B.Tech (Electronics and Communication Engineering) –Regulations -2020
Program Effective from the batch admitted in the Academic Year 2020-21

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
**SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING (AUTONOMUS)**

**SRI VENKATESWARA UNIVERSITY**
**TIRUPATI-517502 (A.P), INDIA.**

**Vision of the Department:**

To be a lead department imparting quality and value embedded higher education and research emphasizing freedom of learning and practice.

**Mission of the Department:**

1. Transforming students into full-fledged professionals and to become leaders in dynamic global environment.
2. Augmenting knowledge and technologies in rapidly advancing fields of Electronics and Communication Engineering.
3. Promoting in depth research and create centre of excellence in thrust areas.

# PROGRAM OUTCOMES

1. PO1- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems related to Electronics & Communication and Engineering.
2. PO2- **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems related to Electronics & Communication Engineering and reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3- **Design/development of solutions:** Design solutions for complex engineering problems related to Electronics & Communication Engineering 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.
4. 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.
5. 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.
6. 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 Electronics & Communication Engineering professional engineering practice.
7. PO7- **Environment and sustainability:** Understand the impact of the Electronics & Communication Engineering professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. PO8- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms ofthe engineering practice.
9. PO9- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. 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.
11. PO11- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to manage projects and in multidisciplinary environments.
12. 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.

**Program specific outcomes (PSOs)**

1. PSO1- Competence in analysis and design of Analog and Digital system using hardware and software tools.
2. PSO2- Understand, analyse the present and future generations of Wireless communication technologies.

**Programme Educational Objectives (PEOs)**

**ECE graduates will**

1. PEO 1- have adequate analytical capabilities and practical knowledge to attend to the current challenging tasks and to absorb futuristic trends.
2. PEO 2 - To provide strong foundation in basic sci**ences and communication skills.**
3. PEO 3- able to abreast with the latest hardware and software design techniques and cutting edge technologies.
4. PEO 4- able to enhance the knowledge and skills continually throughout their career and to make them capable to adapt in diverse environments.
5. PEO 5- imbibe leadership qualities among the students to take up challenging roles in their career by ensuring professional ethics with high sense of social responsibility.

**SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING**
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
**SCHEME OF INSTRUCTION –CHOICE BASED CREDIT SYSTEM**
**B.Tech (Electronics and Communication Engineering)**
**R-20 – Program Effective for the batch admitted from the Academic Year 2020-21**
**Semester V (Third Year)**

| S.NO | Course Code | Category | Course Title | Hours/Week | | | Credits | Scheme of Evaluation Marks | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Internal | End Sem | |
| 1 | PCC | EC501C | Computer Organization & Architecture | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | PCC | EC502C | Microprocessors and Microcontrollers | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | PCC | EC503C | Digital Signal Processing | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | PCC | EC504C | Antennas and Wave Propagation | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | PCC | EC505C | Digital Communications | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | PCC-Lab | EC506L | Microprocessors and Microcontrollers Lab | 0 | 0 | 3 | 1.5 | 40 | 60 | 100 |
| 7 | PCC-Lab | EC507L | Digital Signal Processing Lab | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| 8 | PCC-Lab | EC508L | Analog and Digital Communications Lab | 0 | 0 | 3 | 1.5 | 40 | 60 | 100 |
| 9 | SC | EC509S | Web Design and Development | 1 | 0 | 2 | 2 | 100 | --- | 100 |
| 10 | MC | EC510A | Universal Human Values | 2 | 0 | 0 | 0 | 100 | --- | 100 |
| 11. | SI | EC511I | Community Service Project (CSP) during second year (To be evaluated during V semester) with minimum duration of 45 hours. | | | | 1.5 | 100 | --- | 100 |
| **Total Credits** | | | | | | | **22.5** | **620** | **480** | **1100** |

***L – Lecturer hours; Tut. – Tutorials; P/D – Practical or Drawing; T - Total***

| Category | CREDITS |
|---|---|
| Professional Core Course -PCC | 19 |
| Skill Oriented Course-SC-Internal evaluation for 100 Marks | 2 |
| Summer Internship | 1.5 |
| **TOTAL CREDITS** | **22.5** |

**SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING**
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
**SCHEME OF INSTRUCTION –CHOICE BASED CREDIT SYSTEM**
**B.Tech (Electronics and Communication Engineering)**
**R-20 – Program Effective for the batch admitted from the Academic Year 2020-21**
**Semester VI (Third Year)**

| S.NO | Category | Course Code | Course Title | Hours/Week | | | Credits | Scheme of Evaluation Marks | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Internal | End Sem | |
| 1 | PCC | EC601C | Microwave Engineering | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | PCC | EC602C | Computer Networks | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | PEC | EC603C | Professional Elective-I | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | PEC | EC604C | Professional Elective-II | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | OEC | EC605C | Open Elective-1(Through MOOCS) | 3 | 0 | 0 | 3 | 0 | 0 | 100 |
| 6 | OEC | EC606C | Open Elective-2(Through MOOCS) | 3 | 0 | 0 | 3 | 0 | 0 | 100 |
| 7 | PCC-Lab | EC607L | Microwave Engineering Lab | 0 | 0 | 3 | 1.5 | 40 | 60 | 100 |
| 8 | PCC-Lab | EC608L | Computer Networks Lab | 0 | 0 | 3 | 1.5 | 40 | 60 | 100 |
| 9 | SC | EC609S | Internet of Things and Applications | 2 | 0 | 0 | 2 | 100 | --- | 100 |
| 10 | MC | EC610A | Professional Ethics in Engineering. | 2 | 0 | 0 | 0 | 100 | --- | 100 |
| Summer Industry Internship with duration of 4 to 6 weeks (To be evaluated during VII semester) | | | | | | | | | | |
| **Total Credits** | | | | | | | **23** | **440** | **360** | **1000** |

***L – Lecturer hours; Tut. – Tutorials; P/D – Practical or Drawing; T - Total***

| Category | CREDITS |
|---|---|
| Professional Core Course -PCC | 9 |
| Professional Elective- PEC | 6 |
| Open Elective Course/Job Oriented elective-OEC | 6 |
| Skill Oriented Course-SC -Internal evaluation for 100 Marks | 2 |
| **TOTAL CREDITS** | **23** |

**SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING**
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
**SCHEME OF INSTRUCTION –CHOICE BASED CREDIT SYSTEM**
**B.Tech (Electronics and Communication Engineering)**
**R-20 – Program Effective for the batch admitted from the Academic Year 2020-21**
**Semester VII (Fourth Year)**

| S.NO | Category | Code | Course Title | Hours/Week | | | Credits | Scheme of Evaluation Marks | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Internal | End Sem | |
| 1 | PCC | EC701C | Digital Image and Video Processing | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | PEC | EC702C | Professional Elective-III | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | PEC | EC703C | Professional Elective-IV | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | PEC | EC704C | Professional Elective-V | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | OEC | EC705C | Open Elective-III (Through MOOCS) | 3 | 0 | 0 | 3 | 0 | 0 | 100 |
| 6 | OEC | EC706C | Open Elective-IV (Through MOOCS) | 3 | 0 | 0 | 3 | 0 | 0 | 100 |
| 7 | SC | EC707S | Machine Learning | 2 | 0 | 0 | 2 | 100 | 0 | 100 |
| 8 | SI | EC708I | Summer Industry Internship (4 to 6 Weeks) completed during VI Semester | | | | 3 | 100 | 0 | 100 |
| **TOTAL CREDITS** | | | | | | | **23** | **360** | **240** | **800** |

***L – Lecturer hours; Tut. – Tutorials; P/D – Practical or Drawing; T - Total***

| Category | CREDITS |
|---|---|
| Professional Core Course -PCC | 3 |
| Professional Elective- PEC | 9 |
| Open Elective Course/Job Oriented elective-OEC | 6 |
| Skill Oriented Course-SC-Internal evaluation for 100 Marks | 2 |
| Industrial/Research Internship-SI | 3 |
| **TOTAL CREDITS** | **23** |

**SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING**
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
**SCHEME OF INSTRUCTION –CHOICE BASED CREDIT SYSTEM**
**B.Tech (Electronics and Communication Engineering)**
**R-20 – Program Effective for the batch admitted from the Academic Year 2020-21**
**Semester VIII (Fourth Year)**

| S.NO | Course Code | Category | Course Title | Hours/Week | | | Credits | Scheme of Evaluation Marks | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Internal | End Sem | |
| 1 | EC801P | **PW** | Project-Work and Internship | 0 | 0 | 0 | 12 | 40 | 60 | 100 |
| **Total Credits** | | | | | | | **12** | | | **100** |

***L – Lecturer hours; Tut. – Tutorials; P/D – Practical or Drawing; T – Total***

| S.No | Semester | Credits |
|---|---|---|
| 1. | I | 18 |
| 2. | II | 19 |
| 3. | III | 24 |
| 4. | IV | 21.5 |
| 5. | V | 22.5 |
| 6. | VI | 23 |
| 7. | VII | 23 |
| 8. | VIII | 12 |
| **TOTAL CREDITS** | | **163** |

| B.Tech. (R20) - Program Electives | | | | |
|---|---|---|---|---|
| **I** | **II** | **III** | **IV** | **V** |
| **(VI-Semester)** | **(VI-Semester)** | **(VII-Semester)** | **(VII-Semester)** | **(VII-Semester)** |
| CMOS VLSI Design | Cyber Security | Neural Networks and Fuzzy Logic | Satellite Communication | Embedded System Design |
| Information Theory and Coding | Nano Electronics | Radar Engineering | Fiber Optic Communication | Real Time Operating Systems |
| Optimization Techniques | Sensors and Transducers | Testing and Testability | Wireless Communication | FPGA Based System Design |
| Hardware-Software Co-design | Electronic Instrumentation | Bio-Medical Instrumentation | MEMS | Digital Signal Processors & Architectures |

# B.Tech (Electronics and Communication Engineering)
# Programme Syllabus

## ( Effective from the Academic Year 2020-21)

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING**

**(AUTONOMUS)**

**SRI VENKATESWARA UNIVERSITY**

**TIRUPATI-517502 (A.P), INDIA.**

**EC501C- Computer Organization & Architecture**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:** It is important to understand Computer Architecture in order to structure a program so that it runs efficiently on a real machine. When selecting a system to use, it is important to understand the tradeoff among various components, so you can accurately compare competing systems, and understand technical literature on new computer systems. This course will cover the basic concepts of Computer organization and its Architecture that are important for you to understand, including the CPU control and data-path, memory systems including caching and virtual memory, and input/output subsystems.

**Prerequisite Courses:** Digital Logic Design

**Course Objectives**: The purpose of the course is

1. To understand the structure of a computer and its operations.
2. To understand the RTL and Micro-level operations and control in a computer.
3. Understanding the concepts of computer arithmetic, instruction set design, micro-programmed control unit, pipelining and vector processing, I/O Systems and memory organization, and operating systems.

**UNIT - I:**
**Basic Structure of Computers:** Computer Types, Functional Unit, Basic Operational Concepts, Bus Structures, Software, Performance, Multiprocessors and Multi Computers, Data Representation, Fixed Point Representation, Floating – Point Representation.

**Register Transfer Language and Micro Operations:** Register Transfer Language, Register Transfer Bus and Memory Transfers, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit, Instruction Codes, Computer Registers Computer Instructions – Instruction Cycle, Memory – Reference Instructions, Input – Output and Interrupt, STACK Organization, Instruction Formats, Addressing Modes, DATA Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

**UNIT - II**:
**Micro Programmed Control:** Control Memory, Address Sequencing, Microprogram Examples, Design of Control Unit, Hard Wired Control, Microprogrammed Control.

**The Memory System:** Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Cache Memories Performance Considerations, Virtual Memories Secondary Storage, Introduction to RAID.

**UNIT - III:**
**Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer Modes, Priority Interrupt, Direct Memory Access, Input –Output Processor (IOP), Serial Communication; Introduction to Peripheral Components, Interconnect (PCI) Bus, Introduction to Standard Serial Communication Protocols like RS232, USB, IEEE 1394.

**UNIT - IV:**
**Operating Systems Overview:** Overview of Computer Operating Systems Functions, Protection and Security, Distributed Systems, Special Purpose Systems, Operating Systems Structures-Operating System Services and Systems Calls, System Programs, Operating Systems Generation.

**Memory Management:** Swapping, Contiguous Memory Allocation, Paging, Structure of The Page Table, Segmentation, Virtual Memory, Demand Paging, Page-Replacement Algorithms, Allocation of Frames, Thrashing Case Studies - UNIX, Linux, Windows.

**Principles of Deadlock:** System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

**UNIT - V:**

**File System Interface:** The Concept of a File, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection.

**File System Implementation:** File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

**Text Books:**

1. Computer Organization – Carl Hamacher, Zvonks Vranesic, Safea Zaky, 5th Edition, McGraw Hill.
2. Computer Systems Architecture – M. Moris Mano, IIIrd Edition, Pearson
3. Operating System Concepts- Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 8th Edition, John Wiley.

**References:**

1. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson
2. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition PHI
3. Fundamentals of Computer Organization and Design - Sivaraama Dandamudi Springer Int. Edition.
4. Operating Systems – Internals and Design Principles, Stallings, sixth Edition–2009, Pearson Education.
5. Modern Operating Systems, Andrew S Tanenbaum 2nd Edition, PHI.

**Course Outcomes:** After the completion of the course the student will be able to:

1. Visualize the organization of different blocks in a computer.
2. Use micro-level operations to control different units in a computer.
3. Have knowledge about the organization of Arithmetic and Logical unit and I/O unit.
4. Understand the design of Memory unit, and the overview of computer system hardware and learn about major activities of an Operating systems in a computer with regard to file management, and operating system functions.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | 1 | - | - | 2 | - | - |
| CO2 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | - | - | 2 | - | - |
| CO3 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | - | - | 2 | 1 | - |
| CO4 | 3 | 2 | 3 | 3 | 1 | - | - | - | 1 | - | - | 1 | - | - |
| CO5 | 3 | 3 | 3 | 2 | 1 | - | - | - | 1 | - | - | 2 | - | 1 |

**EC502C Microprocessors and Microcontrollers**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:** The purpose of this course is to teach students the fundamentals of Microprocessor and Microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a Microprocessor / Microcontroller implementation.

This course will start with a discussion on a simple microprocessor, 8085. Understanding this architecture is the basis to follow any other complex CPU architecture. It will be followed by a complete overview of a range of microcontrollers covering 8051, PIC, AVR and ARM. The hardware intricacies of these processors and their programming will be covered.

**Pre-requisite Courses:** Digital Logic Design, Analog Circuits.

**Course Objectives:** The purpose of the course is

1. To familiarize the Architecture, Instructions and Timings of microprocessors and micro controllers.
2. To introduce 8051 architecture and programming of microcontrollers.
3. To provide the knowledge about interfacing techniques of I/O and memory.
4. To understand the concepts of ARM architecture and Advanced ARM processors.

