THIRD SEMESTER

ECE2101 **Electronic Devices-I** **[3 1 0 4]**

Course Outcomes:

At the end of the course, students will be able to
CO1. Understand the principles of semiconductor Physics and apply it to electronic devices.
CO2. Understand construction and operation of semiconductor devices.
CO3. Appreciate different devices for different applications.
CO4. Analyze PN junctions, JFETs, MOSFETs, and BJTs
CO5. Apply electronic devices to design and implement circuits and systems.

Syllabus:

Semiconductor Physics fundamentals: intrinsic and extrinsic semiconductors. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility, and resistivity; sheet resistance. **PN Junctions:** PN junction formation, depletion region, and forward/reverse bias. Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Diode circuits: rectifiers, clippers, and clampers. Avalanche breakdown, Zener diode, Schottky diode.**Junction Field Effect Transistors (JFETs):** JFET fundamentals: construction and operation. JFET characteristics and applications.**Metal Oxide Semiconductor FETs:** MOSFET fundamentals; n-channel and p-channel MOSFETs; MOSFET characteristics and regions of operation. MOSFET small-signal analysis, Common source, common gate, and common drain amplifier configurations. MOSFET Applications: MOSFET-based digital circuits. MOSFET as a switch and its role in digital systems. **Bipolar Junction Transistors (BJTs):** BJT fundamentals: construction and operation. BJT characteristics and comparison with MOSFETs.

References:

1. R. L. Boylestad, L. Nashelsky, *Electronic Devices and Circuit Theory,* (10e), Pearson, 2009.
2. A. S. Sedra, K. C. Smith, *Microelectronic Circuits, Technology and System Applications*, (7e), Oxford University Press, 2014.
3. B.G. Streetman, and S. K. Banerjee, *Solid State Electronic Devices,* (7e), Pearson, 2014.
4. S. M. Sze and K. N. Kwok, *Physics of Semiconductor Devices*, (3e), John Wiley &Sons, 2006.
5. P. R. Gray, P. J. Hurst, S. H. Lewis, *Analysis and design of analog integrated circuits* (5e), Hoboken, NJ: Wiley, 2015.
6. D. A. Neamen, *Semiconductor physics and devices: Basic principles* (4e)z. Boston, MA: McGraw-Hill, 2012.

ECE2102 **Digital Electronics** **[3 1 0 4]**

CO1. Analyse and Design Combinational circuits
CO2. Describe and characterize flip flops & its applications.
CO3. Design and analyse Sequential Circuits and analyse timing analysis.

CO4. Design Finite State Machines and Algorithmic State Machines.
CO5. Understand the different Logic families and semiconductor families.

Syllabus:

Introduction of Combinational logic design: Overview of Boolean Algebra and K-Map, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder. MSI devices: Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Barrel shifter and ALU.

Sequential logic design: latch, Flip-flop, S-R FF, D FF, JK FF, T FF, and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Timing Analysis of sequential circuits.

Designing of State Machines: Finite state machines, Design of synchronous FSM, State Reduction, Timing issues in synchronous circuits. Algorithmic State Machines, Designing synchronous circuits like Pulse train generator, Pseudorandom Binary Sequence generator, Clock generation. Design of asynchronous circuits.

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices, Logic implementation using Programmable Devices.

References:

1. A. A. Kumar, *FUNDAMENTALS OF DIGITAL CIRCUITS*. Prentice Hall India Pvt., Limited, (2e), 2016.
2. R. P. Jain, *Modern Digital Electronics*. McGraw-Hill Education (India) Pvt Limited, (4e), 2003.
3. W.H. Gothmann, *Digital Electronics- An introduction to theory and practice*, PHI, (2e), 2006.
4. R.P. Jain, Modern digital Electronics, Tata McGraw Hill, (4e), 2009.
5. S. Brown and Z. Vranesic, Fundamentals of Digital logic with Verilog Design, McGraw Hill, (3e) 2013.

ECE2103 Signals and systems [3 1 0 4]

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1. Understand different types of signals-continuous and discrete,odd and even,periodicand aperiodic etc.Be able to classify systems based on their properties
CO2. Understand the characteristics of LTI systems
CO3. Calculate Fourier series and Fourier transform of continuous and discrete time signals.
CO4. Analyze signal and system properties like stability and causality using Laplace and Z transforms.
CO5. Comprehend the effects of sampling on a continuous time signal.

