**LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY**
**(An Autonomous Institution)**
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
**SCHEME OF INSTRUCTION & EXAMINATIONS [LR-21]**
**AICTE Model Curriculum**
**B.E. V-Semester (2023-2024)**

| S. No. | Course Code | Category | Course Title | Scheme of Instructions | | | | Scheme of Examination | | | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | Contact Hours/Week | Maximum Marks | | Duration in Hours | |
| | | | | | | | | CIE | SEE | | |
| Theory Course | | | | | | | | | | | |
| 1 | U21MB501 | HSMC | Business Economics & Financial Analysis | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 2 | U21EC501 | PCC | Microprocessors & Microcontrollers | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 3 | U21EC502 | PCC | Digital Communication | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 4 | U21EE501 | ESC | Control Systems | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 5 | --- | PEC | Professional Elective - I | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 6 | --- | OEC | Open Elective - I | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| Practical/ Laboratory Course | | | | | | | | | | | |
| 7 | U21EC5L1 | PCC | Microprocessors & Microcontrollers Lab | 0 | 0 | 3 | 3 | 25 | 50 | 3 | 1.5 |
| 8 | U21EC5L2 | PCC | Analog and Digital Communications Lab | 0 | 0 | 3 | 3 | 25 | 50 | 3 | 1.5 |
| Internship | | | | | | | | | | | |
| 9 | U21EC5P1 | PROJ | Summer Internship (During Summer Vacations after IV Sem) | - | - | - | - | 50 | - | - | 1 |
| Skill Development Course | | | | | | | | | | | |
| 10 | U21MA5L1 | BSC | Aptitude and Reasoning | - | - | 2 | - | 25 | 50 | 3 | 1 |
| Total | | | | 18 | 00 | 8 | 24 | 365 | 450 | 27 | 23 |

**L:** Lecture*(Hrs/Wk/Sem)* **T**: Tutorial *(Hrs/Wk/Sem)* **P**: Practical / **D**: Drawing *(Hrs/Wk/Sem)*

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination
**HSMC**: Humanities and Social Sciences Management Course **PEC**: Professional Electives
**OEC**: Open Electives PC : Programme Core PROJ : Project

**Note**:

1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| U21EC501 | **MICROPROCESSORS AND MICROCONTROLLERS** | | | | | | Core |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| Digital Electronics | L | T | D | P | | | |
| | 3 | - | - | - | 40 | 60 | 3 |

**Course Objectives:**

1. Familiarize the architecture of microprocessors.
2. Familiarize the basic concept and architecture of microcontrollers
3. Provide the knowledge about interfacing techniques of bus & memory.
4. Provide the knowledge of serial communication techniques
5. Understand the concepts of ARM architecture.

.**Course Outcomes: On completion of this course, students are able to**:

1. Analyze the internal architecture, organization and assembly language programming of 8086 processors.
2. Analyze the internal architecture, organization and assembly language programming of 8051 controllers
3. Implement the interfacing techniques to 8051 based systems.
4. Apply the Serial Communication and Bus Interface concept.
5. Demonstrate the internal architecture of ARM processors and basic concepts of ARM processors.

**UNIT-I:**

**8086Architecture:** Introduction to Microprocessors, Functional diagram, Register Organization, Memory Segmentation, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086

Instruction Set and Assembly Language Programming of 8086: Instruction formats, Addressing modes, Instruction Set, Simple Programs involving Logical, Branch Instructions, Sorting, and String Manipulations.

**UNIT-II**

**Introduction to Microcontrollers**: Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instructionsetof8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming 8051TimersandCounters

**UNIT–III**

I/O And Memory Interface: LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

**UNIT–IV**

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232,USB.

**UNIT–V**

ARM Architecture: ARM Processor fundamentals, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set–Data processing, Branch instructions load store instructions, Software interrupt instructions, Program status register instructions

**Suggested Readings:**


1. Advanced Microprocessors and Peripherals–A.K. Rayand K.M. Bhurchandani, TMH, 2nd Edition 2006.
2. ARM System Developers guide, Andrew NSLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012
3. The 8051Microcontroller, Kenneth. J.Ayala, Cengage Learning, 3rd Ed,2004.
4. Microprocessors and Interfacing, D.V. Hall, TMGH,2nd Edition2006.
5. The 8051Microcontrollers, Architecture and Programming and Applications-K. UmaRao, Andhe Pallavi, Pearson,2009.
6. Digital Signal Processing and Applications with the OMAP-L138Experimenter.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| U21EC502 | DIGITAL COMMUNICATION | | | | | | Core |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Probability & Statistics and Analog Communication | 3 | - | - | - | 40 | 60 | 3 |

**Course Objectives**: This course aims to:

1. Make the student learn the different techniques involved in the digital transmission of analog signals.
2. Give the student an understanding of the various concepts of information theory.
3. Student an understanding of source coding, and channel coding schemes.
4. Enable the student to interpret the performance of digital modulation schemes and various
5. Understand the Spread spectrum modulation schemes.

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

1. Demonstrate the concept of pulse digital modulation schemes and compare their performance.
2. Interpret the concept of information theory and apply source coding schemes.
3. Demonstrate various error control schemes and develop the encoding and decoding techniques to detect and correct the errors.
4. Analyze different digital modulation schemes and can compute the bit error performance.
5. Identify and apply spread spectrum modulation techniques.

**UNIT-I**

**Digital Transmission of Analog Signals:** Elements of a digital communication system, Uniform quantization, PCM system, Bandwidth requirement of PCM system, Noise in PCM Systems, Non-uniform quantization, TDM-PCM system. Differential quantization, Differential PCM system, Delta Modulation, Noise in DM system, ADM. Comparison of PCM, DPCM, DM and DM schemes .

**UNIT-II**

**Information Theory:** Uncertainty, Information and Entropy, Source coding: Source coding theorem, Shannon – Fano algorithm and Huffman coding. Discrete memory-less channels, Types of channels, cascaded channels, mutual information, Channel capacity, Information rate and Information capacity.

**UNIT-III**

**Error Control Coding:** Need for error control coding, Types of transmission errors. Linear Block Codes (LBC): description of LBC, generation, Syndrome and error detection, minimum distance of a block code, error detecting capabilities and error correcting, Hamming codes, Standard array and syndrome decoding. Convolution codes: description, encoding, decoding: Exhaustive search method and sequential decoding.

**UNIT-IV**

**Digital Carrier Modulation Schemes:** Optimum receiver for Binary Digital Modulation Schemes, Binary ASK, PSK, DPSK, FSK signaling schemes and their error probabilities. Introduction to MSK, Comparison of Digital Modulation Schemes. Introduction to M-ary Signaling Schemes: QPSK, Synchronization methods.

**UNIT–V**

**Spread-Spectrum Modulation:** Need for spreading a code, generation and properties of PN sequence. Direct Sequence Spread Spectrum, Frequency Hopping spread spectrum systems and their applications. Acquisition and Tracking in DSSS and FHSS Systems.

**Suggested Reading:**


1. Digital and Analog Communication Systems, Sam Shanmugham K., Wiley, 2012.
2. Communication Systems, Simon Haykin, 4/e, Wiley India, 2011.
3. Principles of Communication Systems, Herbert Taub, Donald L. Shilling & Goutam Saha, 4/e, Tata McGraw-Hill Education 2013.
4. Digital Communications, John Proakis, Massoud Salehi, 5/e, McGraw Hill Higher Education, 2007.
5. Communication Systems, R.P. Singh, S.D. Sapre, 2/e, Tata McGraw Hill Education, 2008

| Course code | Course title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **U21EE501** | **CONTROL SYSTEMS** | | | | | | **Core** |
| Pre-requisites | Contact Hours Per Week | | | | CIE | SEE | Credits |
| Linear Algebra, Laplace Transforms, | L | T | D | P | | | |
| | 3 | - | - | - | 40 | 60 | 3 |

Course Objectives: The course will introduce the students to

1. To develop basic skills of utilizing mathematical tools needed to analyze and design classical linear control systems.
2. To assess the system performance using time domain analysis and methods for improving it.
3. Acquire the knowledge of stability analysis techniques
4. To assess the system performance using frequency domain analysis and techniques for improving the performance and study of compensators.
5. To understand and develop the state space representation of control systems.

Course Outcomes: After completing this course, the student will be able to:

1. Understand different mathematical models for any electromechanical LTI systems and determine the transfer function of an LTI system using block diagram & signal flow graph.
2. Analyze the given first and second order systems based on their performance parameters &PID controllers.
3. Analyze absolute and relative stability of an LTI system using time domain techniques.
4. Analyze the stability of an LTI system using frequency domain techniques and understand the concepts of compensators.
5. Develop various state space models for LTI systems and to determine its Controllability and Observability.