**Unit -I**

Overview of microcomputer systems and their building blocks, Introduction to 8-bit microprocessor (8085) Architecture, addressing modes, Instruction set, Machine cycles, instruction cycle and timing states, instruction timing diagrams, simple programs in 8085.

**Unit -II**

**Semiconductor memories**: RAM, ROM, SRAM, and DRAM. Memory interfacing, concepts of interrupts and Direct Memory Access.

**8086 microprocessor** – Architecture, Instruction set, Addressing modes, Interrupt system. Minimum mode 8086 system, Maximum mode 8086 system and timing diagrams. Concepts of virtual memory, Cache memory, Architectures of 286, and 386 processors.

**Unit -III**

**8051 Microcontroller:** Architecture, register set, addressing modes, Instruction set, Interrupt structure, I/O ports functions, timer and serial port operations, External memory interfacing with 8051.

Assembly language programming of 8051, Parallel I/O Ports, Interrupts, Timer and Counter, Serial Communication Programming.

**Unit -IV**

**I/O interfacing:** LED, LCD, Keyboard, Stepper motor, DC Motor, ADC, DAC Interface to 8051. Assemblers and compilers, C language programs, Programming and debugging tools.

**Serial Communication and Bus Interface:** Serial Communication Standards, Serial Data Transfer Scheme, Onboard communication interfaces - I2C, SPI, and CAN; External communication interfaces - 9-pin RS-232, USB, Bluetooth, Wi-Fi, and ZigBee. Architectures of PIC, Architecture of AVR.

**Unit -V**

**ARM 32-bit Microcontroller:** Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence. (Text 5: Ch 1, 2, 3)

**Text/Reference Books:**

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996. (UNIT I).
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface", Morgan Kaufman Publishers. (UNIT II).
3. Barry B. Brey, The Intel Microprocessors 8086/8088, 80, 86, 80286, 80386 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and interfacing, Prentice Hall of India Private Limited, New Delhi, 2003, Pearson Education, 2004. (UNIT II).
4. Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Penram International Publishing/ Thomson Publishers, 2nd Edition, 2005.
5. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3‖, 2nd Edition, Newnes, (Elsevier), 2010. (UNIT V).

**Course Outcomes**: Upon completing this course, the student will have the ability to:

1. Do assembly language programming.

2. Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc and develop systems using different microcontrollers.

3. Understand the usage of Communication interfaces with Microcontrollers.

4. Understand design ARM / PIC Microcontroller-based systems.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | 3 | - | - | 2 | - | - |
| CO2 | 3 | 3 | 2 | 2 | 1 | - | - | - | 3 | - | - | 2 | 1 | - |
| CO3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 3 | - | - | 2 | - | - |
| CO4 | 3 | 2 | 3 | 3 | 2 | - | - | - | 3 | - | - | 1 | - | 1 |

**EC503C-Digital Signal Processing**

Instruction : Hours/Week : **3L:0T:0P** **Credits: 3**
Sessional Marks : **40** End Semester Examination Marks: **60**

**Course Description:**

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Analyze the digital signals using various digital transforms DFT,FFT etc. Review of discrete-time linear, time-invariant systems, Fourier transforms and z-transforms. Introduction to Multirate signal processing, TMS DSP processors.

**Course Learning Objectives:**

1. To describe signals mathematically and understand how to perform mathematical operations on signals.
2. It will provide knowledge of Digital filter.
3. Design and develop the basic digital system.
4. To discuss multi rate signal processing and applications.
5. Knowledge on TMS DSP processors and their applications.

**Unit -1**

**Discrete Fourier Transform:**
Review of Discrete-time Fourier Transform, Z-Transform, Discrete Fourier transform - Properties, linear convolution, circular convolution of sequences using DFT. Computation of DFT.
**Fast Fourier Transforms:** Fast Fourier transforms (FFT)-Radix2 decimation in time and decimation in frequency FFT algorithms, inverse FFT and FFT for composite N.

**Unit-2**

**IIR Digital Filters:** Analog filter approximations-Butterworth and Chebyshev, design of IIR digital filters from analog filters, design examples: analog-digital transformations. Realization structures for IIR filters – direct, canonic, cascade, parallel forms.

**Unit-3**

**FIR Digital Filters:** Characteristics of FIR digital filters, frequency response. Design of FIR digital filters using window techniques, frequency sampling technique. Realization structures of FIR Filter - Transversal, Poly-phase and Linear phase structures. comparison of IIR and FIR filters.

**Unit -4**

**Multirate Digital Signal Processing Fundamentals:** Basic sample rate alteration devices, Multirate Structures for sampling rate Converters, Multistage design of decimator and Interpolator, Polyphase Decomposition.

**Unit -5**

**DSP PROCESSORS:**
Architecture of TMS320C5X: Introduction, Bus structure, Central Arithmetic Logic Unit, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped Registers, Program controller, some flags in the status registers, On-chip memory, On-chip peripherals.

**Text Books**

1. John G. Proakis, Dimitris G.Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications”, Pearson Education/PHI, 4th ed., 2007.
2. Sanjit K Mitra, “Digital Signal Processing: A computer-based approach”, Tata Mcgraw Hill, 3rd edition, 2009.
3. A.V. Oppenheim and R.W. Schaffer, “Discrete Time Signal Processing”, Prentice Hall of India.

4. B. Venkataramani, M.Bhaskar, Digital Signal Processors: Architecture, Programming and Applications, Tata McGraw Hill, 2002.
5. Handouts on DSP Processors.
6. Texas Instruments DSP Processor user manuals and application notes

**Course Outcomes:**

Students must be able to:

CO1: Apply DFT for the analysis of digital signals and systems
CO2: Design IIR and FIR filters
CO3: Design the Multirate Filters
CO4: Analyze and apply suitable DSP algorithm for specific application

## MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OBJECTIVES:

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | 3 | 2 | - | - | - | - | - | - | 2 | **3** | - | 1 |
| **CO2** | - | 3 | 3 | - | - | - | - | - | - | - | 3 | **2** | - | 1 |
| **CO3** | 2 | - | 2 | 2 | - | - | - | - | - | - | 2 | - | - | - |
| **CO4** | 2 | - | 2 | 2 | - | 3 | 2 | 2 | - | - | 3 | - | - | - |

**EC504C- Antennas & Wave Propagation**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Pre-requisite:** Electromagnetic Theory and Transmission Lines .

**Course Description:** Antennas and propagation effects play a crucial role in RF systems. In practice, the design of a working system such as mobile phone networks, WIFI, RFID, Satellite communication and GPS requires a good understanding of these components. This course teaches the fundamentals of antenna and propagation and shows the application in practical examples. The course covers the theory of radiation, fundamental antenna parameters and concepts, wire antennas such as dipoles and loop antennas, antenna arrays, aperture antennas, microstrip antennas, numerical analysis, communication & radar systems and propagation effects.

**Course Objectives:** The course objectives are:

1. To understand the concept of radiation, antenna definitions and significance of antenna parameters, to derive and analyze the radiation characteristics of thin wire dipole antennas and solve numerical problems.
2. To analyse the characteristics and design relations of UHF, VHF and Microwave Antennas.
3. To identify the antenna array requirements, to determine the characteristics of ULAs and estimate the patterns of BSA, EFA, and Binomial Arrays.
4. To understand the concepts and set-up requirements for microwave measurements, and familiarize with the procedure to enable antenna measurements.
5. To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.

**UNIT-I**

Antenna Basics: Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Fields from Oscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation, Retarded Potentials–Helmholtz Theorem

Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths. Loop Antennas.

**UNIT-II**

Antenna Arrays: Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays.

**UNIT-III**

VHF, UHF and Microwave Antennas - I: Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics, Helical Antennas – Helical Geometry, Helix Modes, Practical Design Considerations for Monofilar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types, Fermat's Principle, Optimum Horns, Design Considerations of Pyramidal Horns.

**UNIT-IV**

VHF, UHF and Microwave Antennas - II: Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas – Geometry and Parameters, Characteristics of Microstrip Antennas. Reflector Antennas – Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features.

**UNIT-V**

Ground Wave Propagation –Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation –Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering phenomena, Troposphere Propagation. Sky Wave Propagation –Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation.

**Text/Reference Books:**

1. Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4th ed., (Special Indian Edition), 2010.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd edition,2000.
3. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
4.. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications,New Delhi, 2001.

**Course outcomes:** At the end of this course students will have the ability to

CO1: Understand the basic parameters of antenna (L1) and apply the concepts to various antennas based on frequency, configuration and establish the radiation patterns of antenna arrays (L2)
CO2: Analysis of VHF, UHF and Microwave Antennas (L3)
CO3: Design and analysis of microstrip antennas (L4)
CO4: To understand the wave propagation in different frequency ranges (L5)

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | - | 1 | - | 2 | 1 | 2 | 1 | 3 | 3 | - | - |
| **CO2** | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 1 | 3 | 3 | - | 1 |
| **CO3** | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 1 | 1 | 1 | 2 | 3 | - | 1 |
| **CO4** | 3 | 3 | 2 | 3 | 2 | 2 | 3 | - | 1 | 1 | 2 | 3 | - | 1 |

## EC505C -DIGITAL COMMUNICATIONS

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**

Digital Communications is a fundamental course in the stream of Electronics and Communication Engineering. This course introduces the basic concepts and principles involving in the analysis of a digital communication system including various Modulation techniques, concepts involved at the Matched filter, ISI, Signal space analysis, various digital modulation techniques and error detection and correction methods. All modern communication systems uses these concepts as fundamentals to design, operate the same. This course helps students comprehend respective Engineering competitive examinations such as GATE, IES etc.,

**Course Objectives:**

1. To understand the key modules of digital communication systems with emphasis on its modulation techniques
2. To analyze Matched filter, Inter-symbol interference, correlative level coding concepts
3. To understand signal space analysis to understand geometric representation of signals
4. To Understand generation and detection of various digital modulation schemes
5. To get introduced to the concept and basics of information theory and Error detection and correction codes.

**UNIT I**

**Digital Coding of Analog Waveforms:** Sampling, Quantization, Quantization noise, Encoding, Pulse Code Modulation, Regeneration, Decoding & Filtering, Noise considerations in PCM systems, Time-Division Multiplexing, Synchronization, Differential encoding, Delta Modulation, Differential Pulse Code Modulation, Processing gain, Adaptive Delta Modulation,

**UNIT II**

**Baseband Pulse Transmission:** Matched filter and it's Properties, Matched filter for rectangular pulse, Error rate due to noise, Inter-symbol Interference, Nyquist's criterion for distortion-less baseband binary transmission, Duo binary, Modified duo binary in Correlative-level coding, Baseband M-array PAM transmission, Eye patterns. .

**UNIT III**

**Signal Space Analysis:** Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Response of bank of correlators in noise, Coherent detection of signals in noise, Correlation receiver, Probability of error.

**UNIT IV**

**Digital Modulation Techniques**: Introduction, Pass band transmission model, ASK, Coherent Phase Shift Keying – Binary phase shift keying, Quadrature shift keying, Binary Frequency shift keying, M-array Quadrature Amplitude Modulation, Non-coherent orthogonal modulation schemes-Differential PSK, Non-Coherent Binary FSK.
(Error probability, Generation and Detection, Power spectra, Bandwidth above schemes)

**UNIT-V**

**Error Control Coding:** Introduction, Examples of Error Control Coding, Methods of controlling Errors, Types of Errors, Types of Codes. Linear Block Codes: Matrix Representation of Linear Block Codes, Error Detection and Error Correctio Capabilities of Linear Block Codes. Convolution Codes: Encoders for Convolution Codes, Decoders for Convolution Codes. Illustrative Problems.

**TEXT BOOKS**

1. Simon Haykin, "Communication Systems," by John Wiley & Sons,3rd Edition, 2010.
2. Sam Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2006.

**REFERENCES**:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006.
2. J.S. Chithode, "Digital Communications", Technical Publications, Ist Edition, 2020
3. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", McGraw-Hill International Edition, 5th Edition, 2010.

**Course Outcomes:**

1. Understand the Digital communication System and able to analyse the different Digital modulation techniques.
2. Understand the concepts of baseband digital modulation schemes and Inter Symbol Interference.
3. Analyze Signal space concepts, probability of error performance of various digital binary modulation systems and are able to design digital communication systems.
4. Design a system with Error correcting codes by learning Block Codes, Cyclic Codes and Convolutional Codes.

**Mapping of course outcomes with program outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 1 |
| **CO2** | 2 | 1 | 1 | 2 | - | - | - | - | - | - | - | - | - | 1 |
| **CO3** | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 |
| **CO4** | 1 | 1 | 1 | 2 | 1 | - | - | - | - | - | - | 1 | - | 1 |

## EC506L -Analog and Digital Communication Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits: **1.5**
Sessional Marks: **40** Semester Examination Marks: **60**

**Course Description:**

This course gives students deep knowledge in Analog and Digital communication systems at the practical level so that students can understand the logical, analytical, and mathematical background of the communication system. This lab focuses on understanding the fundamental concepts of signal flow in Analog and Digital communication system. The Detailed analysis of AM, FM, Pulse modulations, digital modulation techniques, sampling and reconstruction, Data Conditioning and Reconditioning are done. The course covers the basic types of Analog and Digital modulation in both Simulink and equipment based.

**Course Objectives**

1. The course gives students deep knowledge in analog and digital communication systems at the practical level.
2. The course aims to make the student familiar with Analog and Digital Modulation and Demodulation techniques, transmission, reception etc.
3. The Course aims to write and simulate the MATLAB code to study the modulation techniques.
4. The Couse enhance the understanding theory of Analog and Digital Communication concepts.

**Hands-on experiments related to the course contents ECPCT404.**
**List of Experiments:**

1. Fourier Synthesis
2. AM Transmitter & Receiver
3. FM Transmitter & Receiver
4. AM/FM Radio Receiver
5. Analog signal sampling & Reconstruction
6. Generation & Detection of PAM/PWM/PPM
7. Generation & Detection of PCM
8. Generation & Detection of DM/SIGMA DELTA/ ADM
9. Baseband digital data transmission
10. Data conditioning & Reconditioning
11. Generation & Detection of BPSK/DPSK/DEPSK
12. Simulation of digital modulation schemes
    (i) Phase Shift Keying (PSK), differential phase shift keying (DPSK), DEPSK
    (ii) QPSK, M-ary PSK, Quadrature Amplitude Modulation (QAM)

**Course Outcome**s:

After the completion of the course the student will be able to:

1. Generate AM and FM signals and evaluate their performance.
2. Perform signal sampling by determining the sampling rates for baseband signals and reconstruct the signals.
3. Generate digital modulation signals for ASK, PSK and FSK and perform their detection.