Syllabus:

Introduction to signals and systems & their classification and their properties.**Continuous**

time and discrete time Linear time-invariant (LTI) systems: the impulse response and step response, convolution. Frequency response and its relation to the impulse response, Fourier series representation, Fourier Transform, properties, magnitude, and phase response. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT) of signals.

The **Laplace Transform** for continuous time signals and systems, region of convergence, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The **z-Transform** for discrete time signals and systems- eigen functions, region of convergence, system functions, poles and zeros of systems and sequences, z-domain analysis. System realization through block-diagram representation and system interconnection. **State- space analysis** and multi-input, multi-output representation. The state-transition matrix and itsrole. The **Sampling Theorem and its implications**- Spectra of sampled signals. Reconstruction:ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relationbetween continuous and discrete time systems.

References:

1. A.V. Oppenheim, A. S. Willsky & A. Nawab, *Signals and Systems*, (2e), PHI. /Pearson Education, New Delhi, 1997.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, *Signals and Systems - Continuous and Discrete*, (4e), Prentice Hall, 1998.
3. B. P. Lathi, *Linear systems and Signals*, (2e), Oxford University Press, 2005.
4. Douglas K. Lindner, *Introduction to Signals and Systems*, Mc-Graw Hill International Edition: c1999.
5. S. Haykin & B. V. Veen, *Signals and Systems*, (2e), John Wiley &Sons, New Delhi, 2007.
6. H. Hsu, R. Ranjan, *Signals and Systems*, (2e), Schaums's outline, Tata McGraw – Hill, New Delhi, 2008.

ECE2120 Circuits & network theory [3 0 2 4]

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1. Apply the knowledge of basic circuital law and simplify the network using reduction techniques
CO2. Evaluate transient response, Steady state response, network functions
CO3. Determine different network functions.
CO4. Evaluate two-port network parameters
CO5. Synthesize an electrical network from a given impedance/admittance function

Syllabus:

Network theorems and elements: Superposition, Thevenin's and Norton's Theorem, maximum power transfer theorem. Networks with dependent sources. **Transients analysis:** Impulse, Step, Ramp and sinusoidal response analysis of first order and second order circuits. Time domain & transform domain (Laplace) analysis. Initial and final values of networks; **Two port networks:** Two Port General Networks: Two port impedance, admittance, hybrid, ABCD parameters and their inter relations. Equivalence of two ports. **Interconnection of two port**

networks: filters, image impedance symmetric T and pi networks; **Network functions:** Terminals and terminal pairs, Driving point Impedance, admittance and transfer functions. Procedure for finding network functions for general two terminal pair networks, Stability & causality, Hurwitz polynomial, positive real function; **Network synthesis:** The four-reactance function forms, specification for reactance function. Foster form of reactance networks. Cauer form of reactance networks Synthesis of R-L and R-C and L-C networks in Foster and Cauer forms.

References:

1. Van Valkenburg, Mac Elwyn, *Network analysis, (3e),* Prentice Hall of India*, 2000.*
2. A. Sudhakar, S. P. Shyammohan, *Circuits and Network,*(5e),Tata McGraw-Hill, New Delhi, 2017.
3. *William H. Hayt,Jr. Jack E. Kemmerly, Stevem M. Durbin, Engineering Circuit Analysis, (8e), McGraw-Hill Education,2012.*
4. Ashfaq Husain, *Networks and Systems, (2e),* Khanna Book Publishing, 2021.
5. Ravish S. Salivahanan, S. Pravin Kumar, *Circuit Theory,* Vikas Publishing.

Lab:

Experiments are carried out on hardware and software to analyze the circuits & networks.

ECE2121 Linear Integrated circuits [3 0 2 4]

Course Outcomes:

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

CO1. Identify the characteristics of an ideal op amp and model the ideal op amp for circuit analysis.

CO2. Analyse op amp circuits that perform useful functions such as precisely amplifying signals etc., and their linear and non-linear applications.

CO3. Design different type of filters by using Op amp circuit.

CO4. Analyse IC555 timer using Op amp for different applications.

CO5. Analyse data converters and IC565 and IC566 using op-amp.