UNIT-I

Introduction to Control Systems: Classification of control systems, Feed-Back Characteristics, Effects of feedback, Mathematical modeling of Electrical and Mechanical systems, Transfer function, Transfer function of Potentiometer, Synchro, AC Servo motor, DC Servo motor, Block diagram reduction techniques, Signal flow graph, Mason's gain formula.

UNIT-II

Time Domain Analysis: Standard test signals, Time response of first order systems, Transient response of second order system for unit step input, Time domain specifications, Steady state response, Steady state errors and error constants, Effects of P, PD, PI and PID controllers.

UNIT-III

Stability Analysis in S-Domain: The concept of stability, Routh's stability Criterion, Absolute stability and relative stability, Limitations of Routh's stability.

Root Locus Technique: The root locus concept, Construction of root loci, Effects of adding poles and zeros on the root loci.

UNIT-IV

Frequency Response Analysis: Introduction to frequency response, Frequency domain specifications, Bode plot, Stability analysis from Bode plots, Determination of transfer function from the Bode Diagram, Polar Plots, Nyquist Plots, Stability Analysis, Gain margin and phase margin. Concept of Lag, Lead and Lag-Lead Compensators.

UNIT-V

State Space Analysis: Concepts of state, State variables and state model, Derivation of state models of linear time invariant systems, State transition matrix, Solution of state equation, Concepts of Controllability and Observability. Discrete-time systems, Difference Equations, State-space models of linear discrete-time systems.

Suggested readings:


1. Control System Engineering, I.J. Nagrath, M. Gopal, New Age International (P) Ltd. Publishers, 5th Edition, 2017.
2. Control Systems, A. Anand Kumar, 2nd Edition, PHI publications, 2014.
3. Automatic Control Systems, B.C. Kuo, John Wiley and son's Publishers, 9th edition, 2009.
4. Modern Control Systems, K. Ogata, 5th Edition. PHI publication, 2010.
5. Control Systems, N.C Jagan, 2nd Edition, BS Publications, 2008.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| U21EC5L2 | ANALOG AND DIGITAL COMMUNICATIONS LAB | | | | | | Core |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Analog and Digital Communication | - | - | - | 3 | 25 | 50 | 1.5 |

**Course Objectives**:

1. To design AM, FM, PAM, PWM and multiplexing techniques.
2. To analyze the digital modulation (i.e. ASK, FSK, QPSK) generation.
3. To understand the pulse modulation, PCM, Delta and Digital modulation techniques

**Course Outcomes**:

On completion of this course, students are able to

1. Demonstrate and simulate modulation and demodulation of AM and FM.
2. Construct and understand the need for pre-emphasis and de-emphasis at the transmitter and receiver respectively.
3. Demonstrate the generation of PAM, PWM circuits.
4. Determine the generation and detection of baseband transmission PCM, DM, and ADM
5. Generation of ASK, FSK, DPSK and QPSK

**List of Experiments**

**PART-A**

1. Analog Modulation and Demodulation
2. Frequency Modulation and Demodulation
3. Pre-Emphasis and De-Emphasis
4. Time Division Multiplexing and Demultiplexing
5. SSB-SC Modulator and Detector
6. PAM and PWM Modulation and Demodulation

**PART-B**

1. Pulse Code Modulation and Demodulation
2. Delta Modulation and Demodulation
3. Adaptive Delta Modulation and Demodulation
4. ASK and FSK Modulation and Demodulation
5. Differential Phase Shift Key Modulation and Demodulation
6. Quadrature Phase Shift Key Modulation and Demodulation

**Note**:

1. At least 10 experiments must be conducted in the semester.

**Suggested Readings:**

1. "DigitalandAnalogCommunicationSystems",LeonWCouchII.,6th edition,PearsonEducationInc.,20

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| U21EC5L1 | MICROPROCESSORS AND MICROCONTROLLERS LAB | | | | | | Core |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Digital Electronics | - | - | | 3 | 25 | 50 | 1.5 |

**Course Objectives:**

1. To familiarize the architecture of microprocessors.
2. To familiarize the basic concept and architecture of microcontrollers
3. To provide the knowledge about interfacing techniques of bus & memory.
4. To understand the concepts of 8051 architecture.

**Course Outcomes:**

**On completion of this course, students are able to:**

1. Summarize the internal architecture, organization and assembly language programming of 8086 processors.
2. Verify the internal architecture of 8051
3. Interpret the organization and assembly language programming of 8051controllers
4. Demonstrate the interfacing techniques to8086
5. Utilize the interfacing techniques to 8051

**Cycle1: Using 8086 Processor Kits and/or Assembler**

1. Assembly Language Programs to 8086 to Perform
2. Assembly Language Programs to 8086 to Perform Arithmetic, Logical, on 16 Bit and32-Bit Data.
3. Assembly Language Programs to 8086 to Perform String Operations on 16 Bit and32-Bit Data.
4. Assembly Language Programs to Perform Bit level Logical Operations, Rotate, Shift
5. Assembly Language Programs to Perform Bit level Swap and Branch Operations.

**Cycle2: Using 8051 Microcontroller Kit**

1. Introduction to IDE
2. Assembly Language Programs to Perform Arithmetic (Both Signed and Unsigned) 16 Bit Data Operations, Logical Operations (Byte and Bit Level Operations).
3. Assembly Language Programs to Perform Rotate, Shift, Swap and Branch Instructions.
4. Time delay Generation Using Timers of 8051.
5. Serial Communication from /to8051to/from I/O devices.

**Cycle3: Interfacing I/O Devices to 8051 & LPC2148**

1. 7 Segment Display to 8051.
2. Matrix Keypad to 8051.
3. LCD Display using LPC2148
4. Buzzer using LPC2148

**Note**:

At least 10 experiments must be conducted in the semester.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| U21EC5P1 | SUMMER INTERNSHIP | | | | | | Core |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | - | - | - | - | 50 | - | 1 |

**Course Objectives:**

The objective of the course is to:

1. Produce an accurate record of work performed during the Internship/Co-op
2. Apply engineering knowledge to a problem in industry
3. Produce a technical report
4. Discuss work in a team environment, if relevant to the project
5. Conduct herself/himself responsibly, safely, and ethically in a professional environment

**Course Outcomes:**

After completing the course, the student will be able to:

1. Design/develop a small and simple product in hardware or software.
2. Complete the task or realize a pre specified target, with limited scope, rather than taking up a complex task and leave it.
3. Learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to pre specified criteria.
4. Implement the selected solution and document the same.

**Guidelines:**

Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organizations /Computer Industry/Software Companies/R&D Organization for a period of 4 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co- ordinate (person from industry). The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship

1. Overview of company/project
2. Safety training
3. Discussions with project teams
4. Background research, review of documents, white papers, and scientific papers
5. Planning, designing, and reviewing the planned work
6. Executing the plans
7. Documenting progress, experiments, and other technical documentation
8. Further team discussions to discuss results
9. Final report writing and presentation

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

**Note:** Students have to undergo summer internship of 4 weeks at the end of semester IV and credits will be awarded after evaluation in V semester.

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**AICTE Model Curriculum**
**B.E. VI-Semester (2023-2024)**

| S. No. | Course Code | Category | Course Title | Scheme of Instructions | | | | Scheme of Examination | | | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | Contact Hours/Week | Maximum Marks CIE | Maximum Marks SEE | Duration in Hours | |
| **Theory Course** | | | | | | | | | | | |
| 1 | U21CS608 | ESC | Data Communications and Networks | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 2 | U21EC601 | PCC | Antennas and Wave Propagation | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 3 | U21EC602 | PCC | VLSI Design | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 4 | U21EC603 | PCC | Digital Signal Processing | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 5 | -- | PEC | Professional Elective - II | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| Practical/ Laboratory Course | | | | | | | | | | | |
| 6 | U21EC6L1 | PCC | Digital Signal Processing Lab | 0 | 0 | 3 | 3 | 25 | 50 | 3 | 1.5 |
| 7 | U21EC6L2 | PCC | VLSI & ECAD Lab | 0 | 0 | 3 | 3 | 25 | 50 | 3 | 1.5 |
| 8 | U21EC6P1 | PROJ | Mini Project | 0 | 0 | 6 | 6 | 50 | 50 | 3 | 3 |
| **Skill Development Course** | | | | | | | | | | | |
| 9 | U21EC6L3 | PCC | Computer Applications Lab | - | - | 2 | - | 50 | 50 | 2 | 1 |
| Total | | | | 15 | 0 | 14 | 27 | 325 | 500 | 26 | 22 |

**L:** Lecture*(Hrs/Wk/Sem)* **T**: Tutorial *(Hrs/Wk/Sem)* **P**: Practical / **D**: Drawing *(Hrs/Wk/Sem)*

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination
**PCC: Program core course** **PEC**: Professional Electives **PROJ**: Project Work

**Note**:

1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **U21EC601** | **ANTENNAS AND WAVE PROPAGATION** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Electromagnetic Waves &Transmission Lines | 3 | - | - | | 40 | 60 | 3 |

**Course Objectives:**

1. To describe the basic principles of antennas and introduce the antenna terminologies.
2. To discuss the working principles of wire antennas, non-resonant antennas, antenna arrays and techniques for measurement of antennas characteristics.
3. To explain the various modes of radio wave propagation.