4. Simulate MSK, DPSK, QPSK and DEPSK schemes and estimate their BER.

**Mapping of course outcomes with program outcomes:**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 3 | - | - | - | 3 | - | - | - | 3 | 3 |
| **CO2** | 3 | | 2 | 2 | 3 | - | - | - | 1 | - | - | - | 3 | 3 |
| **CO3** | 2 | 2 | 3 | 3 | 3 | - | - | - | 2 | - | - | - | 2 | 3 |
| **CO4** | 2 | 2 | 3 | 3 | 3 | - | - | - | 2 | - | - | - | 2 | 3 |

## EC507L Microprocessors and Microcontrollers Laboratory

Instruction : Hours/Week : **0L:0T:3P** Credits: **1.5**
Sessional Marks : **40** Semester Examination Marks: **60**

**Course Overview:** This course introduces the assembly language programming of 8085 and 8051 Microcontroller. It gives a practical training of interfacing the peripheral devices with the 8085 microprocessor/ 8051microcontroller. It is useful for developing students to be proficient in the assembly language programming skills and real time applications of Microprocessor as well as microcontroller.

**Course Objectives**: The purpose of the course is

1. To expose students to the operation of typical microprocessor (8085) and microcontroller (8051) trainer kits.
2. To prepare the students to be able to solve different problems by developing different programs.
3. To develop the building of Microcontroller based systems.

**Hands-on experiments related to the course contents EC502C.**
**Pre-requisites: None**

Every student is free to do his / her choice of experiments in the Laboratory. Student can do at least 10 to 12 experiments only.

**List of Experiments:**

**(8085/8086 Microprocessor Assembly Language Programming)**

1. Write a simple program for arithmetic operations – addition, subtraction, multiplication and division of 16 – bit number.
2. Write a simple program for string operations like string concatenation, swapping.
3. Write a program for interfacing LCD with 8085 and display a message.
4. Write a program for interfacing Stepper Motor with 8085.
5. Write a program for flashing LEDs using 8253 /8254 (PIT) and interrupts.

**(8051 Microcontroller Assembly Language Programming)**

6. Write a program for performing simple arithmetic operations.
7. Write a program for performing simple Logical operations.
8. Write a simple program for flashing LEDs using software delays, timers and interrupts.
9. Write a program for interfacing Seven Segment Display / LCD with 8051 and display messages.
10. Write a program for interfacing Keypad with 8051 and display keypad input on LCD.
11. Write a program for square waveform generation, with different frequencies and duty cycles.
12. Write a program for serial communication through UART using polling and interrupt methods.
13. Write a program for interfacing ADC with 8051.
14. Write a program for Pulse Width Modulation using on-chip PWM and analog I/O modules.

Write a program for interfacing Seven Segment Display and/or LCD to ARM or 8086 processor.

**Course Outcomes:** After the completion of the course the student will be able to:

1. Write assembly language programmes for arithmetic and Logical operations using 8085 µp.
2. Develop assembly language programs / C and C++ programs using microcontrollers.

3. Write 8051 assembly language programs to control inbuilt timer and communication modules.
4. Interface ADC and DAC modules with microprocessor-based systems and Write assembly language programmes using ARM / 8086 processor.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | **2** | **1** | **1** | **1** | **-** | **-** | **-** | **3** | **-** | **-** | **2** | **-** | **-** |
| **CO2** | **3** | **2** | **2** | **2** | **1** | **2** | **2** | **2** | **3** | **-** | **-** | **2** | **1** | **-** |
| **CO3** | **2** | **2** | **2** | **2** | **2** | **-** | **-** | **-** | **3** | **-** | **-** | **2** | **-** | **1** |
| **CO4** | **3** | **2** | **3** | **3** | **2** | **-** | **-** | **-** | **3** | **-** | **-** | **1** | **-** | **1** |

**EC508L-Digital Signal Processing Lab**

Instruction : Hours/Week : **0L:0T:2P** Credits: **1**
Sessional Marks : **40** Semester Examination Marks: **60**

**Course Description:**

The course is to make familiar with practical implementation of the digital signal processing. digital signal processing involving filtering, deconvolution, spectral estimation, and a variety of other techniques. Laboratory work involves developing signal processing systems on a personal computer and using them with both real and simulated data. Questions related to hardware realizations are also considered. Students can able to develop DSP algorithms for convolution, correlation, DFT, filtering of signals etc. Introduction to TMS Processors software and Hardware tools.

**Course Learning Objectives:**

1. Understanding the mathematical operations on discrete signals
2. Can able to design Inverse DFT and FFT of a discrete time signals.
3. Model IIR and FIR filters using different techniques.
4. Implementing different DSP algorithms on TMS processors.

**Part A – Using MATLAB**

1. Generation of standard signals, periodic and Aperiodic signal
2. DFT and IDFT
3. FFT algorithms - Decimation in Time / Decimation in Frequency.
4. Linear and Circular Convolution in time domain and in frequency domain (using DFT)
5. Spectrum Analysis using DFT
6. IIR filter design
7. FIR filter design
8. Decimation and Interpolation

**Part B – Using Code Composer Studio**

9. Linear convolution of two sequences.
10. Circular convolution of two sequences.
11. Generation of Elementary signals.
12. MAC operation using various addressing modes
13. FIR Implementation.

**Learning Resources**

**Text Books**

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007.
2.A.V. Oppenheim, R. W. Schafer, Discrete-Time Signal Processing, 3/e, Prentice Hall of India, 2009.

**Reference Books**

1. Fundamentals of Digital Signal Processing - Lonnie C Ludeman, John Wiley & Sons, 2003
2. Digital Signal Processing "A – Computer Based Approach" - Sanjit K Mitra, Tata Mc Graw Hill 2nd Edition, 2003
3. Theory and Application of Digital Signal Processing - Lawrence R Rabiner & Bernard Gold, Prentice Hall.

**e- Resources & other digital material**

1. http://www.nptel.iitm.ac.in/

2. http://www.ee.umanitoba.ca/~moussavi/dsp815/LectureNotes/index.html
3. http://www.ece.cmu.edu/~ee791
4. http://cobweb.ecn.purdue.edu/~ipollak/ee438/FALL04/notes/notes.html

**Course Outcomes**

Upon successful completion of the course, the student will be able to

1. Interpret discrete-time signals using DFT
2. Apply FFT algorithms for various signal processing operations
3. Design the Multirate Filters
4. Design IIR and FIR digital filters for real time DSP applications

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | 1 | - | - | 3 | - | 1 |
| **CO2** | 3 | - | - | 1 | - | - | - | - | - | - | - | 2 | 1 | - |
| **CO3** | 3 | 3 | - | - | - | - | - | - | - | 3 | - | 2 | - | 1 |
| **CO4** | 3 | 3 | 3 | - | 2 | 1 | - | 2 | - | - | - | 2 | - | 1 |

**EC509S-WEB Design and Development**

Instruction: Hours/Week: **2L:0T:0P** **Credits: 2**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Description**: This course offers a preliminary treatment of Web Design and Development concepts that yield visible and audible results through web pages. The course includes an introduction to the World Wide Web, industry standard browsers, effective site and page design, HTML, XHTML, CSS, XML, web graphics and client-side scripting. The course includes detailed discussion of design practices, such as the appropriate use of text and graphics, font and color selection, meta-tags, navigation techniques, media formats, and methods of enhancing the user experience.

**COURSE OBJECTIVES:**

1. To introduce the fundamentals of Internet, and the principles of web design.
2. To construct basic websites using HTML and Cascading Style Sheets.
3. To build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.
4. To develop modern interactive web applications using PHP, XML and MySQL.

**Unit–I**

**Introduction:** Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, Features of latest version of Web.

**Web Design:** Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.

**Unit–II**

**HTML:** Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of latest version of HTML.

**Style sheets:** Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of latest version of CSS.

**Unit–III**

**JavaScript:** Client-side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: JavaScript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations.
**DHTML:** Combining HTML, CSS and JavaScript, Events and buttons.

**Unit–IV**

**XML:** Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT.

**PHP:** Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions.

**Unit–V**

**PHP and MySQL:** Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.

**TEXT BOOKS:**

1. Ralph Moseley and M. T. Savaliya, Developing Web Applications, Wiley-India Private Limited, 2011.
2. Robert W.Sebesta, Programming the World Wide Web, 7th edition, Pearson Education, 2013.

**REFERENCES:**

1. Kogent Learning Solutions Inc., Web Technologies Black Book, Dreamtech Press, 2009.
2. Joel Sklar, Principles of Web Design, Cengage Learning, 6th Edition, 2015.
3. B. M. Harwani, Developing Web Applications in PHP and AJAX, Tata McGraw-Hill, 2010.
4. Internet and World Wide Web How to program, Paul J. Deitel, Harvey M. Deitel, and Abbey Deitel, 5th Edition, Pearson Education, 2011.

**COURSE OUTCOMES:** At the end of this course, the students will be able to

1. Describe the concepts of World Wide Web, and the requirements of effective web design.
2. Develop web pages using the HTML and CSS features with different layouts as per need of applications.
3. Use the JavaScript to develop the dynamic web pages.
4. Construct simple web pages in PHP and to represent data in XML format and use server-side scripting with PHP to generate the web pages dynamically using the database connectivity.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | 2 | - | - | - | - | - | 1 | 2 | 1 | - | 1 |
| **CO2** | 3 | 3 | 2 | 1 | 3 | 1 | - | - | - | - | 1 | - | - | - |
| **CO3** | 2 | 2 | 1 | - | - | 3 | - | - | - | - | - | 1 | - | 1 |
| **CO4** | 1 | 2 | 3 | 1 | 2 | 3 | - | - | - | - | - | - | - | - |

| EC510A- Universal Human Values | |
|---|---|
| Instruction: Hours/Week: **2L:0T:0P** | **Credits: 0** |
| Sessional Marks: **100** | End Semester Examination Marks: **0** |

**COURSE DESCRIPTION:**

The methodology of this course is universally adaptable, involving a systematic and rational study of the human being vis-à-vis the rest of existence. It is free from any dogma or value prescriptions. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with and within the student himself/herself finally.

**Pre-requisites/co-requisites:** None.

**COURSE OBJECTIVES:**

1. To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. To understand (or developing clarity) the harmony in the human being, family, society and nature/existence.
3. To strengthen self-reflection and to develop commitment and courage to act.
4. To understand social responsibility of an engineer.
5. To appreciate ethical dilemma while discharging duties in professional life.

**UNIT I**

**Introduction - Need, Basic Guidelines, Content and Process for Value Education:** Purpose and motivation for the course, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

**UNIT II**

**Understanding Harmony in The Human Being - Harmony in Myself!:**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility(Sukh and Suvidha).Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health.

**UNIT III**

**Understanding Harmony in The Family and Society- Harmony in Human-Human Relationship:** Understanding harmony in the Family - the basic unit of human interaction. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness(Ubhay-tripti); Trust**(Vishwas)** and Respect **(Samman)**as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution (Samadhan), Prosperity(Samridhi), fearlessness (**Abhay**) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society(AkhandSamaj), Universal Order(SarvabhaumVyawastha) - from family to world family.

**UNIT IV**

**Understanding Harmony in The Nature and Existence - Whole Existence as Coexistence:**

Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

**UNIT V**

**Implications of The Above Holistic Understanding of Harmony on Professional Ethics:** Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems.

Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.

**TEXT BOOKS:**

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.
2. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

**REFERENCE BOOKS:**

1. E. F. Schumancher, 1973, Small is Beautiful: a study of economics as if people mattered. Blond & Briggs, Britain.
   A. N. Tripathy, 2003, Human Values, New Age International Publishers.
2. Ivan IIIich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
3. A Nagraj, 1998 Jeevan Vidya ekParichay, Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press, Reprinted 1986, 1991.
5. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
6. E G Seebauer& Robert L.Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.
7. M Govindrajan, S Natrajan& V. S Senthil kumar, Engineering Ethics (including Humna Values), Eastern Economy Edition, Prentice Hall of India Ltd.
8. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
9. India Wins Freedom - Maulana Abdul Kalam Azad.

**Relevant CDs, Movies, Documentaries & Other Literature:**

1. value Education website, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. AI Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charle Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology - the Untold Story.

**COURSE OUTCOMES:** On completion of this course, the students will be able to

1. To become more aware of themselves, and their surroundings (family, society, nature) and distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
2. Understand the role of a human being in ensuring harmony in society and nature.
3. To become sensitive to their commitment towards what they have understood (human values, human relationship and human society) .
4. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

**ASSESSMENT:**

(i). Assessment by faculty mentor: 20 marks
(ii). Socially relevant project/Group Activities/Assignments: 20 marks
(iii). Semester End Examination: 60 marks

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 3 | - | - | - | 1 | 1 | 1 | - | 1 | 1 | - | - |
| **CO2** | 3 | - | - | 1 | - | 3 | 2 | - | - | - | - | - | - | - |
| **CO3** | 1 | - | - | - | - | 3 | - | - | - | - | - | - | - | - |
| **CO4** | - | 2 | - | - | - | 1 | 2 | 3 | 3 | 1 | 1 | 2 | - | - |

## EC601C -Microwave Engineering

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Prerequisite: Antennas and Propagation

**Course Description:** The course will be broadly focusing on analysis, design and development of microwave circuits and systems. The course will cover introduction to Microwaves, Microwave transmission modes, Transmission lines, Impedance Matching, Microwave Network Analysis, Directional Coupler, Power Divider, Microwave Filters, Microwave Attenuator, RF switches and phase shifters, Microwave Amplifiers, Low Noise Amplifier, Microwave Mixers and Oscillators, Microwave Antennas, Microwave Measurements, Microwave Systems.

**Course Objectives:**

1. To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
2. To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
3. To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S-Matrix for various types of microwave junctions.
4. Understand the utility of Optical Fibres in Communications.

**UNIT – I**

Microwave Tubes: Limitations and Losses of conventional Tubes at Microwave frequencies, Cavity Klystrons – Structure, Re-entrant Cavities, Velocity Modulation Process, Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics. Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

**UNIT - II**

M-Type Tubes: Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical Traveling Wave Magnetron – Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics,

Microwave Solid State Devices: Introduction, Classification, Applications. Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

**UNIT - III**

Waveguide Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees. Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components – Gyrator, Isolator.

**UNIT – IV**

Scattering matrix: Importance of S-matrix, Scattering Matrix Properties, Directional Couplers – 2 Hole, Bethe Hole S Parameters, [s] matrix of Magic Tee and Circulator, Measurement of S-parameters.

MICs : Advantages of MIC's, Hybrid MIC's, Strip lines and microstrip lines, Monolithic MICs

**UNIT V**

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, Measurement of Low and High VSWR., Cavity Q-factor and Impedance Measurements. Antenna gain measurements.

**TEXT BOOKS:**

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition
3. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 4t. 4. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012
5. Microwave and Radar Engineering, Kulkarni, Umesh publications, 1998.
6. Microwave Engineering, Annapurna Das and Sisir K.Das, Tata Mc Graw-Hill, 2000.