Syllabus:

Operational amplifiers: Function and characteristics of the ideal Op-amp Differential and common mode signals, Block level representation of Op-amp.**Linear applications of op-amp**: Weighted Amplifier, Converter circuits, design specification of Differentiator and Integrator circuits, instrumentation amplifier and bridge amplifier. **Non-linear applications of operational amplifier**: Active filters: Design and analysis of low pass, high pass, band pass, band elimination and all pass active filters. rectifiers, peak detector, sample and hold circuit, comparators, window detector, Schmitt trigger, square wave, triangular wave generators, oscillators. **Timer IC**: pin details and internal working of 555 IC. Applications: multivibrator, Schmitt trigger. **Data converters**: Principles and specifications of digital to analog converter (DAC) and analog to digital converters (ADC), binary weighted and R-2R DAC, successive approximation type, counter type and servo tracking type and dual slope ADC. Phase-locked

loop IC 565 and voltage-controlled oscillator IC 566: Analysis and applications. IC based voltage regulators and power amplifiers.

References:

1. R.A. Gayakwad, *Op-Amps and Linear Integrated Circuits,* (4e), Prentice Hall of India, 2002.
2. W. D. Stanley, *Operational Amplifiers with Linear Integrated Circuits*, (4e), Pearson Education, 2007.
3. F. Sergio, *Design with Op amps & Analog Integrated Circuits*, (4e), McGraw Hill, 2014.
4. D. Roy Chowdhury, *Linear Integrated Circuits*, (2e), New Age International (p) Ltd, 2003.
5. William D.Stanley, *Operational amplifiers with linear integrated cuircuits,(*4e), Pearson Education India,2009.

Lab:
Experiments are performed on hardware as well as software to study linear and non-linear applications of op-amp. Also, circuits based on PLL, VCO and timer IC are designed and performed on hardware as well as software.

ECE2130 Electronic devices Lab-1 [0 0 2 1]

Course Outcomes:
CO1. Understand semiconductor device characteristics
CO2. Analyze device characteristics to determine important device and circuit parameters
CO3. Implement circuits with diodes
CO4. Implement circuits with BJT and FET
CO5. Understand the effect of input frequency on amplifier circuits

Syllabus:

Experiments are carried out on hardware and software to analyze the characteristics of semiconductor devices like diodes, transistors and MOSFET. Circuits based on these devices are studied for various device and circuit parameters on hardware as well as software.

ECE2131 Digital Electronics Lab [0 0 2 1]

Course Outcomes:

CO1. Analyze the various digital ICs and understand their operation.
CO2. Design and analyze combinational circuits.
CO3. Design and analyze synchronous sequential logic circuits.
CO4. Classify all digital circuits using software.

Syllabus:
Experiments of this lab are implemented at Hardware as well as software level. List of experiments include study of implementation of combinational and arithmetic circuits using logic gates and MSI chips, designing of sequential circuits and implementation of FSMs for their applications.

ECE2170 **Project Based Learning 1** **[0 0 2 1]**

Syllabus:

Based on the identification of a research problem/ latest innovation and literature review. Evaluation will be based on the report and presentation.

FOURTH SEMESTER

ECE2201 **Electronic Devices-II** **[4 0 0 4]**

Course Outcomes:

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

CO1. Understand the principles of semiconductor physics as applied to advanced electronic devices
CO2. Analyze and describe the operation of traditional electronic devices such as PN junctions, JFETs, and MOSFETs.
CO3. Explore the principles and advantages of FinFET technology.
CO4. Design and analyze FinFET-based circuits for specific applications.
CO5. Evaluate the impact of FinFET technology on the development of advanced semiconductor devices.

Syllabus:

Review of Semiconductor Physics and Traditional Electronic Devices: Recap of semiconductor fundamentals. In-depth review of PN junctions, JFETs, and MOSFETs. **FinFET Technology:** Evolution of MOSFETs to FinFETs, Advantages and challenges of FinFET technology. **FinFET Device:** FinFET structure and fabrication, Operational principles of FinFETs. Analyzing FinFET characteristics, Modeling FinFET behavior for circuit simulation. **FinFET Circuit Design:** Design considerations for FinFET-based circuits, Applications of FinFETs in analog and digital circuits. **Future Trends:** Scaling trends in FinFET technology, FinFETs in integrated circuits and system-on-chip (SoC) designs. Case studies of FinFET applications in real-world scenarios.