**Course Outcomes:**

**On completion of this course, students are able to:**

1. Characterize the basic principles of antennas and learn the antenna terminology.
2. Apply the design considerations of different types of wire antennas and make proficient in analytical skills for understanding practical antennas
3. Analyze the non-resonant antennas for various ranges of frequencies and get updated with latest developments in the smart antennas.
4. Apply the principles and design considerations of antennas as well as antenna arrays, measure standard antenna parameters and obtain awareness about radiation hazards.
5. Explain the various modes of radio wave propagation used for different applications.

## UNIT–I

**Antenna Fundamentals:** Introduction, principle of radiation, radiation pattern, beam area, radiation intensity, beam efficiency, directivity, gain, resolution, antenna apertures, effective length and effective area, Friis transmission equation, fields from oscillating dipole, antenna field zones, antenna polarization, front–to-back ratio, antenna theorems, antenna impedance and antenna temperature.

## UNIT– II

**Thin Linear Wire Antennas**: Introduction, current distributions, half-wave dipole and quarter wave monopole, helical antennas-types, helical geometry, helix modes-characteristics of monofilar helical antenna radiating in normal and axial mode,

## UNIT-III

**Non-Resonant Antennas**: Comparison between resonant and non-resonant antennas, Rhombic Antenna, Yagi-Uda Antenna, Folded dipole antennas. Horn antenna: Radiation from Horns and design considerations, Reflector antenna: Parabolic Reflector and Cassegrain Antennas, Micro Strip Antennas- Basic characteristics, Design of Rectangular Patch Antennas

## UNIT-IV

**Antenna Arrays:** Array of point sources, the two-element array with equal and unequal amplitudes, different phases, the linear n-element array with uniform distribution, Broadside, and End fire arrays, Principle of Pattern Multiplication, Binomial array.

**Antenna Measurements:** Introduction, Basic Concepts-Source of Errors, Measurement setup directional patterns, gain, VSWR (absolute and comparison methods)

## UNIT-V

**Wave Propagation:** Ground, Space and Surface waves, Troposphere refraction and reflection, Duct propagation, Sky wave propagation, Regular and irregular variations in ionosphere Line of sight propagation.

**Suggested Reading**


1. Antennas and Wave Propagation , J. D. Kraus, R. J. Marhefka, and Ahmad S. Khan, McGraw-Hill, 4th Edition, 2010.
2. Antenna Theory: Analysis and Design, Constantine A. Balanis, 3rd Edition, John Wiley, 2005.
3. Electromagnetic Waves and Radiating Systems, Edward C. Jordan and Keith G. Balmain, 2nd Edition, PHI, 1968.
4. Antennas and Radiowave Propagation, Robert E. Collin, McGraw-Hill, 1985.
5. Antennas and Wave Propagation, A.R.Harish and M. Sachidananda Oxford University Press, 2007..
6. Antenna and wave propagation , K D Prasad, 2nd edition, Satya Prakashan, 2007

| course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **U21EC602** | **VLSI DESIGN** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Electronic Circuit Analysis &Pulse and Linear ICs | 3 | - | - | - | **40** | **60** | **3** |

**Course Objective:**

1. Give exposure to different steps involved in the fabrication of ICs.
2. Explain electrical properties of MOS and Bi-CMOS devices to analyze the behavior of inverters designed with various loads
3. Give exposure to the design rules to be followed to draw the layout of any logic circuit.
4. To explore and understand gate level design.
5. Provide design concepts to design building blocks of data path of any system using gates, and to understand basic programmable logic devices and testing of CMOS circuits.

**Course Outcomes:**

**On completion of this course, students are able to:**

1. Acquire qualitative knowledge about the fabrication process of integrated circuits using MOS transistors and basic electrical properties of MOS transistors.
2. Analyze the layout of any logic circuit which helps to understand and estimate parasitic effect of any logic circuit.
3. Design building blocks of data path systems, memories and simple logic circuits using PLA,PAL, FPGA and CPLD
4. Analyze dynamic CMOS & pseudo NMOS structures of logic gates, SRAM & DRAM cells
5. Explain different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system.

**UNIT-I**

Introduction: Introduction to IC Technology and Fabrication of – MOS, PMOS, NMOS, CMOS & Bi-CMOS. Basic Electrical Properties: Electrical Characteristics of MOSFETs, Threshold voltage, NMOS-FET Current Voltage equations, trans-conductance and draincharacteristics of MOS-FET, RC model of a FET, MOS capacitances, gate-source and gate- drain capacitances, Junction capacitances in a MOSFET, Latch-up and its prevention, scaling concept of MOSFETs.

**UNIT-II**

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling,Crosstalk.

**UNIT-III**

Gate Level Design: Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out.

**UNIT –IV**

Data Path Subsystems: Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters. Array Subsystems: SRAM, DRAM, ROM.

**UNIT – V**

Programmable Logic Devices: Design Approach – PLA, PAL, Standard Cells FPGAs, and CPLDs, Floor planning and routing. CMOS Testing: CMOS Testing, Test Principles, Design Strategies for test, Chip level Test Techniques.

**Suggested Readings:**


1. Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Dougles and A.Pucknell, PHI, New Edition.
2. CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris, Ayan Banerjee, 3rd Ed, Pearson, 2009.
3. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011
4. CMOS logic circuit Design - John. P. Uyemura, Springer, 2007.
5. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.
6. VLSI Design- K. Lal Kishore, V. S. V. Prabhakar, I.K International, 2009.
7. Digital Integrated Circuits A design perspective, Jan M. Rabey and others Pearson Education 2016.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **U21EC603** | **DIGITAL SIGNAL PROCESSING** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Signals &System | 3 | - | - | | 40 | 60 | 3 |

**Course Objectives:**

1. To understand the fast computation of DFT and appreciate the FFT processing.
2. To study the designs and structures of digital (IIR and FIR) filters and analyze for a given specifications.
3. To acquaint in Multi-rate signal processing techniques and finite word length effects
4. Describe the DSP processor architecture for the efficient implementation of digital filters.

**Course Outcomes:**

**On completion of this course, students are able to**

1. Evaluate the DFT &FFT for given sequence reducing computational complexity of DFT.
2. Analyze the performance characteristics of digital filters using various transformation techniques.
3. Design the digital filters and their realization
4. Apply different sampling rates using interpolation and decimation
5. Compare the Architecture of DSP processor with Microprocessors.

**UNIT– I**

**Introduction to DFT & FFT :** Discrete Fourier transform (DFT) definition; Properties of DFT; Linear and circular convolution using DFT; **Fast-Fourier-transform (FFT):** Direct computation of DFT; Need for efficient computation of the DFT (FFT algorithms); Radix-2 FFT algorithm for the computation of DFT and IDFT using decimation-in-time and decimation-in-frequency algorithms.

**UNIT-II**

**Finite impulse-response Filters (FIR) :**Characteristics of FIR Digital Filters, Linear phase filters, Windowing techniques for design of Linear phase FIR filters- Rectangular, Triangular or Bartlett, Hamming, Hanning, Kaiser windows, Comparison between FIR and IIR

**UNIT-III**

**Infinite Impulse- response Filters (IIR):** Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital Filters from Analog Filters-Impulse Invariant Techniques, Bilinear Transformation **Method.**

**UNIT–IV**

**Realization of Filters:** Realization IIR and FIR filters using direct form-I and direct form-II, cascade, lattice, and parallel form .Finite Word Length Effects: Limit cycles, Overflow Oscillations, Round-off Noise in IIR Digital Filters.

**Multi rate Digital Signal Processing:** Introduction-Decimation by factor D and interpolation by a factor I- Sampling Rate conversion by a Rational factor I/D, Applications of multi rate DSP

**UNIT-V**

**Introduction to DSP Processors:** Difference between DSP and the microprocessors architecture-their comparison and need for ASP, RISC and CPU- general Purpose DSP processors: TMS 320C67XX processors, architecture, addressing modes-instruction set.