**Course Outcomes:** At the end of this course students will have the ability to

1. Known power generation at microwave frequencies and derive the performance characteristics. (L2)
2. Understand the principles of solid-state devices. (L1)
3. Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications (L4)
4. Understand the utility of S-parameters in microwave component design (L3) and to know the measurement procedure of various microwave parameters. (L5)

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 3 | 3 | - | - |
| **CO2** | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | - |
| **CO3** | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | - | - |
| **CO4** | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 3 | 3 | - | 1 |

## EC602C-Computer Networks

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**
Computer Networks plays a vital role in the era of communication systems in resources sharing applications. The aim of this course is to introduce the concepts of Computer networking and its applications.

**Course Objectives:**

1. To understand the basic concepts of computer networks and internet
2. To gain knowledge about the design issues of link layer and internet layer
3. To gain knowledge about the concept of connection oriented and connection less Protocols.
4. To gain knowledge in developing different applications.

**Unit -1**
Introduction to Computer Networks and the Internet: Principles of network applications and Internet Challenges &Layering concepts.
OSI Reference Model & TCP/IP Reference Model.
**Unit -2**
**DATA Link layer:** ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, Ethernet, Wireless LAN, Flow Control, Error Detection and Error Correction.
**Unit-3**
**Internet Layer**:
IP Addressing, IP Protocol, Routing Algorithms, queuing disciplines.
Congestion Control Algorithms, Resource Reservation, Admission Control and Differentiated services.
**Unit-4**
**Transport Layer:** User Datagram Protocol, Connection oriented transport protocol– Transmission Control Protocol, Remote Procedure Call. Port Addressing and Socket Programming.
**Unit-5.**
**Application layer**: The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, JPEG, MPEG.
Network Security: DES & RSA.

**Text / Reference books:**

1. J.F. Kurose and K. W. Ross, "Computer Networking – A top-down approach Pearson Education, 5th Edition
2. Andrew S Tanenbaum, "Computer Networks", Prentice Hall India Fourth Edition.
3. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition
4. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall
5. William Stallings, "Data and Computer Communication, 8th Edition, Pearson Prentice.

**Course Outcomes:** At the end of this course students will demonstrate the ability to

1. Design of computer networks in Internet.
2. Understand the concepts of error handling, flow control IP Addressing and Routing.
3. Understand the concept of TCP and UDP protocols.
4. Develop several protocols foe web Applications.

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | _ | 3 | 3 | -- | 1 |
| **CO2** | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | _ | - | 1 |
| **CO3** | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | _ | - | 1 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | _ | 3 | _ | - | 1 |

| **EC607L- Microwave Engineering Lab** | |
|---|---|
| Instruction : Hours/Week : **0L:0T:2P** | Credits: **1.5** |
| Sessional Marks : **40** | Semester Examination Marks: **60** |

**Course Description:**
Electromagnetic waves and Microwave Lab will provide practical understanding on Microwave Bench setup such as Reflex Klystron and operation of various components of the same, Gunn diode and their characteristics. This course also ensures to have practical exposure on Antenna parameters measurements and simulation of the same & optical devices and it's characteristics.

**Course Objectives:**

1. To understand Microwave Bench setups
2. To analyze various parameters of microwave measurements
3. To understand Antenna measurements
4. To understand the characteristics of optical fiber devices.

**List of Experiments:**

1. Reflex klystron characteristics – I
2. Reflex klystron characteristics – II
3. Gunn diode Oscillator
4. Waveguide parameters
5. VSWR measurements
6. Directional Couplers
7. Attenuation Measurement
8. Impedance Measurement
9. Dipole Antenna Simulation using IE3D software
10. Antenna measurements

**Course Outcomes:** At the end of the course the students will be able to

1. Able to measure the performance of simple microwave circuits and devices.
2. Perform microwave measurements with sophistical instruments such as vector network analyser and spectrum analyzer.
3. Able to assess the performance of optical devices such as Light sources, fibers and detectors.
4. Able to plot the loss characteristics of optical fibers.

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | 1 | - | 1 | 1 | - | - | - | - | - | - | - | - |
| **CO2** | 1 | 2 | 2 | 1 | 1 | | - | - | - | - | - | - | - | - |
| **CO3** | 1 | 1 | 1 | - | 1 | 1 | - | - | - | - | - | 1 | - | - |
| **CO4** | 1 | 1 | 1 | - | 1 | | - | - | - | - | - | 1 | - | - |

## EC608L- COMPUTER NETWORKS LAB

Instruction: Hours/Week: **0L:0T:3P** **Credits: 1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Prerequisites:** Nil

**Course Over view:** This course is designed to impart knowledge about detailed knowledge of Computer Networks, various protocols used in Communication, Managing and configuring Cisco Switches and Routers, and various WAN technologies. Learn basic concepts of computer networking and acquire practical notions of protocols with the emphasis on TCP/IP.

**Course Objectives:** A lab provides a practical approach to Ethernet/Internet networking: Networks are assembled, and experiments are made to understand the layered architecture and how to do some important protocols work.

1. Explain network technologies and how devices access local and remote networks.
2. Explain how switching operates in a small to a medium-sized business network.
3. Design an IPv4 and IPv6 addressing scheme to provide network connectivity for a small to a medium-sized business network.
4. Implement basic network connectivity between devices.

**Major Equipment Required:** Required software (Open Source) like NS-2, NSG-2.1 and Wire SHARK

**Note:**

(a). Minimum of 12 Experiments have to be conducted

(b). All the Experiments may be Conducted using Network Simulation software like NS-2, NSG-2.1 and Wire SHARK/equivalent software.

For Experiments 2 to 10 Performance may be evaluated through simulation by using the parameters Throughput, Packet Delivery Ratio, Delay etc.

**List of Experiments:**

1. LAN Configuration.
2. IP Addressing.
3. Error Correction and Error Detection.
4. Routing Algorithms
5. FCFS and SJF algorithms
6. Round Robin Algorithm.
7. Peer to peer file sharing and Socket Programming
8. RSA algorithm.
9. DNS look up tables
10. HTML Design.
11. HTTP.

**Course Outcomes:** At the end of the course the students will be able to

1. Understand network technologies and to access local and remote networks.
2. Operate switching in a small to a medium-sized business network.
3. Design an IPv4 and IPv6 addressing scheme to provide network connectivity for a small to a medium-sized business network.
4. Implement basic network connectivity between devices.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | 3 | - | - | 2 | - | 1 |
| CO2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | - | - | 2 | - | 1 |
| CO3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 3 | - | - | 2 | - | 1 |
| CO4 | 3 | 2 | 3 | 3 | 2 | - | - | - | 3 | - | - | 1 | - | - |

## EC609S- Internet of Things and Its Applications

Instruction: Hours/Week: 0**L:1T:2P** **Credits: 2**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**

Internet of Things (IoT) cuts across different application domain verticals ranging from civilian to defense sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support a lot. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different lot solutions. IoT-based applications such as innovative shopping systems, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT-based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

**Course Learning Objectives:**

The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It's becoming the Internet of Things (IoT). The course enables student:

1. To understand the fundamentals of Internet of things and protocols.
2. It introduces some of the application areas where Internet of Things can be applied.
3. To build a small low-cost embedded system using Arduino / Raspberry Pi or equivalent boards.
4. To apply the concept of Internet of Things in the real-world scenario.

**UNIT I:**

**Fundamentals of IoT:** Introduction to IoT – Characteristics, Sensing, Actuation, Physical Design - Protocols – Logical Design – Enabling technologies – IoT Levels – Six Levels of IoT - Domain Specific IoTs.

**UNIT II:**

**IOT and M2M:** M2M, IoT vs M2M, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN and NFV for IoT, IOT system Management with NETCONF-YANG.

**UNIT III:**

**IoT Design Methodology:** IoT Systems Management – IoT Design Methodology – Specifications Integration and Application Development. Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.

**UNIT IV:**

**Data Analytics for IoT:** Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis.

**UNIT V:**

**Tools for IoT:** Chef, Puppet, IOT code generator Case studies: Chef. Puppet – Multi-tier Deployment, NETCONF-YANG.

**IOT Applications:** IoT applications for industry- Future Factory Concepts, Smart Applications, Smart Cities and Smart Homes. Case Study: Agriculture, Healthcare, Activity Monitoring. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

**Text Book & References:**

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A Hands-on Approach", Universities Press, 2015.
2. Chef, Puppet, IOT code generator Case studies: Chef. Puppet – Multi-tier Deployment, NETCONF-YANG, Raspberry Pi.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
4. *Simon Monk, "Programming the Raspberry Pi*: *Getting Started with Python",* McGrawHill, *2013*
5. Marco Schwartz, "Internet of Things with the Arduino Yun", Pack Publishing, 2014.

**Course Outcomes:** Upon completion of this course, students will be able to:

1. Design a portable IoT using Arduino/ equivalent boards and relevant protocols.
2. Develop web services to access/control IoT devices.
3. Deploy an IoT application and connect to the cloud.
4. Analyze applications of IoT in real-time scenario.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | - | **1** | **1** | - | - | - | - | - | - | **2** | **1** | - |
| **CO2** | - | - | 3 | **2** | **1** | - | - | - | - | - | - | **2** | **1** | - |
| **CO3** | - | **2** | - | **3** | **1** | - | - | - | - | - | - | **2** | -- | **1** |
| **CO4** | - | - | - | - | **1** | **3** | **3** | **3** | - | - | - | **1** | | |

**EC610A- Professional Ethics in Engineering**

Instruction: Hours/Week:**2L:0T:0P** **Credits: 0**
Sessional Marks: **100** End Semester Examination Marks: **0**

**COURSE DESCRIPTION:**
This course is designed to introduce engineering students to the concepts of engineering ethics. It will allow students to explore the relationship between ethics and engineering and apply classical moral theory and decision making to engineering issues encountered in academic and professional careers. It mainly focuses on improving the capacities of leadership /management through training in professional ethics. Codes of ethics have been invoked as a basis for professional engineering licensure. Violations of such ethical codes have led to many well-known tragic engineering failures that endangered human life and jeopardized public welfare. This discipline will doubtless take its place alongside such well-established fields as medical ethics, business ethics, and legal ethics.
**Pre-requisites/co-requisites:** None.

**COURSE OBJECTIVES**
To enable the students
1. To create an awareness on Engineering Ethics and Human Values.
2. To instill Moral and Social Values and Loyalty and to appreciate the rights of others.
3. To study the moral issues and decisions confronting individuals and organizations engaged in engineering profession.
4. To study the related issues about the moral ideals, character, policies, and relationships of people and corporations involved in technological activity.

**UNIT I**
**Human Values**: Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation –Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II**
**Engineering Ethics:** Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

**UNIT III**
**Engineering as Social Experimentation:** Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT-IV**
**Safety, Responsibilities and Rights:** Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR)
Discrimination.

**UNIT V**
**Global Issues:** Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct– Corporate Social Responsibility.

**TEXTBOOKS:**
1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

**REFERENCES:**

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey,2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi,2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.

**COURSE OUTCOMES:** Upon completion of the course, the student should be able to:

1. Discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.
2. Learn the moral issues and problems in engineering; find the solution to those problems.
3. Learn the need for professional ethics, codes of ethics and roles, concept of safety, risk assessment.
4. Gain exposure to Environment Ethics & computer ethics; know their responsibilities and rights.

**Grading**/Assessment:

(i). Attendance: 20 marks

(ii). Group Activities/Assignments: 20 marks

(iii). Semester End Examination: 60 marks

**Mapping of course outcomes with program outcomes:**

| CO/ PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | - | 1 | 2 | - | 1 | 1 | - | - | 2 | - | - |
| CO2 | 3 | 3 | 2 | - | 1 | - | - | - | 1 | - | - | 2 | - | - |
| CO3 | 2 | 2 | 2 | - | 1 | - | - | - | 1 | - | - | 2 | 1 | - |
| CO4 | 3 | 2 | 3 | - | 1 | - | 3 | 2 | 1 | - | - | 1 | - | - |

**EC701C -Digital Image and Video Processing**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**

In this course you will learn the basic principles and tools used to process images and videos, and how to apply them in solving practical problems. Digital images and videos are everywhere these days – in thousands of scientific, consumer, industrial, and creative applications. Which are obtained from a wide range of the electromagnetic spectrum - from visible light and infrared to gamma rays and beyond. The ability to process image and video signals is therefore an incredibly important skill to master for engineering/science students, software developers, and practicing scientists. Digital image and video processing continues to enable the multimedia technology revolution we are experiencing today.

This course will strengthen fundamental knowledge about digital image and video processing techniques along with mathematical framework to describe and analyze images and videos. Digital image and video processing is used in almost all engineering fields and wide range of applications in industrial automation, medical, agriculture, security, entertainment, education and many more.

**Course Objectives:**

The student should be made to:
1. To know the concept of image fundamentals and mathematical transforms necessary for image Processing
2.To study the image enhancement and segmentation techniques
3.To learn about different color models and image compression procedures
4.To understand fundamentals of Video Coding

**UNIT-1:**

Digital Image Fundamentals: Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Image Transforms: Need for image transforms, Fourier transform, 2-D Discrete Fourier transform and its properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform.

**UNIT –II**

Image Enhancements and Filtering: Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain.

Sharpening filters: first and second derivative, frequency domain filters – low-pass and high-pass filters.

Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding –global and adaptive, region-based segmentation.

**UNIT –III**

Image Compression: Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Shannon Fano coding, Huffman coding, Bit plane coding, Transform coding, Predictive coding, Lossy Predictive coding, JPEG Standards.

**UNIT –IV**

Color Image Processing: Color models– RGB, YUV, HSI; Color transformations– formulation, color complements.

Video Processing: Video Formation, Perception and Representation, Video capture and display, Analog video raster, Analog color television systems, Digital video.

**UNIT –V**

Fundamentals of Video Coding: Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B;

Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.
Video Segmentation: Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts.

**Text/ Reference Books:**

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008.
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004.
3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015.
4. S.Jayaraman, S.Esakkirajan and T.VeeraKumar, "Digital Image processing, Tata Mc Graw Hill publishers, 2009 .
5. Yao Wang,Jorn Ostermann and Ya Qin Zhang "Video processing and Communications" Prentice Hall Publishers, 2002, ISBN 0-13-017547-1.

**Course Outcomes:**

At the end of the course, students will demonstrate the ability to:
1. Mathematically represent the various types of images and analyze them.
2.Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding.
4. Apply basic operations on video and estimate the motion of two-dimensional video.

**Mapping of course outcomes with program outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 1 | 2 | 1 | - | - | - | - | 3 | 2 | - | - |
| **CO2** | 3 | 2 | 3 | 2 | 2 | 1 | - | - | - | - | 3 | 1 | - | - |
| **CO3** | 2 | 2 | 2 | 1 | 1 | 2 | - | - | - | - | 3 | 3 | 2 | - |
| **CO4** | 2 | 2 | 2 | 1 | 1 | 2 | - | - | - | - | 3 | 3 | 2 | - |

**EC707S-Machine learning and its Applications.**

Instruction: Hours/Week: **2L:0T:0P** **Credits: 2**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Description:**

This course provides an introduction to the fundamental methods at the core of modern machine learning. It covers theoretical foundations as well as essential algorithms for supervised and unsupervised learning. Classes on theoretical and algorithmic aspects are complemented by practical lab sessions.