References:

1. Samar K. Saha, *FinFET Devices for VLSI Circuits and Systems,(1e),* CRC Press, 2021.
2. Jean-Pierre Colinge (Ed.), *FinFETs and Other Multi-Gate Transistors,(1e),* Springer, 2008.
3. Corrado Di Natale, *Introduction to Electronic Devices,(1e),* Springer, 2023.
4. S. Salivahanan, N. Suresh Kumar, *Electronic Devices and Circuits*,(5e), McGrawHill, 2022.
5. Segio M. Rezende, *Introduction to Electronic Materials and Devices,(1e),* Springer, 2022.

ECE2202 **Computer and Processor Architecture** **[3 1 0 4]**

Course Outcomes:

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

CO1. Classify the organization and structure of modern computer systems.
CO2. Demonstrate an understanding of addressing techniques and control unit design.
CO3. Examine microarchitecture and its role in computer system design.
CO4. Apply knowledge of cache memory and its impact on system performance.
CO5. Analyze pipelining and parallel processing in computer architecture.

Syllabus:

Introduction to Computer Architecture: Overview of computer architecture and design, Basic Structure of Computers, Functional units, Instruction set architecture basics, Processor design principles. **Data Path and Control Unit Design. Memory Systems and Input/Output Systems:** Understanding memory hierarchies, Input/output system organization, **Cache Memory and Pipelining:** Principles and types of cache memory, Overview and analysis of pipelining. **Parallel Processing and Performance Evaluation:** Concepts of parallel processing in computer architecture, Performance evaluation for architectures. **Advanced Topics and Emerging Trends: Computer arithmetic** and its role in system design, System-on-chip design and emerging trends in computer architecture, Discussion on parallel computing, energy-efficient designs, and emerging memory technologies.

References:

1. V.C. Hamacher, Z. Vranesic & S. Zaky, “Computer Organization”, McGraw Hill International Edition, Computer Science series, (5e), 2002.
2. M. Morris Mano, “Computer System Architecture, Pearson”, (3e), 2008.
3. John P. Hayes, “Computer Architecture and Organization”, TMH, (3e), 1998
4. M. Dalrymple, “Inside an Open-Source Processor”, elector, (1e) 2021.
5. S. Brown and Z. Vranesic, “Fundamentals of Digital logic with Verilog Design”, McGraw Hill, (3e), 2014.
6. J. Ledin, “Modern Computer Architecture and Organization”, Packt Publishing Ltd, (1e), 2022.

Lab:

An Introduction to Computer Architecture, Microprocessor, Assembly language programming, and Verilog. Experiments to be performed using 80x86 / Arm / OpenSPARC.

ECE2220 System Design using HDL [3 0 2 4]

Course Outcomes:

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

CO1. Describe the basic attributes, operators & syntax of Verilog HDL for implementation of digital circuits using Verilog for enhanced employability.
CO2. Discuss the structural, register-transfer level (RTL), and algorithmic levels of abstraction for modelling digital hardware systems.
CO3. Explain modelling of combinational and sequential digital systems (Finite State Machines) for acquiring skills in the domain of Digital Systems.
CO4. Apply the concept of test-benches to create testing behavioural environments for simulation-based verification
CO5. Illustrate problems of finite state machine for various system implementation.

CO6. Analyse circuits efficiently in digital system design to achieve optimization for high device utilization and performance for digital applications.

Syllabus:

Introduction to Verilog HDL, Hardware Simulation & Synthesis, **Verilog Attributes:** Switch level, Gate level. Pin to Pin Delay, Dataflow, Top-Down design with Verilog, Subprograms, Operators, Syntax and constraints. **Characterization of HDL:** Timing, concurrency, data types, nets, Verilog primitives. Modelling of Test Bench. Combinational and Sequential Design. Usage of subprograms, parametrization and specifications, path delay specification. Utilities for high level Description. Dataflow description, Behavioural Description of Hardware, Modelling for Hardware Design. Interface design & Modelling.