**Suggested Readings:**


1. Digital Signal Processing Alan V. Oppenheim and Ronald W. Schafer, ,2/e,PHI,2010.
2. Digital Signal Processing: Principles, Algorithms and Application" John G. Praokis and Dimtris G. Melonakos". 4/e, PHI, 2007.
3. Digital Signal Processing using DSP Micro processor Avathar Singh and S.Srinivasan,",2/e, ThomsonBooks,2004.
4. Digital Signal Processing using MATLAB John G Proakis and Vinay KIngle3/e, Cengage Learning, 1997.
5. Understanding Digital Signal Processing , Richard GLyons 3/e, Prentice Hall.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| U21EC6L1 | DIGITAL SIGNAL PROCESSING LAB | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| Basic Simulation Lab | L | T | D | P | | | |
| | - | - | - | 3 | 25 | 50 | 1.5 |

**Course Objectives:**

1. Implement the basic algorithms of DFT, IDFT FFT and IFFT.
2. Design FIR Filter with specific magnitude and phase requirements.
3. Design IIR Filter with specific magnitude and phase requirements.
4. Describe the basics of Multirate signal processing.
5. Design and implement digital filterson DSP processors.

**Course Outcomes:**

1. Illustrate various signal processing algorithms.
2. Analyze FIR Filter with specific magnitude and phase requirements.
3. Analyze IIR Filter with specific magnitude and phase requirements.
4. Illustrate the basics of Multirate signal processing.
5. Analyze digital filtrations DSP processors.

**Part-A**

Perform the following programs using MATLAB Simulator/Equivalent Software

1. Perform DFT and FFT algorithm.
2. Perform Linear convolution.
3. Perform Circular Convolutions.
4. Perform FIR filters design using different window functions.
5. Perform IIR filters design using Butterworth and Chebyshev
6. Perform Decimation process.
7. Perform Interpolation process.

**Part-B**

Implement the following experiments using C6713 DSP Kit

1. Introduction to DSP processors.
2. Implement Linear Convolution.
3. Implement Circular Convolution.

**NOTE:**

1. For Section ‘A’MATLAB with different toolboxes like signal processing.
2. Block set and SIMULINK/MATHEMATICA/any Equivalent software can be used.

**Suggested Reading:**

1. Jaydeep Chakravorthy, ‘’Introduction to MATLAB Programming: Toolbox and Simulink”,1/e, University Press,2014.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **U21EC6L2** | **VLSI AND ECAD LAB** | | | | | | Core |
| | Contact Hours per Week | | | | CIE | SEE | Credits |
| Prerequisite | L | T | D | P | | | |
| VLSI design | - | - | - | 3 | 25 | 50 | 1.5 |

**Course Objectives:**

1. To introduce the students to understand basics in Hardware design using CAD tools
2. Understand and Experience Verilog Design Flow
3. Learn Transistor-Level CMOS Logic Design using both Verilog and VHDL
4. Understand VLSI Fabrication and experience CMOS Physical Design using backend tools

**Course Outcomes:**

After completing this course, the student will be able to

1. Demonstrate Xilinx ISE suite to write Verilog code for logic gates, combinational circuits and sequential circuits.
2. Write Verilog code for basic logic gates, complex logic gates, combinational circuits, and sequential circuits using switch level, gate level, data flow and behavioral modeling.
3. Develop test bench code using Verilog and verify the simulation results.
4. Demonstrate the FPGA implementation of digital circuits and generate the synthesis report.
5. Simplify the layouts of basic logic gates using Micro wind

All the following experiments have to be implemented using HDL and MICROWIND/CADENCE/MENTOR GRAPHICS/Any Equivalent Software

1. Realize all the logic gates
2. Design of 8-to-3 encoder (without and with priority) and 2-to-4 decoder
3. Design of 8-to-1 multiplexer and 1-to-8 de-multiplexer
4. Design of 4 bit binary to gray code converter
5. Design of 4 bit comparator
6. Design of Full adder using 3 modeling styles
7. Design of flip flops: SR, D, JK, T
8. Design of 4-bit binary, BCD counters (synchronous/ asynchronous reset) or any sequence counter
9. Finite State Machine Design
10. Layout of combinational logic circuits.

Suggested readings:


1. Digital Design 6th Edition by M. Morris Mano.
2. Verilog HDL 2 Edition by Samir Palnitkar.

| Course Code | Course Title | | | | | Core / Elective |
|---|---|---|---|---|---|---|
| U21EC6P1 | MINI PROJECT | | | | | PROJ |
| Prerequisite | Contact Hours Per Week | | | CIE | SEE | Credits |
| | L | T | P | | | |
| - | - | - | 6 | 50 | 50 | 3 |

**Course Objectives:**

Enhance practical and professional skills.

1. Familiarize tools and techniques of systematic literature survey and documentation
2. Expose the students to industry practices and team work.
3. Encourage students to work with innovative and entrepreneurial ideas.
4. Make students evaluate different solutions based on economic and technical feasibility

**Course Outcomes:**

After completing the course, the student will be able to:

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

**Guidelines:**

1. As part of the curriculum in the VI- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Four students will be allotted to one faculty supervisor for mentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Mini projects shall have inter-disciplinary/ industry relevance.
5. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling
6. All the investigations should be clearly stated and documented with the reasons/explanations.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference.
8. The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
9. The preliminary results (if available) of the problem may also be discussed in the report.
10. The work has to be presented in front of the PRC committee which consists of one Supervisor and a minimum of two faculty members from the respective Department of the Institute.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| U21EC6L3 | **COMPUTER APPLICATIONS LAB** | | | | | | Core |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Microprocessors and Microcontrollers | - | - | - | 2 | 50 | 50 | 1 |

**Course Objectives**:

1. Familiarize with the usage of IDE tools and execution of programs using ARM processor.
2. Know about the usage of various devices like LCD, Temperature sensor, Buzzer,
3. Also to know the Know about the usage of Stepper Motor by interfacing them toLPC2148.
4. Understand the designing and implementation of combinational and sequential logic circuits using keil micro vision.
5. Implement basic gates at transistor level

**Course Outcomes:**

**After completing this course, the student will be able to**

1. Familiarize with the usage of IDE tools and programming
2. Implement use various on chip like LCD, Temperature sensor, Buzzer using LC2148
3. Analyze the devices like Stepper Motor by interfacing them to ARMP processor
4. Design the digital logic circuits in various modeling styles using Verilog HDL
5. Implement basic gates at transistor level

**Interfacing Programs using embedded Con ARM Microcontroller Kit**

1. Program to perform arithmetic operation (addition ,subtract ,multiply, division)
2. Program to interface8-Bit LED and switch interface
3. Program to implement Buzzer interface on IDE environment
4. Program to display message in a 2line x16 characters LCD display and verify the result in debug terminal
5. Stepper motor interface
6. ADC&TemperaturesensorLM35interface
7. Transmission from kit and reception from PC using serial port.
8. Program to interface GPIO
9. Program to produce show the Time delay
10. Program for External interrupt using push button

**NOTE: All the experiments must be implemented**

| Course Code | Course Title | Core/Elective |
|---|---|---|

**(An Autonomous Institution)**

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**SCHEME OF INSTRUCTION & EXAMINATIONS [LR-21]**

**(W. e. f Academic Year 2021-22)**

**PROFESSIONAL ELECTIVE COURSES**

| S. No. | Course Code | Category | Course Title | Scheme of Instructions | | | | Scheme of Examination | | | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | Contact Hours/Week | Maximum Marks CIE | Maximum Marks SEE | Duration in Hours | |
| Theory Course | | | | | | | | | | | |
| 1 | U21EC503 | PEC 1 | Optical Communications | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC504 | | Electronic Measurement and Instrumentation | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC505 | | Bio-Medical Electronics | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC506 | | Computer Organization & Operating Systems | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 2 | U21EC604 | PEC 2 | Cellular & Wireless Communication | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC605 | | Embedded System Design | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC606 | | Digital Image Processing | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC607 | | Fundamentals of IOT | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | | | | | | | | | | | |
| 3 | U21EC703 | PEC 3 | Satellite Communication | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC704 | | Digital signal processer Architectures | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC705 | | Multirate Signal Processing | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC706 | | Digital system Design through Verilog | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 4 | U21EC707 | PEC 4 | Radar Systems | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC708 | | Internet of Things and Applications | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC709 | | Audio and Video Processing | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC710 | | Field Programmable Gate Arrays | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| 5 | U21EC801 | PEC 5 | Spread Spectrum Communications | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC802 | | Principles and Applications of AI | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC803 | | Global Navigational Satellite Systems | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |
| | U21EC804 | | Low power VLSI Design | 3 | 0 | 0 | 3 | 40 | 60 | 3 | 3 |

| U21EC503 | **OPTICAL COMMUNICATIONS** | | | | | | **Professional elective-1** |
|---|---|---|---|---|---|---|---|
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Digital communication | **3** | **-** | **-** | | **40** | **60** | **3** |

**Course Objectives:**

1. Understand operating principles of light sources and detectors used in optical transmitters and Receivers.
2. Familiarize the Design an optical link in view of loss and dispersion.
3. Learn concepts of propagation through optical fiber modes and configurations,
4. Analyze Losses and dispersion through optical fiber.