**COURSE OBJECTIVES:**

1. To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
2. To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3. Explore supervised and unsupervised learning paradigms of machine learning.
4. To explore Deep learning technique and various feature extraction strategies.

**Unit 1:**

Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes. Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods. Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

**Unit 2**

Unsupervised Learning -Clustering: K-means/Kernel K-means , Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models).

**Unit 3**

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests.)

**Unit 4**

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.

**Unit 5**

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference Recent trends in various learning techniques of machine learning and classification methods for IOT applications, Various models for IOT applications.

**Text / References Books:**

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

**Course Outcomes:** After completion of course, students would be able to:

1. Understand the mathematical and statistical prospective of machine learning algorithms through python programming.

2. Design and evaluate the unsupervised models through python in built functions.
3. Evaluate the machine learning models pre-processed through various feature engineering algorithms by python programming.
4. Design and apply various reinforcement algorithms to solve real time complex problems.

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 1 | 1 | - | - | - | - | 2 | 1 | - | 2 | - | 1 |
| CO2 | 2 | 1 | 2 | - | - | - | - | - | 2 | 1 | - | 2 | 2 | - |
| CO3 | - | 2 | 2 | - | - | - | - | - | 1 | 1 | - | 2 | 2 | - |
| CO4 | - | - | - | 2 | - | - | - | - | 2 | 1 | - | 2 | - | - |

| B.Tech. (R20)<br>EC603C --Program Elective-I | |
|---|---|
| **S.No** | **Name of the Program Elective** |
| 1. | CMOS VLSI Design |
| 2. | Information Theory and Coding |
| 3. | Optimization Techniques |
| 4. | Hardware-Software Co-design |

**EC603C- CMOS VLSI Design**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**

This is an introductory course that covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems including CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation and testing, low power techniques, design tools and methodologies, VLSI architecture.

**Prerequisite Courses:** Electronic Devices, Analog Circuits and Digital Logic Design

**Course Learning Objectives:**

1. To learn basic CMOS Circuits.
2. To learn CMOS process technology.
3. To learn techniques of chip design using programmable devices.
4. To learn the concepts of designing VLSI Subsystems.

**Unit -1**

**Integrated circuit fabrication process:** oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.

Brief Introduction to MOS, PMOS, NMOS, CMOS & BiCMOS technologies. Review of MOS transistor models, Non-ideal behavior of the MOS Transistor, $\mathbf{I_{ds} - V_{ds}}$ relationships, MOS transistor threshold Voltage, Transistor as a switch, Inverter characteristics.

**Unit -2**

**Integrated Circuit Layout:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for CMOS Inverters and Gates, Scaling of MOS circuits.

**Basic Circuit Concepts:** Sheet Resistance $R_s$ and its concepts to MOS, Area Capacitance calculations, Inverter Delays, driving large Capacitive Loads, Wiring Capacitances. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout.

**Unit -3**

**Combinational Circuit Design:** CMOS logic families including static, dynamic and dual rail logic, Switch logic, Alternate gate circuits. Shifters, Adders, Parity generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multipliers, Counters, High Density Memory Elements.

**Unit -4**

**Sequential Circuit Design:** Static Circuits, Design of latches and Flip-flops.

**Test and Testability:** Fault-modeling and simulation, test generation, design for testability, Built-in-self-test.

**Unit -5**

**Physical Design:** Floor-Planning, Placement, routing, Power delay estimation, Clock and Power routing.

**Design styles:** Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices.

**Text/Reference Books:**

1. Neil H.E. Weste and David Money Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2015.
2. Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, Essentials of VLSI circuits and systems, PHI, 2005 Edition.
3. John M. Rabaey, A. Chandrakasan, B. Nikolic, Digital Integrated Circuits: A Design Perspective", 2nd Edition, Pearson, 2016.

**Course Outcomes:** At the end of the course the students will be able to

1. Learn CMOS process technology.
2. Analyze and implement various CMOS static logic circuits using Lambda based design rules.
3. Design different CMOS circuits using various logic families along with their circuit layouts for subsystem design.
4. To learn techniques of chip design using programmable devices and use HDL tools for designing VLSI Subsystems.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 2 | 1 | 3 | - | - | - | - | - | - | - | - | - | - | 1 |
| CO3 | 2 | - | - | 3 | - | - | - | - | - | - | - | - | - | - |
| CO4 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |

## EC603C-INFORMATION THEORY AND CODING

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**

Information is the source of a communication system, whether it is analog or digital. Information theory is a mathematical approach to the study of coding of information along with the quantification, storage, and communication of information. With the increasing importance in the field of digital communications, the information theory emphasizes basic aspects such as discrete modulation techniques and coding theory. The purpose of this course is to introduce various concepts in information theory, error detection and correction codes. various fundamental concepts of encoding algorithms.

**Course Objectives:**

The student should be made to:

1. Be familiar with the concept of amount of information, entropy, channel capacity
2. To know the different communication channels, channel capacity and relation among them.
3. To understand and analyze the various error-detection and error-correction codes
4. To know the design concepts of cyclic codes, convolution codes.

**UNIT I**

**Information Theory:** Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model of Information Sources, Entropy and Information rate of Markoff Sources

**UNIT II:**

**Source Coding:** Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI

Encoding of the Source Output, Shannon's Encoding Algorithm. Shannon Fano Encoding Algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm.

**UNIT III**

**Information Channels:** Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of: Binary Symmetric Channel, Binary Erasure Channel, Muroga,s Theorem, Continuous Channels

**UNIT IV**

**Error Control Coding:** Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting Hamming Codes, LDPC CODES

**Binary Cyclic Codes:** Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction

**UNIT V**

**Cyclic Codes:** Golay Codes, BCH Codes.

**Convolution Codes:** Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm, TURBO CODES .

**Text Books:**

1. Digital and analog communication systems, K. Sam Shanmugam, John Wiley
1. India Pvt. Ltd, 1996.
2. Digital communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008.
3. Information Theory and Coding, Muralidhar Kulkarni, K.S. Shivaprakasha, WileyIndia Pvt. Ltd, 2015, ISBN:978-81-265-5305-1.

**Reference Books:**

1. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007
2. Principles of digital communication, J. Das, S. K. Mullick, P. K. Chatterjee, Wiley, 1986 - Technology & Engineering
3. Digital Communications – Fundamentals and Applications, Bernard Sklar, Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
4. Information Theory and Coding, K.N.Haribhat, D.Ganesh Rao, CengageLearning, 2017.

**Course Outcomes:**

Upon completion of the course, the student should be able to:

1. Describe basic parameters of Information, the concepts of source coding techniques, and Error Control coding techniques)
2. Apply knowledge of Information theory and error control coding techniques to solve problems
3. Analyze various source coding and channel coding techniques for error detection and error correction in the information bearing signals
4. Analyze and compare audio and video coding techniques

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | 1 | - | - | - | - | 1 | - | - | - |
| **CO2** | 3 | - | 3 | | 1 | 1 | - | - | - | - | 2 | - | - | - |
| **CO3** | 3 | 2 | 2 | 3 | 2 | 2 | - | - | - | - | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | 3 | 3 | 3 | 3 |

| EC603C-Optimization Techniques | |
|---|---|
| Instruction: Hours/Week: **3L:0T:0P** | **Credits: 3** |
| Sessional Marks: **40** | End Semester Examination Marks: **60** |

**Course Description:**

The students will try to learn the operation research models using optimization techniques based upon the fundamentals of engineering mathematics (minimization and Maximization of objective function). The problem formulation by using linear, dynamic programming, game theory and queuing models.

**Course Objectives:**

1. Operation research models using optimization techniques based upon the fundamentals of engineering mathematics (minimization and Maximization of objective function).
2. The problem formulation by using linear, dynamic programming, game theory and queuing models.
3. The stochastic models for discrete and continuous variables to control inventory and simulation of manufacturing models for the production decision making.
4. Formulation of mathematical models for quantitative analysis of managerial problems in industry.

**Unit 1**

Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

**Unit 2**

Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

**Unit 3**

Single Variable Optimization Problems: Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

**Unit 4**

Multi Variable and Constrained Optimization Technique, Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method, Gradient based method, Cauchy‘s Steepest descent method, Newton‘s method , Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method

**Unit 5**

Intelligent Optimization Techniques: Introduction to Intelligent Optimization, Soft Computing, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Grammer Approach - Example Problems

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

**Textbooks and References:**

1. S. S. Rao, “Engineering Optimisation: Theory and Practice”, Wiley, 2008.
2. K. Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall, 2005.
3. C.J. Ray, “Optimum Design of Mechanical Elements”, Wiley, 2007.
4. R. Saravanan, “Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.

5. D. E. Goldberg, "Genetic algorithms in Search, Optimization, and Machine learning", Addison-Wesley Longman Publishing, 1989.

**Course Outcomes:**

At the end of this course, students will be able to

1. Understand importance of optimization.
2. Ability to go in research by applying optimization techniques in problems of Engineering and Technology.
3. Apply basic concepts of mathematics to formulate an optimization problem .
4. Analyze and appreciate variety of performance measures for various optimization problems .

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | - | - | 1 | - | - | - | 1 | - | - | - | - |
| **CO2** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 2 | - |
| **CO3** | 1 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 | 2 | 1 | - |
| **CO4** | - | 1 | 2 | - | - | - | - | - | - | - | - | 1 | 1 | 1 |

## EC603C-Hardware-Software Co-design

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Description:**
This course will cover the fundamental topics in HW/SW codesign and partitioning concepts in designing embedded systems. The emphasis will be on goals and methodology for partitioning hardware/software in embedded systems.

**Course Objectives:**

1. To provide an understanding of system-level design of embedded systems comprised of both hardware and software.
2. To investigate topics such as Hardware Software partitioning, mapping and scheduling, Co-simulation, synthesis and verification relevant to co-design.
3. To explore, analysis and optimization processes in support of algorithmic and architectural design decisions.
4. Gain design experience with case studies using contemporary high-level methods and tools.

**UNIT I**
**NATURE OF HARDWARE AND SOFTWARE**
Hardware, Software, Definition of Hardware/Software Co-Design – Driving factors Platform design space – Application mapping – Dualism of Hardware design and software design – Concurrency and parallelism, Data flow modeling and Transformation – Data Flow Graph – Tokens, actors and queues, Firing rates, firing rules and Schedules – Synchronous data flow graph – control flow modeling – Adding time and resources – Transformations.

**UNIT II**
**DATA FLOW IMPLEMENTATION IN SOFTWARE AND HARDWARE**
Software Implementation of Data Flow – Converting queues and actors into software, Dynamic Scheduler – Hardware Implementation of Data Flow – single rate SDF graphs into hardware, Pipelining – Analysis of control flow and data flow – construction of control and data flow graph – Translating C into hardware – Designing data path and controller.

**UNIT III**
**DESIGN SPACE OF CUSTOM ARCHITECTURES**
Finite state machines with data path – FSMD design example, Limitations – Micro programmed Architecture – Micro programmed control, microinstruction encoding, Micro programmed data path, micro programmed machine – General purpose Embedded Core – RISC pipeline, Program organization SoC interfaces for custom hardware – Design Principles in SoC Architecture

**UNIT IV**
**HARDWARE/ SOFTWARE INTERFACES**
Principles of Hardware/software communication – synchronization schemes, communication constrained versus Computation constrained, Tight and Loose coupling - On-chip buses – Memory mapped interfaces – coprocessor interfaces – custom instruction interfaces – Coprocessor hardware interface – Data and control design, programmer's model.

**UNIT V**
CASE STUDIES Trivium Cripto coprocessor – Trivium stream cipher algorithm, Trivium for 8-bit platforms – AES coprocessor, CORDIC coprocessor – algorithm and implementation.

**Text Books and References:**

1. Ralf Niemann, "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems",
   Kluwer Academic Pub, 1998.
2. Jorgen Staunstrup, Wayne Wolf, "Hardware/Software Co-Design: Principles and Practice" , KluwerAcademic Pub, 1997.

3. Giovanni De Micheli, Rolf Ernst Morgon, "Reading in Hardware/Software Co-Design" Kaufmann Publishers, 2001.
4. Patrick Schaumont, A Practical Introduction to Hardware/Software Codesign, 2nd Edition, Springer.

**Course Outcomes: After completion of this course the students will be able to**

1. Analyze and apply design methodologies.
2. Appreciate the fundamental building blocks of the using hardware and software co-design and
3. Relate implementation and testing environments and techniques and their interrelationships.
4. Get familiar with modern hardware/software tools for building prototypes and to be able to demonstrate practical competence in these areas

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 2 | 3 | - | - | - | - | - | - | - | 1 | 1 | 1 | 2 |
| **CO2** | 2 | 1 | - | - | - | - | - | - | 1 | - | - | - | 3 | 1 |
| **CO3** | - | 1 | 3 | - | 1 | - | 1 | - | 3 | 1 | 1 | 1 | - | - |
| **CO4** | 3 | 2 | 3 | 3 | 3 | 1 | 2 | - | 1 | 1 | - | - | - | 3 |

| B.Tech. (R20)<br>EC604C-Program Elective-II | |
|---|---|
| **S.No** | **Name of the Program Elective** |
| 5. | Cyber Security |
| 6. | Nano Electronics |
| 7. | Sensors and Transducers |
| 8. | Electronic Instrumentation |

## EC604C-Cyber Security

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**

The course deals with the underlying principles of cryptography and network security. It develops the mathematical tools required to understand the topic of cryptography. Starting from the classical ciphers to modern day ciphers, the course provides an extensive coverage of the techniques and methods needed for the proper functioning of the ciphers. The course deals with the construction and cryptanalysis of block ciphers, stream ciphers and hash functions. The course defines offers the construction and cryptanalysis of public key ciphers, namely RSA. The key exchange problem and solutions using the Diffie-Hellman algorithm are discussed. Message Authentication Codes (MAC) and signature schemes are also detailed. The course deals with modern trends in asymmetric key cryptography, namely using Elliptic Curves. The course ends with the awareness about different network attacks and precautions to be taken for the security.

**Course Objectives:**

The student should be made to:

1. To know the basics of Cryptography and Network Security.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4. To have the knowledge of security requirements for a network against various threats

**UNIT-I**

**Introduction**: OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data Encryption Standard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES – AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality

**UNIT-II**

**Public Key Cryptography** Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography - Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography and RSA.

**UNIT-III**

**Authentication And Hash Function:** Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm - Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard.

**UNIT-IV**

**Network Security** Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME - IP Security – Web Security.

**UNIT-V**

**System Level Security** Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

**TextBook:**

1. William Stallings, "Cryptography And Network Security – Principles and Practices", Prentice Hall of India, Third Edition, 2003.

