 |
| 5.2 | Example: Fixed Broadband Access in Rural Area | 1 |
| 5.3 | Multi-Cell Deployment: Preliminaries and Algorithms | 1 |
| 5.5 | Multi-Cell Deployment Examples | 1 |
| 5.6 | Mobile Access - Dense Urban 178 Scenario | 1 |
| 5.7 | Suburban Scenario | 1 |
| 5.8 | Minimum Per-Terminal Throughput Performance | 1 |
| 5.9 | Additional Observations - Comparison of Power Control Policies | 1 |

**Course Designer(s)**

1. Mr.R.Satheeshkumar - satheeshkumar@ksrct.ac.in

Passed in BoS Meeting held on 18/05/2024
Approved in Academic Council Meeting held on 25/05/2024

Chairman
BoS / ECE
CHAIRMAN BOARD OF STUDIES
Department of ECE
K.S.Rangasamy College of Technology
Tiruchengode - 637 215.