**Course Outcomes:**

After completing this course, the student will be able to:

1. Analyze the losses inserted in an optical fiber
2. Study of material used and underlying principles of optical signal generation
3. Design of optical detection systems
4. Design an optical link in view of loss and dispersion.
5. Study of modes of optical communication through optical waveguides

**UNIT–I**

Optical fibers: structures wave guides Evolution of fiber optic system, Elements of Optical Fiber Transmission link, Ray Optics, Optical Fiber Modes and Configurations, Mode theory of Circular Waveguides, Overview Low frequency data transportation of Modes and Key concepts, Linearly Polarized Modes, Single Mode Fibers and Graded Index fiber structure.

**UNIT– II**

Attenuation and Dispersion: Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Waveguides-Information Capacity determination, Group Delay, Material Dispersion, Waveguide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in Guided Index fibers, Mode Coupling, Types of OFC Connectors and issues involved Design Optimization of Single and cut-off wavelength.

**UNIT-III**

Optical Sources, Amplifiers and Coupling: Direct and indirect Band gap materials, LED structures, Light source materials, Quantum efficiency, LED power, Modulation of LED, laser Diodes, Modes and Threshold condition, Rate equations, External Quantum efficiency, Resonant frequencies, Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers, Power Launching and coupling, Lensing schemes, Fiber-to-Fiber joints, Fiber splicing.

**UNIT-IV**

Photo detectors& Receivers: PIN and APD diodes, Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise, Comparison of Photo detectors, Fundamental Receiver Operation, preamplifiers, Error Sources, Receiver Configuration, Probability of Error, Quantum Limit.

**UNIT-V**

Digital Links , Optical Networks: Point-to-Point link system considerations -Link Power budget, Rise - time budget, Noise Effects on System Performance, Operational Principles of WDM and Applications. Erbiumdoped Amplifiers Introductory concepts of SONET/SDH Network Multiple signal interface in fibers, Bandwidth utilization, Interface with nano-electronic devices.

**Suggested Reading**


1. Gourd Keiser, "Optical Fiber Communication," 4/e, TMH, 2000.
2. J.Senior, "Optical Communication, Principles and Practice," PHI, 1994.
3. J.Gower, "Optical Communication System," PHI, 2001.
4. Binh, "Digital Optical Communications," First Indian Reprint 2013, (Taylor & Francis), Yesdee Publications.
5. MMK.Liu, Principles and Applications of Optical Communications, TMH, 2010

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| U21EC504 | ELECTRONIC MEASUREMENT & INSTRUMENTATION | | | | | | PEC 1 |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Electronic Devices and Circuits | 3 | - | - | - | 40 | 60 | 3 |

**Course Objectives:**

1. Understand the different standards of measurements and its usage in measurement of various physical parameters.
2. Study different types of transducers, bridges and their usage in measurement of various quantities.
3. Understand the electronic sensors and various measuring techniques using signal analyzers.
4. Study different types of oscilloscopes and their uses in measurement of time, frequency of different signals.
5. Learn about various types of biomedical instrumentation equipment.

**Course Outcomes:**

**On completion of this course, students are able to:**

1. Implement the standards of measurement and its application for measurement of various physical parameters.
2. Illustrate the different types of transducers and bridges.
3. Demonstrate the characteristics of electronic sensors and signal analyzers.
4. Analyze the different oscilloscopes working and its applications.
5. Analyze the usage of Bio Medical Instrumentation in daily life.

**UNIT-I**

Electronic Measurement fundamentals: Accuracy, Precision, Resolution and Sensitivity. Errors and their types. Standards of measurement, classification of standards, IEEE standards. Measurement of Physical Parameters: Flow Measurement, Liquid level Measurement, Measurement of Humidity, Moisture, Velocity, Force, Pressure, Data Acquisition Systems.

**UNIT-II**

Transducers: Classification, Strain Gauges, Force and Displacement Transducers, LVDT, Synchros, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers, gyroscopes. Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

**UNIT-III**

Electronic Sensors: Characteristics of sound, pressure, power and loudness measurement. Microphones and their types, Temperature measurement, resistance wire thermometers and thermocouples.
Signal Analyzers: AF, HF Wave Analyzers, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers.

**UNIT-IV**

Oscilloscopes: Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations Applications: Measurement of Time, Period and Frequency Specifications. Special Purpose Oscilloscopes: Sampling Oscilloscopes, Digital Storage CROs.

**UNIT-V**

Biomedical Instrumentation: Human physiological system concepts. Bio-potential electrodes, Bio-potential recorders-ECG, EEG, EMG, X- ray machines and CT scanners, magnetic resonance and imaging systems, Ultrasonic Imaging systems and its applications.

**Suggested Reading:**


1. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W. D. Cooper,
2. PHI 5th Edition 2003.
3. Electronic Instrumentation: H. S. Kalsi – TMH, 2nd Edition 2004.
4. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
5. Khandpur. R.S., "Handbook of Bio- Medical Instrumentation", TMH, 2003.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| U21EC505 | BIO MEDICAL ELECTRONICS | | | | | | Professional elective-1 |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Electronic Measuring Instrumentation | 3 | | - | | 40 | 60 | 3 |

**Course Objectives:**

1. To identify significant biological variables at cellular level and ways to acquire different bio-signals.
2. Elucidate the methods to monitor the activity of the heart, brain, eyes and muscles.
3. To introduce therapeutic equipment for intensive and critical care.
4. Outline medical imaging techniques and equipment for certain diagnosis and therapies.
5. Deals with measuring blood pressure and use of pacemaker and defibrillator and ventilator.

. **Course Outcomes:**

On completion of this course Students will be able to

1. Demonstrate bio systems and medical systems from an engineering perspective.
2. Identify the techniques to acquire record and primarily understand physiological activity of the human body through cell potential, ECG, EEG, BP and blood flow measurement and EMG.
3. Develop the working of various medical instruments and critical care equipment.
4. Know the imaging techniques including CT, PET, SPECT and MRI used in diagnosis of various medical conditions.
5. Extract and realize the features involved in Brain computer interface

**UNIT-I**

Bo-Potential Signals and Electrodes: Bio-signals and their characteristics, Organization of cell, Nernst equation of membrane, Resting and Action potentials. Bio-amplifiers, characteristics of medical instruments, problems encountered with measurements from living systems. Bio-potential electrodes – Body surface recording electrodes, Internal electrodes, micro electrodes. Bio-chemical transducers – reference electrode, the pH electrodes, Blood gas electrodes.

**UNIT-II**

Cardiovascular Instrumentation: Heart and cardiovascular system Heart electrical activity, blood pressure and heart sounds. Cardiovascular measurements electro cardiography – electrocardiogram, ECG Amplifier, Electrodes and leads, ECG recorder principles. Types of ECG recorders. Principles of blood pressure and blood flow measurement.

**UNIT-III**

Equipment for Critical Care: Therapeutic equipment – Pacemaker, Defibrillator, Shortwave diathermy, Hemodialysis machine. Respiratory Instrumentation – Mechanism of respiration, Spirometry, Pneumotachograph, Ventilators.

**UNIT-IV**

EEG, EMG and Respiratory Measurements: EEG block diagram, electrodes and their placement, EMG block diagram, electrode and their placement, study of neuromuscular junction, nerve conduction velocity using EMG. Respiratory Instrumentation: Mechanism of respiration, Spirometrey, Pnemuotachograph and its types, ventilators and its mode of operation.

**UNIT-V**

Principles of Medical Imaging: Radiography, computed Radiography, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear Medicine, Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET), Ultrasonography, Introduction to Telemedicine.

**Suggested Readings:**


1. Biomedical Instrumentation and Measurements – by Leslie Cromwell, F.J. Weibell, E.A.
i. Pfeiffer, PHI.
2. Principles of Applied Biomedical Instrumentation – by L.A. Geoddes and L.E. Baker, John
i. Wiley and Sons.
3. Introduction to Biomedical equipment technology-by Joseph Carr and Brown.
4. Medical Instrumentation, Application and Design – by John G. Webster, John Wiley.
5. Hand-book of Biomedical Instrumentation – by R.S. Khandpur, McGraw-Hill, 2003

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **U2IEC506** | **COMPUTER ORGANIZATION AND OPERATING SYSTEMS** | | | | | | **Professional Elective-1** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | **Credits** |
| | L | T | D | P | | | |
| Programming for Problem Solving | 3 | - | - | - | **40** | **60** | **3** |

**Course Objectives** :

1. To visualize the organization of different blocks in a computer.
2. use of micro-level operations to control different units in a computer.
3. To Understand Various types of Memories in computer.
4. Understand basics of Operating systems in a computer.
5. To illustrate File system and Memory Management.