**References**:
1. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.
2. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Third Edition, Pearson Education.

**Course Outcomes**

1. Understand different encryption techniques
2. Implement basic security algorithms required by any computing system
3. Analyze the vulnerabilities in any computing system to design a security solution
4. Analyze the possible security attacks and their effective countermeasures in real time systems

**Mapping of course outcomes with program outcomes:**

| CO/ PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 1 | 1 | - | - | - | - | 2 | - | - | - |
| **CO2** | 3 | 3 | 3 | 2 | 1 | 2 | - | - | - | - | 2 | - | - | - |
| **CO3** | 3 | 3 | 2 | 3 | 2 | 2 | - | - | - | - | 3 | 3 | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 3 | 3 | 1 | 1 |

**EC604C-Nano Electronics**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**

This course covers specialized topics in modern Nano electronics. It offers an introduction to electron transport in Nano scale semiconductor devices as well as an introduction to magnetism and spintronics. Models for Nano scale transistors and quantum effects in these will be treated.

**Course Objectives:**

This course is aimed to:

1. Make them understand various advanced concepts in Nano electronics.
2. Explode the fundamentals on QED, SED, molecular electronics, and spintronics.
3. Train the students on state of the art computational tools for modelling and simulation of nano electronics devices.

**UNIT I**

**Introduction**: Evolution of science and nanotechnology, Introduction to nanotechnology, Difference between Nano science and nanotechnology, Feynman predictions on Nano technology, Role of up and top down approaches in nanotechnology, challenges in nanotechnology.

**UNIT II**

**Molecular Nanotechnology:** Electron microscope – scanning electron microscope – atomic force microscope –scanning tunnelling microscope – Nano manipulator – Nano tweezers – atom manipulation – Nano dots – self-assembly – dip pen nanolithography.

**UNIT III**

**Nano powders**-Synthesis and processing of Nano powders-process for producing ultrafine powders-mechanical milling, wet chemical synthesis, gas condensation process, chemical vapour condensation, laser ablation, Design and synthesis of self-assembled nanostructured materials.

**UNIT–IV**

**Nano Materials:** History of Materials, Definition, classification of Nanostructured Materials, cause of interest in Nanomaterial's, Nanomaterial's preparation-present and future applications of Nanomaterials,special nanomaterial's, characterization and tools: carbon nanotubes, Nano composites, carbon fullerenes: An overview of preparation, properties, Electron microscopy techniques: scanning Electron Microscopy, Transmission Electron Microscopy, scanning probe Microscopy-X ray Methods

**UNIT-V**

**Nano Electronics**-Introduction to micro, Nano fabrication: optical lithography, Electron beam lithography, Atomic lithography, Molecular beam Epitaxy, MEMS-Introduction, principles, Types of MEMS:-Mechanical, Thermal, Magnetic MEMS, Fabrication of MEMS.

**Text /Reference Books:**

1. Nano Materials by A S Edelstein& R C Cammarata, Institute of physics publishing, Bristic and Philadelphia
2. Nanotechnology by Mark Ratner & Danier Ratner, Prentice Hall.
3. Micro Manufacturing and Nano technology by N.P.Mahalik.
4. G.W. Hanson, Fundamentals of Nano electronics, Pearson, 2009.
5. W. Ranier, Nano electronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
6. K.E. Drexler, Nano systems, Wiley, 1992.

**E-resources and other digital material**

nptel.iitm.ac.in/courses.php?branch=Ece , www.cdeep.iitb.ac.in

**Course outcomes**

Upon successful completion of the course, the student will be able to:

1. Understand various aspects of Nano-technology and the processes involved in making Nano-components and material.
2. Leverage advantages of the Nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of Nano-technology and the processes involved in making Nano-components and material
4. Leverage advantages of the Nano-materials and appropriate use in solving practical problems.

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 1 | 1 |
| **CO2** | 1 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 | 1 | 1 | 1 |
| **CO3** | 1 | 1 | 3 | 1 | 3 | 1 | 1 | - | 1 | 2 | - | - | 1 | - |
| **CO4** | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | 1 | 1 |

## EC604C-Sensors and Transducers

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview**: It is important to understand the concepts of Sensors and Transducers. When selecting a system to use, it is important to understand the tradeoff among various components, so you can accurately use appropriate instruments. This course will cover the basic concepts of instrumentation that are important for you to understand, including the requirements for specific applications.

**Course Objectives:**

The purpose of the course is

1. To know the performance characteristics of instrument and the quality of measurement based on the type of transducer based on the transduction principles.
2. Understanding the concepts of Measurements and Developments in Sensor Technology.

**UNIT- I**

**Instrument Characteristics:** Block diagram of generalized instrument system, Static characteristics - Desirable & Undesirable characteristics; Dynamic characteristics - Transfer function, Dynamic response of zero order, First order and second order instruments to step input.

**Measurement Errors and Statistical Analysis:** Definition of parameters, Combination of limiting error, Statistical treatment, Curve fitting methods.

**UNIT- II**

**Transducers:** Classification of transducers, Characteristics of transducers.

**Passive Transducer Principles:** Variable resistance - Change in length and area; Variable inductance - Change in self-inductance, Change in mutual inductance, Production of eddy currents, Variable capacitance - Change in area, Distance and dielectric**.**

**UNIT- III**

**Active Transducer Principles:** Thermoelectric, Piezoelectric and Photoelectric effects

**Displacement Measurement:** Introduction, Pneumatic transducers - Flapper Nozzle transducer; Electrical transducers - Resistive, inductive and capacitive; Digital displacement transducer

**UNIT- IV**

**Velocity, Acceleration and Vibration Measurement**: Electromagnetic tachometer, Digital Methods - Photo electric and toothed rotor variable reluctance tachometers, Principles of accelerometers, Types of accelerometers - LVDT, Strain gauge and piezo electric accelerometers.

**UNIT- V**

Developments in Sensor Technology: Introduction, Smart sensors, Micro sensors, IR radiation sensors, Ultrasonic sensors, Fiber optic sensors, Chemical sensors and Bio sensors.

**Text Books:**

1. A.K.Ghosh, "Introduction to Measurements & Instrumentation", 3rd Ed., PHI, 2009. (UNIT I)
2. A.K.Sawhney & Puneet Sawhney, "A Course in Mechanical Measurements & Instrumentation", 12th Ed., Dhanapat Rai & Co., 2012. (UNIT II & III)
3. D.V.S.Murty, "Transducers & Instrumentation", 2nd, Ed., PHI. (UNIT IV)

**Reference Books:**

1. Raman Pallas-Arney & John G.Webster, "Sensors & Signal Conditioning", 2nd Ed., J. Wiley, 2012.
2. D.Patranabis, "Sensors and Transducers" 2nd Ed., PHI, 2013

**E-resources and other digital material**

1. http://nptel.ac.in/courses/112103174/4

http://nptel.ac.in/courses/112103174/3

**Course outcomes :**

Upon successful completion of the course, the student will be able to:

1. Analyze the various performance characteristics of instrument and the quality of Measurement.
2. Identify the type of transducer based on the transduction principles.
3. Select the relevant transducer for measurement of displacement, velocity and acceleration to meet the requirements of industrial applications.
4. Identify the additional attributes in advanced sensors.

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 | - | - |
| **CO3** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - |
| **CO4** | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | 2 |

## EC604C- Electronic Instrumentation

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Description**: This course deals with the basics of electronic instruments used in laboratory and industry. In the process they learn different type of instruments like voltmeter, ammeter, Q meter, Bridges, transducers and display devices CRO, CRT. After learning this subject student will be master in working principle and application of all types of instruments.

**Course Objectives:**

- To explain basic concepts and definitions in measurement.
- To describe the bridge configurations and their applications.
- To understand, design aspects and performance criterion of measuring instruments.
- To understand the working principle of various transducers.

### UNIT-I

Measurement and Error: Definitions, accuracy and precision, types of errors.
DC Ammeters, DC Voltmeters, Series type ohmmeter, Shunt type ohmmeter. AC Voltmeter using rectifiers, True RMS responding voltmeter. Analog Instruments – Transistor voltmeter, micro voltmeter (chopper type) - DC differential voltmeter - AC voltmeters.

### UNIT-II

Cathode Ray Oscilloscopes : Motion of electron in electric field and in magnetic field – Block diagram of CRO, CRT, Electrostatic deflection sensitivity – Vertical and Horizontal deflection systems – Principle of operation of Dual beam, Digital, Dual trace, Sampling and Storage CROs – Measurements with CRO (voltage, current, time, frequency, phase angle, Lissajous figures).

### UNIT-III

Q meter and measurement methods.
Bridges: Wheatstone, Kelvin's, Maxwell, Hay and Schering bridges.
Wave analyzers (AF & RF) - Harmonic distortion analyzers – Spectrum analyzer.

### UNIT-IV

Digital instruments – Digital voltmeters (Ramp, Dual slope, stair case, successive approximation types) Digital Multimeter, universal counter, Digital tachometer, Digital phase meter IEEE 488 Bus.

### UNIT-V

Transducers – Classification and selection of transducers – strain gauges – Temperature measurement (resistance thermometer, thermo couples and thermistors) LVDT – Peizo electric transducer.

**Text Books** :

1. H.S.Kalsi, "Electronic Instrumentation" TMH, 1995.
2. Helfric and Cooper, "Modern Electronic Instrumentation and measurement techniques", PHI, 1995.
3. A.K.Sawhney , " Electrical and electronic measurements and instrumentation", Danapat Rai & Co.,18th edition., 2007.

E-resources and other digital material
1.https://nptel.ac.in/courses/108106070
2.https://nptel.ac.in/courses/108106070

**Course outcomes :**

Upon successful completion of the course, the student will be able to:

1. Emphasize the basic electronics measurement concepts & Design the different analog and digital
   electronics voltmeters
2. Identify and use different analyzers and oscilloscopes.

3. Design the Measurement of different bridges& generators to make measurements and analyze measurement.
4. Analyze the concepts of Transducers based on applications.

**Mapping of course outcomes with program outcomes:**

| PO<br>CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | 1 | - | - | 2 | 1 | - |
| CO2 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | - | - | 2 | - | - |
| CO3 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | - | - | 2 | 1 | - |
| CO4 | 3 | 2 | 3 | 3 | 1 | - | - | - | 1 | - | - | 1 | - | - |

| B.Tech. (R20)<br>EC702C-Program Elective-III | |
|---|---|
| **S. No** | **Name of the Program Elective** |
| 9. | Neural Networks and Fuzzy Logic |
| 10. | Radar Systems |
| 11. | Testing and Testability |
| 12. | Bio-Medical Electronics |

**EC702C-NEURAL NETWORKS AND FUZZY LOGIC**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**

To master the various fundamental concepts of fuzzy logic and artificial neural networks. This will help you to get sufficient knowledge to analyze and design the various intelligent control systems

**Course Objectives:**

1. This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks.
2. It deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components.
3. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.
4. The main objective of this course is to provide the student with the basic understanding of neural networks and fuzzy logic fundamentals.

**Unit – 1**

**Artificial Neural Networks:** Introduction to neural networks, biological neurons, artificial neurons, McCulloch-Pitt's neuron model, neuron modeling for artificial neural systems, feed forward network, perceptron network, Supervised and un-supervised learning.

**Learning Rules:** Hebbian learning Rule, Perceptron learning Rule, Delta learning Rule, Winner-take-all learning rule, Out-star learning rule.

**Unit – 2**

**Supervised Learning:** Perceptrons, exclusive OR problem, single layer perceptron network, multi-layer feed forward networks: linearly non separable patter classification, delta learning rule for multi perceptron layer, error back propagation algorithm, training errors , ADALINE, introduction to Radial Basis Function Networks(RBFN).

**Unit – 3**

**Un-Supervised Learning:** Hamming net, Max net. Winner–take–all learning, counter propagation network, feature mapping, self-organizing feature maps

**Applications of neural Algorithms:** elementary aspects of applications of character recognition.

**Neural Network control applications**: Process identification, Basic dynamic learning control architecture.

**Unit – 4**

**Fundamentals of fuzzy logic and fuzzy sets:** Definition of fuzzy set , a-level fuzzy set , cardinality, operations on fuzzy sets: union, intersection, complement, Cartesian product, algebraic sum, definition of fuzzy relation, properties of fuzzy relations, fuzzy composition.

**Unit – 5**

**Design of Fuzzy Systems:** Components of fuzzy systems, functions of fuzzification, Rule base patterns, Inference mechanisms.

**Methods of de-fuzzification**: COG, COA, MOM, Weighted average, height methods, Design of Fuzzy Systems for temperature setting of water heater, fuzzy system for control of air conditioner.

**Text / References Books:**

1. S.Rajasekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy logic, and Genetic Algorithms", PHI, EEE, 2003.
2. FakhreddineO.Karrry&Clarance De Silva, " Soft Computing and Intelligent Systems, Design Theory, Tools and Applications", Pearson, 2009.
3. Jacek M Zurada, " Introduction to artificial Neural Systems", Jaico Publications.

4. Zimmerman, " Fuzzy Set Theory and its Applications" , Kluwer Academic Publishers.
5. Timothy J. Ross, " Fuzzy Logic with Engineering Applications" ,( McGrawHill).

**Course Outcomes:**

After successful completion of the course, the student will be In a position to

1. Understand the Biological neural systems and construction of artificial neural systems.
2. Understand and explain different learning rules
3. Understand the concept of pattern classification.
4. Identify the different types of supervised and unsupervised training algorithms.

**Mapping of course outcomes with program outcomes:**

| CO/ PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | 1 | - | - | 2 | - | - |
| CO2 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | - | - | 2 | - | - |
| CO3 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | - | - | 2 | - | - |
| CO4 | 3 | 2 | 3 | 3 | 1 | - | - | - | 1 | - | - | 1 | - | - |

**EC702C-RADAR ENGINEERING**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview**:
It is important to understand the concepts of principles of Radar Engineering, Mri radar and practical applications of Radar.

**Course Objectives:**The purpose of the course is
1. To understand the basic principle of radar systems and Doppler and MTI Radar.
2. To know how the detection of Noise and principle of Radar receiver.

**UNIT I**
INTRODUCTION TO RADAR: Basic Radar, The simple form of the Radar Equation, Radar Block Diagram and operation, Applications of Radar, The Radar Equation, Detection of Signals in Noise, Receiver Noise and the Signal to-Noise Ratio, Probability Density Functions- Probabilities of Detection and False Alarm-Integration of Radar Pulses, Radar Cross Section of Targets Radar cross Section Fluctuations- Transmitter Power, Pulse Repetition Frequency-System losses.

**UNIT-II**
MTI Radar: Introduction to Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.

**UNIT- III**
Pulse Doppler Radar: Tracking with Radar, Mono-pulse Tracking, Conical Scan and Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking: Tracking in Range, Other Tracking Radar Topics, Comparison of Trackers, Automatic Tracking with Surveillance Radars (ADT), Radar Antennas.