**Course Outcomes**

1. Outline the basic computer architecture of digital computer.
2. To understand the functionality and interfacing of various peripheral devices.
3. To understand the hierarchical memory systems including cache memory and virtual memory.
4. Overview the fundamental concepts of Operating System.
5. To interpret concepts related to File System Interface and Memory Management.

**UNIT – I**

Basic Structure of Computers: Generations of Computers, Block Diagram of Digital Computer and its functional units, Instruction Codes, Stored Program Organization, Computer Registers, Common Bus Structure, Timing and Control, Instruction Cycle. Register Reference Register, Memory–Reference Instructions, General Register Organization, STACK Organization, Instruction Formats, Addressing Modes, Program Interrupts and types of interrupts, Interrupt Cycle, RISC and CISC Characteristics

**UNIT – II**

General Concepts –Control Memory, Address Sequencing, Conditional Branching, Micro Instruction Format, Design of Control Unit, Hard Wired Control Unit, Peripheral devices, Input output interface, Asynchronous data transfer, Priority Interrupt, Daisy Chaining Priority, DMA Controller, Parallel Processing and Pipelining, Types of Pipelining, Vector Processing, Array Processors.

**UNIT – III**

The Memory System: Basic concepts, Memory hierarchy, Semiconductor RAM memories, Read-Only memories, Speed, Size and Cost, Primary memory, Auxiliary memory, Associative memory, Cache memories and its mapping functions, Virtual Memories, Secondary memories and its types.

**UNIT – IV**

Introduction to Operating Systems : Operating Systems Concepts, System Calls, Processes, Inter process Communication Process Scheduling, Principles of input-output hardware, Principles of input-output software. Principles of Deadlock: Resources, Principle of deadlock, The Ostrich Algorithm, Detection and Recovery, Deadlock Prevention and Deadlock avoidance.

**UNIT – V**

File System Interface: The Concept of a File, Directory Structure, File System Implementation, File System management, File Security, Protection Mechanism.

Memory Management: Swapping, Page-Replacement Algorithms, Segmentation.

**Suggested Readings:**


1. Computer Systems Architecture –M.Moris Mano, III rd Edition, Pearson
2. Modern Operating Systems , Andrew S Tanenbaum, Herbert Bos,4thEdition,Pearson.
3. Computer Organizationand Architecture–William Stallings Sixth Edition, Pearson
4. Structured Computer Organization–AndrewS.Tanenbaum,4thEditionPHI
5. FundamentalsofComputerOrganizationandDesign-SivaraamaDandamudiSpringerInt.Edition.
6. Operating Systems–Internals and Design Principles, Stallings, sixth Edition–2009, Pearson Education.
7. Principles of Operating Systems, B.L. Stuart, Cengage Learning, India Edition.
8. Operating System Concepts-Abraham Silberchatz ,PeterB. Galvin, GregGagne,8 th Edition, John Wiley
9. Computer Organization – Carl Hamacher, Zvonks Vranesic, Safea Zaky,Vth Edition, McGraw Hill

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| U21EC603 | | | | | | | |
| Prerequisite | CELLULAR &WIRELESS COMMUNICATIONS | | | | | | Professional Elective-2 |
| | Contact Hours Per Week | | | | CIE | SEE | Credits |
| Analog and Digital Communications | L | T | D | P | | | |
| | 3 | - | - | 2 | 40 | 60 | 3 |

**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 its operations.
3. To prepare students to understand various modulation schemes and multiple access techniques that are used in wireless communications,
4. To provide an analytical perspective on the design and analysis of the traditional and emerging wireless networks, and to discuss the nature of, and solution methods to, the fundamental problems in wireless networking..
5. To prepare students to understand the emerging technique OFDM and its importance in the wireless communications.

. **Course Outcomes:**

**On completion of this course, students are able to:**

1. Understand the principles of wireless communications.
2. Analyze various multiple access schemes used in wireless communication.
3. Demonstrate wireless local area networks and their specifications..
4. Familiar with some of the existing and emerging wireless standards..
5. illustrate the concept of orthogonal frequency division multiplexing.

**UNIT-I**

**The Cellular Concept-System Design Fundamentals Introduction**, Frequency Reuse, Channel Assignment Strategies, Handoff 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, Trucking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

**UNIT-II**

**Cellular Architecture**

Multiple Access techniques — FDMA, TDMA, CDMA — Capacity calculations–Cellular concept- Frequency reuse — channel assignment- hand off- interference & system capacity- trucking & grade of service — Coverage and capacity improvement.

**UNIT-III**

**Wireless Communications**: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

**UNIT-IV**

**Modulation techniques for mobile radio**: Constant envelop modulation. Spread Spectrum Modulation Techniques: PN Sequences. Direct Sequence Spread Spectrum (DS-SS), Frequency hopped Spread Spectrum (FH-SS). Performance of Direct Sequence Spread Spectrum. Performance of Frequency hopped Spread Spectrum..

**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, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL..

**Suggested Readings:**


1. Wireless Communication and Networking – William Stallings, 2003,.
2. Mobile Telecommunications Networking with IS-41, Mike Gallegher, Randy Snyder, McGraw Hill 1997.
3. Wireless Digital Communications, Kernilo, Feher, PHI, 2002.
4. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., PHI. 2002,
5. Wireless Communications-Andrea Goldsmith, Cambridge University Press. 2005
6. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, PEc2002,

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| U21EC604 | EMBEDDED SYSTEM DESIGN | | | | | | Professional elective-1 |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | 0 | p | | | |
| Microprocessor & Microcontroller | 3 | 0 | 0 | 0 | 40 | 60 | 3 |

**Course Objectives:**

1. To understand the architecture of 8051 microcontrollers.
2. To understand the various applications of Embedded Systems using the concepts of Interfacing.
3. To familiarize with smart sensors and understand various sensor applications.
4. To learn the concepts of RTOS and the design process using RTOS.
5. To familiarize with the design principles of SOC.

**Course Outcomes:**

After completing this course, the student will be able to:

1. Study and analysis of embedded systems.
2. Design and develop embedded systems (hardware, software and firmware)
3. Analyze, real time systems using RTOS and develop applications.
4. Apply knowledge to interface various sensors and its applications in embedded systems.
5. Explain principles of SOC design.

**UNIT-I**

Embedded Computing Introduction, Complex Systems and Microprocessor, Embedded System Design Process, Formalisms for System Design, Design Examples. Microprocessors and Microcontrollers: Microprocessors and Microcontrollers, The 8051 Architecture: Introduction, 8051 Microcontroller Hardware, Input/output Ports and Circuits, External Memory. Counter and Timers, Serial data Input/output, Interrupts.

**UNIT-II**

Programming using 8051. Data Transfer and Logical Instructions. Arithmetic Operations, Decimal Arithmetic. Jump and Call Instructions, Applications: Interfacing with Keyboards, Displays, D/A and A/D Conversions, Multiple Interrupts, Serial Data Communication. Bus protocols: I2Cbus and CAN bus.

**UNIT-III**

Smart Sensors Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface–The Automation. Sensors–Applications Introduction–On-board Automobile Sensors (Automotives Sensors) – Home Appliance Sensors–Aerospace Sensors—Sensors form Manufacturing–Sensors for environmental Monitoring

**UNIT-IV**

Introduction to Real-Time Operating Systems: Tasks and task states, tasks and data, semaphores, and shared data; message queues, mail boxes and pipes, timer functions, events, memory management, interrupt routines in an RTOS environment. Basic Design Using Real Time Operating System Principles semaphores and queues hard real- time scheduling considerations saving memory and power

**UNIT-V**

Introduction to the System Approach System Architecture, Components of the system, Hardware &Software, Processor Architectures, Memory and Addressing. System level inter connection, An approach for SOC Design, System Architecture and Complexity.

**Suggested Readings:**


1. Muhammad AliMazidi Janice Gillespie Mazidi, Rolin D.McKinlay,The8051Microcontroller and Embedded System susing Assembly and C,Prentice HallIndia,2ndEdition.
2. D.Patranabis–―Sensors and Transducers‖– PHI Learning Private Limited
3. Wayne Wolf," Computers and Components" Elsevier, Second Edition. Donald L Schilling & Charles Belove. Electronics Circuits. Discrete &integrated, McGraw Ifill Education (India) Private Limited. 2002.
4. KennethJ.Ayala,"The8051Microcontroller", Third Edition Thomson.
5. David E. Simon An Embedded Software Primer Person Education

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| U21EC605 | DIGITAL IMAGE PROCESSING | | | | | | Professional Elective-2 |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| Digital signal processing | L | T | D | P | | | |
| | 3 | - | - | 3 | 40 | 60 | 3 |

**Course Objectives: students will be able to**

1. To learn the digital image fundamentals
2. Learn simple image enhancement techniques in Spatial and Frequency domain.
3. To learn concepts of degradation function and restoration techniques.
4. To study the image segmentation and representation techniques.
5. Familiarize with image compression.