**UNIT- IV**
Detection of Signals in Noise: Introduction, Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detector, Integrators, Constant-False Alarm Rate Receivers, The Radar operator, Signal Management

**UNIT- V**
The Radar Receiver: Receiver noise Figure, Super heterodyne Receiver, Radar Displays. Applications: Electronic Support Measure (ESM), Electronic Counter Measure (ECM), Electronic Counter-Counter Measure (ECCM), Stealth Technology.

**Text Books:**
1. Merrill I Skolnik, Introduction to Radar Systems, 3rd edition, TMH, 2003.
2. Principles of Modern radar system, M. H. Carpentier, Artech House,1998.
3. Radar Technology, Brookner, Eli, Artech House
4. Peyton Z Peebles Jr. (2004), "Radar Principles", John Wiley Inc.,
5. Bahman Zohuri, 'Radar Energy Warfare and the Challenges of Stealth Technology", Springer.

**E-resources and other digital material**
1. https://ocw.mit.edu/resources/res-ll-003-build-a-small-radar-systemcapable-of-sensing-range- doppler-and-synthetic-aperture-radar-imagingjanuary-iap-2011/lecture-notes/

2. http://www.radartutorial.eu/07.waves/wa04.en.html

**Course outcomes**

Upon successful completion of the course, the student will be able to:

1. Understand the principles and applications of RADAR
2. Demonstrate the Doppler Effect and the concepts of continuous wave radars.
3. Analyze the tracking radar systems and mono pulse radar.
4. Understand radar signal detection in presence of noise and its performance

**Mapping of course outcomes with program outcomes:**

| PO<br>CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | **2** | **1** | **1** | **1** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **1** | **1** |
| **CO2** | 1 | 1 | 1 | 2 | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **3** |
| **CO3** | **2** | **2** | **2** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **3** |
| **CO4** | **3** | **2** | **3** | **3** | **1** | **-** | **-** | **-** | **1** | **-** | **-** | **-** | **-** | **-** |

**EC702C-Testing and Testability**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Pre-requisite, if any: **Digital Logic Design**

**Course Overview:** The purpose of the course is know the to understand the VLSI testing, types of faults and Fault Diagnosis.

**Course Objectives**: The purpose of the course is

1. To learn the role of VLSI testing.
2. Understand the types of Faults, Design for Testability and Fault Diagnosis.

**Unit-1**

Role of testing in VLSI Design flow, Testing at different levels of abstraction, Fault error, defect, diagnosis, yield, Types of testing, Rule of Ten, Defects in VLSI chip. Modelling basic concepts, Functional modelling at logic level and register level, structure models, logic simulation, delay models.

**Unit-2**

Various types of faults, Fault equivalence and Fault dominance in combinational sequential circuits. Fault simulation applications, General fault simulation algorithms- Serial, and parallel, Deductive fault simulation algorithms. Combinational circuit test generation, Structural Vs Functional test, ATPG, Path sensitization methods.

**Unit-3**

Difference between combinational and sequential circuit testing, five and eight valued algebra, and Scan chain-based testing method. D-algorithm procedure, Problems, PODEM Algorithm, Problems on PODEM Algorithm. FAN Algorithm, Problems on FAN algorithm, Comparison of D, FAN and PODEM Algorithms. Design for Testability, Ad-hoc design, Generic scan-based design.

**Unit-4**

Classical scan-based design, System level DFT approaches, Test pattern generation for BIST, and Circular BIST, BIST Architectures, and Testable memory design-Test Algorithms -Test generation for Embedded RAMs.

**Unit-5**

Fault Diagnosis Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.

**Text Book(s):**

1. M. Abramovici, M. Breuer, and A. Friedman, “Digital Systems Testing and Testable Design, IEEE Press, 1990.
2. Stroud, “A Designer’s Guide to Built-in Self-Test”, Kluwer Academic Publishers, 2002.

**References & Web Resources:**

3. M. Bushnell and V. Agrawal, "Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000
4. V. Agrawal and S.C. Seth, Test Generation for VLSI Chips, Computer Society Press.1989.
5. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.
6. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers.
7. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.
8. A.L. Crouch, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International.

**Course Outcomes:** At the end of the course, the students will be able to:

1. Identify the significance of testable design
2. Understand the concept of yield and identify the parameters influencing the same
3. Specify fabrication defects, errors and faults.
4. Implement combinational and sequential circuit test generation algorithms and techniques to improve fault coverage

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | 1 | - | - | 2 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | - | - | 2 | - | - |
| CO3 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | - | - | 2 | - | - |
| CO4 | 3 | 2 | 3 | 3 | 1 | - | - | - | 1 | - | - | 1 | 1 | 1 |

**EC702C-Bio-Medical Instrumentation**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:** The purpose of the course is know the human physiology and various sources of
bioelectric signals and the types of electrodes to be used and Safety aspects to be followed.

**Course Objectives**: The purpose of the course is

1. To gain knowledge on human physiology for measurement of electrical and non-electrical parameter in the human body.
2. Understand medical assisting and therapy equipment and safety measures when using Bio-Medical Instrumentation.

**Unit-1**

Brief introduction to human physiology- Problems encountered while making measurements on a human body-Structure of cell – Function of each components of the cell – Membrane potential – Action potential – Generation and Conduction- Anatomy and Physiological aspects of respiration.

**Unit-2**

Bio-electrodes and bio-potential amplifiers ---Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half cell potential, impedance, polarization effects of electrode – non-polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems .

**Unit-3**

. Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, isolation amplifiers, Chopper amplifier. ECG, EEG, EMG Lead systems and recording methods, Typical waveforms.

**Unit-4**

Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic, X-ray and nuclear imaging.

Prostheses and aids: Introduction to Pacemakers, defibrillators, heart-lung machine, Dialyzers, Diathermy .

**Unit-5**

Safety aspects: – devices to protect against electrical hazards – Ground fault interrupter, isolation transformer, line isolation monitor, receptacle tester, electrical safety analyzer equipment, preventive maintenance .

**Text Book:**

1. Leslie Cromwell, Fred. J, Weibell and Erich A. Pleiffer, “Biomedical Instrumentation and Measurements”, 2nd Ed., Prentice Hall of India, 2004
2. R.S.Kandpur. “Handbook of Biomedical Instrumentation”, 2nd Ed., TataMcGraw Hill, 2011
3. Webster, “Medical Instrumentation Application & Design”, John Wiley & Sons

**E-resources and other digital material:**

1. http://www.eeeuniversity.com/2013/08/ei2311-biomedical-instrumentation.html

**Course outcomes:** Upon successful completion of the course, the student will be able to:

1. Understand the physical foundations of biological systems and bioelectric potentials in medical field and Examine the various sources of bioelectric signals and the types of electrodesto be used.
2. Describe the acquisition and amplification of the bio-signals
3. Gain knowledge on the measurement of electrical and non-electrical parameter in the human body and Understand medical assisting and therapy equipment.
4. Discuss on electrical safety, hazards, protection against shock and testing of electrical systems

**Mapping of course outcomes with program outcomes:**

| PO<br>CO | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO4 | 3 | 2 | 3 | 3 | 1 | - | - | - | 1 | - | - | 1 | - | - |

| B.Tech. (R20)<br>EC703C-Program Elective-IV | |
|---|---|
| **S.No** | **Name of the Program Elective** |
| 13. | Satellite Communication |
| 14. | Fiber Optic Communications |
| 15. | Wireless Communications |
| 16. | MEMS |

| EC703C-Satellite Communication | |
|---|---|
| Instruction: Hours/Week: **3L:0T:0P** | **Credits: 3** |
| Sessional Marks: **40** | End Semester Examination Marks: **60** |

**Course Overview:**

This course will provide you with an in-depth background of satellite communication techniques, modern satellite multiple access, modulation and coding schemes, as well as providing an update on key emerging technologies and future systems.

**Course Objectives:**

1. To Enable students to become familiar with satellites and satellite services.
2. Study of satellite orbits and launching.
3. Study of Earth segment and space segment components.
4. Study of satellite access by various users.

**Unit -1**

**Introduction to Satellite Communication**: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

**Orbital Mechanics**: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

**Unit -2**

**Satellite sub-systems**: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

**Unit -3**

**Typical Phenomena in Satellite Communication**: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift. Satellite link budget.

**Unit -4**

**Satellite link budget**: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

**Unit -5**

**Modulation and Multiple Access Schemes**: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

**Text /Reference Books:**

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002.
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009.
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill, 2009.

**Course Outcomes:** At the end of this course students will demonstrate the ability to

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | - | 1 |
| **CO2** | 2 | 3 | 1 | 2 | 1 | - | - | - | - | - | - | - | - | 1 |
| **CO3** | 1 | 1 | 3 | 3 | 1 | - | - | - | - | - | 1 | - | - | 1 |
| **CO4** | 1 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - |

-

## EC703C-Fiber Optic Communications

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**

Optical fibers have several advantages over conventional copper cables. Optical communication enjoys high bandwidth and thus useful for transmitting huge information securely and with less repeaters to longer distances. The performance of optical system is superior to conventional communication and thus has widespread use in industry.

**Course Objectives:**

Optical Communication has got greater applicability and students of Communication discipline should master the subject. This course will enable the students:

1. To understand deeply the fundamental aspects of optical communication
2. To analyze the types of fibers and understand the performance by comparison
3. To design optical receivers of optical systems
4. To simulate the performance through parameters like BER and S/N Ratio
5. To apply the principles of optical communication to networks.

**Unit -1**

**Overview of Optical Fiber Communication**: The evolution of fiber optic systems, elements of an optical fiber transmission link, block diagram, advantages of optical fiber communication, applications.

Introduction to vector nature of light, propagation of light, Ray theory transmission, total internal reflection, acceptance angle, numerical aperture and skew rays, propagation of light in a cylindrical dielectric rod, Ray model, wave model., Modes, electromagnetic mode theory and propagation, single mode and multimode fibers, linearly polarized modes.

**Unit -2**

Different types of optical fibers, Fiber material, fiber cables and fiber fabrication, fiber joints, fiber connectors, splicer, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation, Fabrication of fibers and measurement techniques like OTDR.

**Unit -3**

**Optical Sources and Detectors**: Coherent and non-coherent sources, quantum efficiency, modulation capability of optical sources, LEDs: Working principle and characteristics, Laser diodes: Working principle and characteristics, Working principle and characteristics of Photo-detectors: PIN-diodes, APDs, detector responsivity, noise analysis in detectors, coherent and non-coherent detection

**Unit -4**

**Optical Receiver, Switches & Amplifiers**

Receiver structure, bit error rate of optical receivers, and receiver performance, Optical link design - BER calculation, quantum limit, power penalties.

Optical switches - coupled mode analysis of directional couplers, electro-optic switches.

Optical amplifiers - EDFA, Raman amplifier.

**Unit -5**

**Optical Networks**: SONET and SDH standards, architecture of optical transport networks (OTNs), network topologies, Operational principle of WDM and DWDM systems, WDM network elements and Architectures, Principles of WDM networks, Solutions.

Nonlinear effects in fiber optic links: Concept of self-phase modulation, group velocity dispersion and solution based communication.

**Text/Reference Books:**

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. John M. Senior, Optical Fiber Communications: Principles and Practice, Pearson, 3rd Ed. 2008.
   G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.

**Course Outcomes:**

At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors.
4. Analyze system performance of optical communication systems and design optical networks and understand non-linear effects in optical fibers.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | - | - | - | - | - | - | - | - | - | - | 1 | | 1 |
| **CO2** | 2 | 2 | - | - | - | - | - | - | - | - | - | 1 | 1 | |
| **CO3** | 2 | 1 | 3 | | | | | | | | | 2 | 1 | |
| **CO4** | - | - | - | - | 2 | 2 | - | 2 | - | 1 | 2 | - | | |

## EC703C - WIRELESS COMMUNICATION

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Description:**

This course provides a comprehensive overview and advanced knowledge of modern mobile and wireless communication systems. Building on the prior knowledge on digital communications, students develop further understanding on the challenges and opportunities brought by the wireless medium in designing current and future wireless communication systems and networks.

**Course Objectives:**

1. To provide the students with the fundamental treatment about many practical and theoretical concepts that forms Basic of wireless communications.
2. To equip the students with various kinds of wireless networks and it's operations .
3. To provide an to provide analytical perspective on the design and analysis of traditional and emerging wireless networks, And to discuss the need to get off and solution methods, the fundamental problems in wireless networking .
4. To train students do understand the architecture and operation of various wireless wide area networks such as GSM, IS-95, GPRS and SMS.
5. To train students to understand wireless LAN architectures and operations.
6. To prepare students to understand the emerging techniques OFDM and its importance in the wireless communications.

**UNIT-I**

**THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS:** Introduction, Frequency reuse, Channel assignment strategies, Handoffs strategies-prioritizing handoffs, Practical handoff considerations, Interference and system capacity – Co-channel interference and system capacity, Channel planning for wireless systems, Adjacent channel interference, Power control for reducing interference, Trunking and grade of service, Improving coverage and capacity in cellular systems - Cell splitting, Sectoring.

**UNIT-II**

**MOBILE RADIO PROPAGATION LARGE-SCALE PATH LOSS:** Introduction to radio wave propagation, Free space propagation model, Relating power to electric field, The three basic propagation mechanisms, Reflection-reflection from dielectrics, Brewster angle, Reflection from prefect conductors, Ground reflection (two-ray) model, Diffraction-fresnel zone geometry, Knife-edge diffraction model, Multiple knife-edge diffraction, Scattering, Outdoor propagation models-Longley-Ryce model, Okumura model, Hata model, PCS extension to Hata model, Walfisch and Bertoni losses (Same floor), Partition losses between floors, Log-distance path loss model, Ericsson multiple breakpoint model, Attenuation factor model, Signal penetration into buildings, Ray tracing and site specific modeling.

**UNIT-III**

**MOBILE RADIO PROPAGATION: SMALL-SCALE FADING AND MULTIPATH:** Small scale multipath propagation-factors influencing small scale fading, Doppler shift, Impulse response model of a multipath channel-Relationship between Bandwidth and received power, small-scale multipath measurements Direct RF pulse system, Spread spectrum sliding correlator channel sounding, Frequency domain channels sounding, Parameters of mobile multipath channels-time dispersion parameters, Coherence bandwidth, Doppler spread and coherence time, Types of small-scale fading-fading effects, Due to multipath time delay spread, flat fading, Frequency selective fading, Fading effects due to Doppler spread-fast fading, Slow fading, Statistical models for multipath fading channels-clarke's model for flat fading, Spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and gans fading model, Level crossing and fading st statistics, Two-ray Rayleigh fading model.