**Course Outcomes:**

**On completion of this course, students are able to:**

1. Determine the fundamental relation between pixels and utility of 2-D transforms in image processer.
2. Implement the enhancement in spatial and frequency domain.
3. Apply degradation and restoration techniques of an image.
4. Implement the various segmentation and Morphological operations on an image
5. Familiarize with the need of compression and evaluation of basic compression algorithms.

**UNIT-I:**
**DIGITAL IMAGE FUNDAMENTALS**

Digital Image Fundamentals and Image Transforms: Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels. Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling Transform.

**UNIT-II:**
**IMAGE ENHANCEMENT**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering,

**UNIT-III:**
**IMAGE RESTORATION**

Image Restoration: Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

**UNIT-IV:**
**IMAGE SEGMENTATION and MORPHOLOGY**

Image Segmentation: Detection of Discontinuities, Edge Linking And Boundary Detection, thresholding, Region Oriented Segmentation.

**Morphological Image Processing**: Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

**UNIT-V**
**IMAGE COMPRESSION**

Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

**Suggested Readings:**


1. Digital Image Processing – Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008
2. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar- TMH, 2010.
3. Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools – Scotte Umbaugh, 2nd Ed, CRC Press, 2011
4. Digital Image Processing using MATLAB – Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, 2nd Edition, TMH, 2010.
5. Digital Image Processing and Computer Vision – Somka, Hlavac, Boyle- Cengage Learning (Indian edition) 2008
6. Introductory Computer Vision Imaging Techniques and Solutions- Adrian low, 2nd Edition, BS

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| U21EC606 | FUNDAMENTALS OF IOT | | | | | | Professional Elective-2 |
| Prerequisite | Contact Hours per week | | | | CIE | SEE | Credits |
| | L | T | O | P | | | |
| Microprocessor & Microcontroller | 3 | 0 | 0 | 0 | 40 | 60 | 3 |

Course Objectives :the student will be able to:

1. learn fundamentals of IoT and its applications and requisite infrastructure
2. familiarize the Internet principles and architecture of IoT.
3. Learn and familiarize applications relevant to IoT
4. Acquire private and security aspects of IoT system

Course Outcomes:

After completing this course, the student will be able to:

1. Analyze the IoT technology and research directions.
2. Comprehend various protocols and architecture of IoT
3. Design simple IoT systems with IoT reference model
4. Analyze with the various applications of IoT
5. Comprehend the different privacy and security approaches at IoT.

**UNIT-I**

**IoT& Web Technology:** The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics

**UNIT-II**

**M2M to IoT:** A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

**UNIT-III**

**IoT Architecture:** State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

**UNIT-IV**

**IoT Applications:** IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi - Controlling LED and LDR using Pi, Opinions on IoT Application and Value for Industry, Home Management, Smart Cities, Smart Environment, Smart Energy, Smart Retail and Logistics, Smart Agriculture and Industry, Smart Industry and eHealth.

**UNIT-V**

**Internet of Things Privacy:** Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

**Suggested Readings:**


1. Designing the Internet of Things", Adrian McEwen, Hakim Classically, Wiley India Publishers,2014.
2. Internet of things: converging technologies for smart environments and integrated ecosystems. Vermesan, Ovidiu and Peter Friess, eds. River publishers, 2013.
3. Internet of Things (A Hands-on Approach)'Vijay Madisetti and ArshdeepBahga,1st edition, VPT, 2014.
4. Rethinking the Internet of Things: A Scalable Approach to Connecting Everything', Francis DaCosta 1st edition, A press Publications, 2013.

**LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY**
**(An Autonomous Institution)**
**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
**SCHEME OF INSTRUCTION & EXAMINATIONS [LR-21]**
**(W.e.f Academic Year 2021-22)**

# OPEN ELECTIVE COURSES

| S. No. | Course Code | Category | Course Title |
|---|---|---|---|
| 1 | U21EE508 | OEC 1 | Non Conventional Energy Systems |
| | U21EE509 | | Energy Conservation and Management |
| | U21CS508 | | Data Base Management Systems |
| | U21IT506 | | Data Structures |
| | U21ME509 | | Basics of Mechanical Engineering |
| | U21ME510 | | Modern Manufacturing Processes |
| | U21CE510 | | Disaster Preparedness and Management |
| | U21CE511 | | Civil Engineering Principles and Practices |
| | U21EC507 | | Principles of Communication Theory |
| | U21EC508 | | Basic Electronics |
| | U21MB501 | | Business Communication |
| | U21MB502 | | Managerial Science and Theory |
| | U21SH501 | | History of Science & Technology |
| | U21SH502 | | Economic Policies in India |

| S. No. | Course Code | Category | Course Title |
|---|---|---|---|
| 2 | U21EE608 | OEC 2 | Fundamental of Power Electronics |
| | U21EE609 | | Electrical Installation and Safety |
| | U21CS607 | | Java Programming |
| | U21IT606 | | Operating Systems |
| | U21ME608 | | Basics Of 3-D Printing |
| | U21ME609 | | Optimization Methods for Engineers |
| | U21CE607 | | Construction Materials |
| | U21CE608 | | Engineering Geology |
| | U21EC608 | | Principles of Data Communication and Network |
| | U21EC609 | | Embedded Systems |
| | U21MB602 | | Total Quality Management |
| | U21MB603 | | Innovation Management |
| | U21SH601 | | Indian Music System |
| | U21SH602 | | Introduction to Art and Aesthetics |

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **U2IEC507** | **PRINCIPLES OF COMMUNICATION THEORY** | | | | | | Open Elective-I |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Analog and Digital Communication | 3 | - | - | - | 40 | 60 | 3 |

**Course Objectives**

1. Introduce fundamental concepts in the understanding of communications systems.
2. Introduce fundamental concepts in the understanding analog and digital communications.
3. Introduce network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
4. Introduce fundamental concepts in the understanding telephone communication systems and optical communication systems.
5. Introduce the evolution of wireless systems and current wireless technologies.

**Course Outcomes**

1. Demonstrate the concepts related to signal transmission and related communication parameters.
2. Explain the various modulation and demodulation techniques in analog and digital communication systems.
3. understand the OS Inter work model and the working of data transmission
4. understand the evolution of communication technologies by learning basic concepts of traditional telephony systems and fundamental concepts related to optical communication systems.
5. understand the fundamental concepts of various current wireless technologies.

**UNIT–I**

Introduction to communication systems: Electromagnetic Frequency Spectrum, Elements of Electronic Communications System, Types of Communication Channels. Signal Transmission Concepts: Baseband transmission and Broadband transmission, Communication Parameters: Transmitted power, Channel bandwidth and Noise, Need for Modulation. Signal Radiation and Propagation: Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

**UNIT–II**

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, /Digital modulation schemes – ASK, FSK ,PSK QPSK, Digital demodulation.

**UNIT–III**

Data Communication and Networking: Topologies, Synchronous and asynchronous data transfer, Modes of Data Communication, OSI Model, Data Link Layer–Media Access control and Logic link control, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer–TCP,UDP.

**UNIT–IV**

Telecommunication Systems: Standard Telephone set, Basic Telephone call procedure, Public Telephone Network, Instruments, local loops, trunk circuits and various telephone Exchanges

Optical Communications: Block diagram Optical Fiber Communication Systems, Optical Fiber – Classification and Configurations, Optical Fiber versus Metallic cable facilities, Wave length Division Multiplexing.

**UNIT–V**

Wireless Communications: AMPS overview, GSM architecture and channels, CDMA IS-95 forward and reverse channels. Current Wireless Technologies: WLL, Wireless LAN, Bluetooth, PAN and ZigBee, RFID communication, Comparison between 1G,2G,2.5G.3G.4G, 5G. Cellular telephone, Cell Splitting, Sectoring, Segmentation, Roaming and Handoffs. Satellite Orbits, Satellite Classification, Spacing and frequency Allocation, Satellite systems link models

**Suggested Readings:**


1. Electronic Communication Systems, Wayne Tomasi,5e, Pearson,2013.
2. Data Communications and Networking, Behrouz A. Forouzan, 5e TMH,2012.
3. Electronic Communications systems, Kennady, Davis, 4e, McGraw Hill,1999.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **U21EC508** | **Basic Electronics** | | | | | | Open Elective-1 |
| Pre-requisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Physics | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives: students will be able to**

1. Study the behavior of Semiconductor diodes in Forward and Reverse bias.
2. Familiarize with the half wave and Full wave rectifiers with L, C Filters.
3. Understand the V-I characteristics of Bipolar Junction Transistor in CB, CE & CC configurations.
4. Familiarize the V-I characteristics of FETs, MOSFETs and study IC fabrication techniques
5. Study the operation of special purpose devices

**Course Outcomes : Students will be able to**

1. Interpret the characteristics and apply diode models to analyze various applications of diodes.
2. Identify the merits and demerits of various filters, formulate and design rectifier circuits with filters Calculate ripple factor, efficiency and percentage regulation of rectifier circuits.
3. Discriminate the BJT configurations to recognize appropriate transistor configuration for any given application and design the biasing circuits with good stability.
4. Distinguish the working principles of BJT and FET also between FET&MOSFET.
5. Acquire knowledge on special purpose devices.