**UNIT-IV**

**EQUALIZATION AND DIVERSITY:** Introduction, Fundamentals of equalization, Training a generic adaptive equalizer, Equalizers in a communication receiver, Linear equalizers, Non-linear equalization Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-zero forcing algorithm, Least means square algorithm, Recurisve least squares algorithm, Diversity techniques-derivation of selection diversity improvement, Derivation of maximal ratio combining improvement, Practical space diversity consideration-selection diversity, Feedback or scanning diversity, Maximal ratio combining, Equal gain combining, Polarization diversity, Frequency diversity, Time diversity, RAKE receiver.

**UNIT-V**

**WIRELESS NETWORKS:** Introduction to wireless networks, Advantages and disadvantages of wireless local area networks, WLAN topologies, WLAN standard IEEE 802.11, IEEE 802.11 medium access control, Comparision of IEEE 802.11 a, b, g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, HiperLan, WLL.

**TEXT BOOKS:**

1. Rappaport,T.S., ―Wireless communications‖, Pearson Education, Second Edition, 2010.(UNIT I, II, IV)
2. Andreas.F. Molisch, ―Wireless Communications‖, John Wiley – India, 2006. (UNIT III,V)

**REFERENCES:**

1. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011
2. Van Nee, R. and Ramji Prasad, ―OFDM for wireless multimedia communications, Artech House, 2000
3. David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication, Cambridge University Press, 2005.
4. Upena Dalal, ―Wireless Communication‖, Oxford University Press, 2009.

**Course Outcomes:**

Upon completion of the course, the student will be able to:

1. Understand the principles of wireless communications.
2. Understand fundamentals of wireless networking.
3. Understand cellular system design concepts.
4. Analyse various multiple access schemes used in wireless communication.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | 1 |
| **CO2** | 2 | - | - | 2 | - | - | - | - | - | - | - | 1 | - | 1 |
| **CO3** | - | 1 | 2 | - | - | 2 | - | - | - | - | 2 | - | - | |
| **CO4** | 1 | 2 | 1 | 1 | - | - | - | - | - | - | 1 | 2 | - | 1 |

**EC703C-MEMS**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Overview:**
The course will cover fabrication technologies, material properties, structural mechanics, basic sensing and actuation principles, packaging, and MEMS markets and applications. The course will emphasize the fabrication and materials of micro/nano systems.

**Course Objectives:**
1. Key aim is to learn micro-electro-mechanical systems (MEMS) and micro-integrated system.
2. Properties of useful materials will be discussed in context to MEMS and BioMEMS. Micro-electronics process modules used in the design and fabrication of MEMS and micro-integrated systems will be presented.
3. Applications of these systems in a variety of sensors and transducers for broad ranges of implantable biomedical applications will be described.
4. Recent advances in wearable biomedical applications of MEMS and bio MEMS will also be discussed in detail.

**Unit -1**
Introduction and Historical Background, Scaling Effects, Micro/Nano Sensors.

**Unit -2**
Actuators and Systems overview: Case studies.

**Unit -3**
Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

**Unit -4**
Micromachining: Surface Micromachining, sacrificial layer processes, Stiction, Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding.

**Unit -5**
Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

**Text/Reference Books:**
1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and
3. Microengineering (Vol. 8). CRC press, (2005).
4. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
5. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
6. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
7. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

**Course Outcomes:**
At the end of the course, students will demonstrate the ability to:
1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.
3. Gain a knowledge of basic approaches for various sensor design
4. Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of Nano-structured materials, micro- and Nano-scale devices.

**Mapping of course outcomes with program outcomes:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 3 | 2 | 2 | 1 | - | - | - | - | 1 | 1 | - | - |
| **CO2** | 1 | - | 3 | 3 | 1 | 1 | 1 | - | - | - | - | - | 1 | - |
| **CO3** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - |
| **CO4** | 2 | 3 | 2 | 1 | - | - | - | - | - | 1 | 1 | - | - | - |

| B.Tech. (R20)<br>EC704C-Program Elective-V | |
|---|---|
| **S.No** | **Name of the Program Elective** |
| 17. | Embedded System Design |
| 18. | Real Time Operating System |
| 19. | FPGA Based System Design |
| 20. | Digital Signal Processors & Architectures |

| EC704C-Embedded System Design | |
|---|---|
| Instruction: Hours/Week: **3L:0T:0P** | **Credits: 3** |
| Sessional Marks: **40** | End Semester Examination Marks: **60** |

**Course Description:**

This course is **to enable the students to understand embedded-system programming and apply that knowledge to design and develop embedded solutions**. Interaction with peripheral devices. Activities. Identify hardware and software components to build an embedded system.

**Prerequisite:** Microprocessors and Microcontrollers; Computer Organization and Operating Systems.

**Course Objectives:**

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware.
3. To understand the necessity of operating systems in correlation with hardware systems.
4. To learn the methods of interfacing and synchronization for tasking.

**UNIT - I:**

**Introduction to Embedded Systems:** Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

**UNIT - II:**

**Typical Embedded System:** Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

**UNIT - III:**

**Embedded Firmware:** Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

**UNIT - IV:**

**RTOS Based Embedded System Design:** Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

**UNIT - V:**

**Task Communication:** Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.

**TEXT BOOKS:**

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

**REFERENCE BOOKS:**

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.
5.

**Course Objectives:**

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware.
3. To understand the necessity of operating systems in correlation with hardware systems.

4. To learn the methods of interfacing and synchronization for tasking.

**Mapping of course outcomes with program outcomes:**

| PO<br>CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | 1 | 2 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 1 | - | 1 | 1 | - | - | - | - | **1** | - | - | 1 | - | - |
| **CO3** | 2 | 2 | 2 | 1 | - | - | - | - | **1** | - | - | **2** | - | - |
| **CO4** | 3 | 2 | 1 | - | - | - | - | - | **1** | - | - | **1** | - | - |

**EC704C-Real Time Operating System**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Course Abstract / Outline:**

In several software applications, especially in embedded application, the operating system is required to support the application to meet the timing constraints. The operating system achieves this by deploying suitable scheduling algorithms. A major problem arises, when the real-time tasks share resources. Priority inversions can take place in this case, unless suitable techniques are deployed. Starting with a brief introduction to real-time operating systems, we first discuss the important real-time task/thread scheduling algorithms and resource sharing protocols. An effort towards standardization of real-time operating systems has come to be known as POSIX-RT. We review POSIX-RT requirements. Besides, we review several commercial and open source real-time operating systems.

**Prerequisites:** C Programming, Computer Organization and Operating Systems, and Operating Systems.

**Course Objectives:**

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware.
3. To understand the necessity of operating systems in correlation with hardware system.
4. To learn the methods of interfacing and synchronization for tasking.

**UNIT – I:**

**Introduction:** Introduction to UNIX/LINUX, Overview of Commands, File I/O, ( open, create, close, lseek, read, write), Process Control ( fork, vfork, exit, wait, waitpid, exec).

**UNIT – II:**

**Real Time Operating Systems:** Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use.

**UNIT – III:**

**Objects, Services and I/O:** Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem.

**UNIT – IV:**

**Exceptions, Interrupts and Timers:** Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

**UNIT – V:**

**Case Studies of RTOS:** RT Linux, Micro C/OS-II, Vx Works, Embedded Linux, and Tiny OS.

**TEXT BOOK:**

1. Qing Li, “Real Time Concepts for Embedded Systems”, 2011, Elsevier.

**REFERENCE BOOKS:**

1. Rajkamal, “Embedded Systems- Architecture, Programming, and Design”, 2007, TMH.
2. W. Richard Stevens, Stephan A. Rago, “Advanced UNIX Programming”, 2006, 2nd Edition, Pearson.
3. Dr. Craig Hollabaugh, “Embedded Linux: Hardware, Software and Interfacing”, 2008, 1st Edition, Pearson.

**Course Outcomes:**

1. Understand concepts of Real-Time systems and modeling
2. Recognize the characteristics of a real-time system
3. Understand and develop document on an architectural design of a real-time system
4. Develop and document Task scheduling, resource management, real-time operating systems and fault tolerant applications of Real-Time Systems.

**Mapping of course outcomes with program outcomes:**

| PO<br>CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | 1 | 2 | 1 | - | - | - | - | - | - | 1 | 1 | - | 1 |
| **CO2** | 2 | **1** | 1 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 2 | 3 | **3** | 2 | 1 | - | - | - | - | - | - | - | - | **1** |
| **CO4** | 1 | 3 | **3** | 1 | 1 | - | - | - | **1** | - | 1 | **1** | - | - |

**EC704C-FPGA Based System Design**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

**Pre-Requisite(s):** Digital Logic Design

**Course Description:** This course covers the advanced design and analysis of digital circuits with HDL. The primary goal is to provide in depth understanding of system design. The course enables students to apply their knowledge for the design of advanced digital hardware systems with help of FPGA tools.

**Course Objectives:**

1. Understand Digital system design using HDL.
2. Know FPGA architecture, interconnect and technologies.
3. Know different FPGA's and implementation methodologies.
4. Understand configuring and implementing digital embedded system, micro-controllers, microprocessors, DSP algorithms on FPGA.

**UNIT I:**

**Verilog HDL Coding Style:** Lexical Conventions - Ports and Modules – Operators - Gate Level Modeling - System Tasks &Compiler Directives - Test Bench - Data Flow Modeling - Behavioral level Modeling -Tasks & Functions.

**UNIT II:**

**Overview of FPGA Architectures and Technologies:** FPGA Architectural options, coarse vs fine grained, vendor specific issues (emphasis on Xilinx FPGA), Antifuse, SRAM and EPROM based FPGAs, FPGA logic cells, interconnection network and I/O Pad.

**UNIT III:**

**Verilog Modelling of Combinational and Sequential Circuits:** Behavioral, Data Flow and Structural Realization – Adders – Multipliers- Comparators - Flip Flops - Realization of Shift Register - Realization of a Counter- Synchronous and Asynchronous FIFO –Single port and Dual port RAM – Pseudo Random LFSR – Cyclic Redundancy Check.

**UNIT IV**

**Synchronous Sequential Circuits:** State diagram-state table –state assignment-choice of flipflops – Timing diagram –One hot encoding Mealy and Moore state machines – Design of serial adder using Mealy and Moore state machines - State minimization – Sequence detection- Design examples: Sequence detector, Serial adder, Vending machine using One Hot Controller. Optimization of Speed: Introduction, Strategies for Timing Improvement; Optimization of Area, Optimization of power.

**Unit V**

**FPGA and its Architecture:** Types of Programmable Logic Devices- PLA & PAL- FPGA Generic Architecture. Types of FPGAs, CLBs vs LAB vs Slices, MUX vs LUT based logic implementation, ALTERA Cyclone II Architecture – Timing Analysis and Power analysis using Quartus-II- SOPC Builder- NIOS-II Soft-core Processor- System Design Examples using ALTERA FPGAs – Traffic light Controller, Real Time Clock -Interfacing using FPGA: VGA, Keyboard, LCD.

**Text Books:**

1. M.J.S. Smith, "Application Specific Integrated Circuits", Pearson, 2000.
2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition, 2003, ISBN: 0130449113.
3. Wayne Wolf, "FPGA Based System Design", with CD-ROM, 2004, Prentice Hall, ISBN: 0131424610.
4. S. Ramachandran, "Digital VLSI System Design: A Design Manual for implementation of Projects on FPGAs and ASICs Using Verilog" Springer Publication, 2007.

5. Stephen Brown & ZvonkoVranesic, "Digital Logic Design with Verilog HDL" TATA McGraw Hill Ltd. 2nd Edition 2007.

**References**:

1. Pong P. Chu, "FPGA Prototyping by Verilog Examples: Xilinx Spartan-3," Wiley-Interscience, 1st Edition, 2008, ISBN-10: 0470185325.
2. Steven Kilts, "Advanced FPGA Design: Architecture, Implementation and Optimization" Wiley-IEEE Press, 1st Edition, 2007, ISBN:0470054379
3. Peter Ashenden, "Digital Design using Verilog", Elsevier, 2007.
4. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL," First Edition, 2003, Prentice Hall, ISBN: 0130891614.

**Course Outcomes:** Upon successful completion of this course, students will be able to:

1. Design and optimize complex combinational and sequential digital circuits by using Verilog HDL.
2. Design and model digital circuits with Verilog HDL at behavioural, structural, and RTL Levels.
3. Develop test benches to simulate combinational and sequential circuits and analyse Digital design in terms of area, power and speed..
4. Understand the FPGA Architecture and Implementation of the combinational and sequential digital circuits in FPGA.

**Mapping of course outcomes with program outcomes:**

| PO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | - | 3 | - | - | - | - | - | - | 1 | - | - | 2 | - | - |
| CO3 | - | - | 3 | - | - | - | - | - | 1 | - | - | 2 | - | - |
| CO4 | - | - | 3 | - | - | - | - | - | 1 | - | - | 1 | - | - |

| EC704C-Digital Signal Processors & Architectures | |
|---|---|
| Instruction: Hours/Week: **3L:0T:0P** | **Credits: 3** |
| Sessional Marks: **40** | End Semester Examination Marks: **60** |

**Course Description:**

This course explains fundamental concepts of Digital Signal Processing and implementation of various applications on Advanced Processor. Helps students to understand architecture of advanced Digital Signal Processor and how to program it for signal processing applications.

**Prerequisite:** Students should have an understanding of Microcontroller architecture as well as basic C and assembly language programming skills and basic understanding of discrete time signals and systems

**Course Objectives:**

1. To describe features and architectural improvements of DSP processors.
2. To introduce addressing modes and instruction description of TMS320C6x processors.
3. To demonstrate data representation in DSP Processors and FIR filters.
4. 4. To demonstrate the usefulness of the adaptive filters and learn techniques of code optimization.

**Unit 1**

Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

**Unit 2**

Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

**Unit 3**

VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed Cand Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

**Unit 4**

Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).

**Unit 5**

FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor,High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

**Textbooks and References:**

1. M. Sasikumar, D. Shikhare, Ravi Prakash, “Introduction to Parallel Processing”, 1st Edition, PHI, 2006.
2. Fayez Gebali, “Algorithms and Parallel Computing”,1st Edition, John Wiley & Sons, 2011

3. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald,"Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman,2000.
4. Ann Melnichuk,Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press,2010.
5. Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
6. E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands,2007.

**Course Outcomes:**

At the end of this course students will be able to

1. Identify and formalize architectural level characterization of P-DSP hardware
2. Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment
3. Deployment of DSP hardware for Control, Audio and Video Signal processing applications
4. Understanding of major areas and challenges in DSP based embedded systems

**Mapping of course outcomes with program outcomes:**

| PO<br>CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | - |
| **CO2** | 1 | **3** | 3 | 3 | - | - | - | - | **1** | - | - | - | - | - |
| **CO3** | 1 | 3 | **3** | 3 | 2 | **1** | - | - | **1** | - | - | - | **1** | - |
| **CO4** | 1 | 1 | **1** | 1 | - | - | - | - | **1** | - | - | **1** | - | - |