**UNIT-1**

Basics of Semiconductors: Energy bands in intrinsic and extrinsic Silicon. Carrier transport: diffusion current, drift current, mobility and resistivity, Hall Effect.

Junction Diode: PN Junction formation, Characteristics, biasing–band diagram and current flow, Diode current equation, Break down in diodes, Diode as a circuit element.

**UNIT-2**

PN Diode Applications: Half wave, Full wave and Bridge rectifiers–their operation performance characteristics and analysis Filters (L, C filters) used in power supplies and their ripple factor calculations, design of Rectifiers with and without Filters.

**UNIT-3**

BIPOLAR JUNCTION TRANSISTOR: Transistor Junctionformation(collector-base,base-emitterJunctions),Transistor biasing –band diagram for NPN and PNP transistors, current components and current flowing BJT Ebers moll model, Modes of transistor operation, BJT V-I characteristics in CB, CE, CC configurations

**UNIT-4**

Junction Field Effect Transistor (FET): Construction, Principle of Operation, Pinch-Off Voltage, Comparison of BJT and FET, FET as Voltage Variable Resistor.

**UNIT-5**

Special Purpose Devices: Zener Diode, Voltage Regulator, Silicon Cathode Rectifier, TRIAC(triode for alternating current), DIAC(Diode for alternating current), Tunnel Diode, Unijunction Transistor(UJT), Varactor Diode, Light Emitting Diode, LASERS, Photo Diode, Photo Detector

**Suggested Readings:**


1. "Fundamentals of Electronic Devices and Circuits" David Bell, 2ndEdition,McGrawHill Publication, 2009.
2. "Electronic Devices and Circuits " S. Salivahanan ,N Suresh Kumar 4$^{th}$Edition McGraw Hill Publication,2017
3. "Electronic Devices and Circuits", Millman and Halkias, 2nd Edition, McGraw Hill Publication, 2007.
4. "Electronic Devices and Circuit Theory", Robert L. Boylestad,10th Edition, PHI, 2009.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| U21EC607 | PRINCIPLES OF DATA COMMUNICATION AND NETWORKS | | | | | | Open Elective-2 |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Programming for Problem Solving | 3 | - | - | - | 40 | 60 | 3 |

**Course Objectives:**

1. To familiarize the concepts of switched communication networks of OSI model for layered architecture and introduce TCP/IP suite of protocols.
2. To learn the concepts of functions of each layer of OSI model for layered architecture and introduce TCP/IP suite of protocols.
3. To understand performance of data link layer protocol for flow and Error control.
4. To analyze different routing protocols.
5. To familiarize various networked applications such a DNS, FTP, www architecture and network security.

**Course Outcomes:**

**On completion of this course, students are able to**:

1. Interpret the functions of layers in OSI model and various network topologies.
2. Demonstrate the network layer protocols, IP addressing and inter-networking.
3. Apply transport layer working with TCP and UDP.
4. Elaborate the application layer and its protocols.
5. Demonstrate the importance of network security principles and its applications.

**UNIT-I**

**Introduction to Data communication:** A Communication Model, Data representation and its flow, Network Types: LAN, WAN, MAN. Network Topologies: Bus, Star, Ring, Hybrid, Line configurations. Reference Models: OSI, TCP/IP. Transmission modes.

**UNIT-II**

**Data Link Layer**: Need for Data Link Control, Design issues, Framing, Error Detection and Correction, Flow control Protocols: Stop and Wait, Sliding Window, ARQ Protocols, HDLC. MAC Sub Layer: Multiple Access Protocols: ALOHA, CSMA, LAN- IEEE 802.2, 802.3, Wireless LAN- 802.11standard.

**UNIT-III**

**Network Layer**: Network layer Services, Routing algorithms: Shortest Path Routing, Flooding, Hierarchical routing, Broadcast, Multicast, Distance Vector Routing, and Congestion Control Algorithms. Internet Working: The Network Layer in Internet: IPV4, IPV6, Comparison of IPV4 and IPV6, IP Addressing

**UNIT-IV**

**Transport Layer**: Transport layer Services, Elements of Transport Layer, Checksum Congestion Control Connection management, TCP and UDP protocols, TCP congestion control, Packet format and flow & error control.

**UNIT-V**

**Application Layer**: Domain Name System, SNMP, Electronic Mail, World Wide Web, HTTP, FTP.

**Network Security**: Cryptography Symmetric Key and Public Key Cipher algorithms, Digital Signatures, Authentication Protocols.

**Suggested Readings:**


1 "Data Communication and Networking,"Behrouz A. Forouzan, 3/e,TMH, 2008.
2 "Data and Computer Communications," William Stallings, 8/e,PHI, 2004.
3 "Computer Networks," Andrew S Tanenbaum, 5/e, PearsonEducation, 2011.
4 "Computer Networks and Internet", Douglas E Comer, 5/e, Pearson Education Asia, 2009.
5 "Data Communications and Computer Networks", Prakash C. Gupta, 2/e, PHI learning, 2013.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| U21EC608 | EMBEDDED SYSTEMS | | | | | | Open elective-II |
| Prerequisite | Contact Hours Per Week | | | | CIE | SEE | Credits |
| | L | T | 0 | p | | | |
| Computer Organization Microprocessor | 3 | 0 | 0 | 0 | 40 | 60 | 3 |

**Course Objectives:**

1. To understand the architecture of 8051 microcontrollers.
2. To understand the various applications of Embedded Systems using the concepts of Interfacing.
3. To familiarize with smart sensors and understand various sensor applications.
4. To learn the concepts of RTOS and the design process using RTOS.
5. To familiarize with the design principles of SOC.

**Course Outcomes: students will be able to learn**

1. Study and analysis of embedded systems.
2. Design and develop embedded systems (hardware, software and firmware)
3. Analyze, real time systems using RTOS and develop applications.
4. Apply knowledge to interface various sensors and its applications in embedded systems.
5. Elaborate the principles of SOC design.

**UNIT-I**

**Embedded Computing Introduction**: Complex Systems and Microprocessor Embedded System Design Process, Formalisms for System Design, Design Examples. Microprocessors and Microcontrollers: Microprocessors and Microcontrollers, The 8051 Architecture: Introduction, 8051 Microcontroller Hardware, Input/output Ports and Circuits, External Memory.

**UNIT-II**

**Introduction to 8051**: Data Transfer and Logical Instructions. Arithmetic Operations, Decimal Arithmetic. Jump and Call Instructions, Applications: Interfacing with Keyboards, Displays, D/A and A/D Conversions, Multiple Interrupts, Serial Data Communication. Bus protocols: I2Cbus and CAN bus.

**UNIT-III**

**Smart Sensors Introduction**: Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface–The Automation. Sensors–Applications Introduction–On-board Automobile Sensors (Automotives Sensors)– Home Appliance Sensors–Aerospace Sensors—Sensors form Manufacturing– Sensors for environmental Monitoring

**UNIT-IV**

**Introduction to Real-Time Operating Systems**: Tasks and task states, tasks and data, semaphores, and shared data; message queues, mail boxes and pipes, timer functions, events, memory management, interrupt routines in an RTOS environment. Basic Design Using Real Time Operating System

**UNIT-V**

**Introduction to the System Approach System Architecture**: Components of the system, Hardware &Software, Processor Architectures, Memory and Addressing. System level inter connection, An approach for SOC Design, System Architecture and Complexity.

**Suggested Readings:**


1. The8051Microcontroller and Embedded Systems using Assembly and C Muhammad Ali Mazidi Janice Gillespie Mazidi, Rolin D. McKinlay, ,Prentice Hall India,2nd Edition.
2. Sensors and Transducers, D. Patranabis, PHI Learning Private Limited.
3. ” Computers and Components" Wayne Wolf, Elsevier, Second Edition. Donald L Schilling & Charles Belove. Electronics Circuits. Discrete &integrated, McGraw Ifill Education (India) Private Limited. 2002.
4. "The8051Microcontroller”, KennethJ.Ayala, Third Edition Thomson
5. “An Embedded Software Primer" David E. Simon, Pearson Education