References:

1. K. S. Kundert and O. Zinke, The Designer's Guide to Verilog-AMS. Springer, (1e) 2004.
2. S. Palnitkar, Verilog HDL, (2e), Pearson education, 2003.
3. J. Bhasker, A Verilog HDL Primer, Star Galaxy Pub., (3e), 2005.
4. S. Brown and Z. Vranesic, Fundamentals of Digital logic with Verilog Design, McGraw Hill, (3e) 2013.
5. M. Morris Mano, Michael D. Ciletti, Digital Design: With an introduction to Verilog HDL, Pearson, (6e), 2017.

ECE2221 Electromagnetic Field Theory [4 0 0 4]

Course Outcomes:

CO1. Recall the fundamentals of Vector Calculus.
CO2. Understand the difference between Electrostatic and Magnetostatic fields using concepts and their behavior in changed mediums.
CO3. Applying Electric and Magnetic fields concept in solving problems.
CO4. Analyze the time-varying Electric and Magnetic field using Maxwell's Equations.
CO5. Estimate the phenomena of Electromagnetic waves propagation in different media.
CO6. Initiate Electromagnetic Field Theory applications.

Syllabus:

Coordinate systems and transformation. **Electrostatic Field**: Coulomb's Law, Electric field intensity, flux density. Electric field due to various charge configurations, Electric Potential, Gauss 's law and its applications, Laplace's and Poisson's equations, Uniqueness theorem, Continuity equation, Capacitances, Energy density in an electric field, Boundary conditions. **Magnetostatic Field**: Magnetic field intensity, flux density, and magnetization, Biot- savart law, Ampere's circuit law, Magnetic static and Vector potential, Energy stored in Magnetic field and boundary conditions. **Electromagnetic fields**: Analogy between electric and magnetic field, Field mapping and concept of field cells, Time varying fields, Displacement current, Maxwell's equations. **Electromagnetic Waves:** Uniform Plane Wave in free space, dielectrics and conductors, skin depth, Plane wave reflection and refraction, Standing Wave ratio, Radiation, EMI and EMC.

References:

1. Mathew N.O. Sadiku, *Elements of Electromagnetics*, (4e), Oxford University Press, 2006.

2. A. V. Bakshi, U. A. Bakshi, *Electromagnetic Field Theory,* (1e), Technical Publications.
3. William H. Hayt and John A. Buck, *Engineering Electromagnetics*, (7e), McGraw Hill 2006.
4. J. D. Kraus, Keith R. Carver, *Electromagnetics with application,* (5e), TMH.
5. N.N. Rao, *Elements of Engineering Electromagnetics,* (6e), Pearson Education, 2006.
6. Edminister, Joseph A. *Theory and problems of electromagnetics*, (2e), The McGraw-Hill Companies, 1997.

ECE2240 Data Structures & Algorithms [3 0 0 3]

Course Outcomes:

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

CO1. Describe the basic concepts of object-oriented programming using C++.
CO2. Explain the basic operations on arrays, lists, stacks and queue data structures.
CO3. Elaborate the notions of trees, binary search trees, Red Black tree, Heap.
CO4. Learn appropriate sorting algorithms such as merge sort, heap sort and quick sort etc. based on the problem given.
CO5. Develop C++ programs for simple applications.

Syllabus:

Introduction to C++: An overview of C++ programming language basic terms and operations. **Linked List:** Representing the linked list in memory with traversing and searching a linked list. **Stack, Queues and Recursion:** Array/ Linked representation of stack and Queues with its applications. **Trees:** Tree Definitions, Type of Trees, Traversal Algorithms, **Heaps and Priority Queues:** Heaps, the Natural Mapping, Insertion into a Heap, Removal from a Heap, Path length: Huffman's algorithm. **Sorting and Searching:** Various sorting algorithms like Bubble Sort etc., Searching and data modification, Hashing. **Graphs:** Types of Graphs, The Adjacency Matrix for a Graph, The Incidence Matrix for a Graph, The Adjacency List for a Graph, Dijkstra's Algorithm, Graph Traversal Algorithms. **Analysis of algorithm**: Synergy between data structures and algorithm, Factors to be considered in the choice of data structures and algorithms.

References:

1. J. R. Hubbard, *Data Structures and Algorithms*, Schaum's Outlines. McGraw-Hill, New York, USA, 2000.
2. Michael T. Goodrich, Roberto Tamassia, David M. Mount, *Data Structures and Algorithms in C++*, 2, illustrated Edition, John Wiley & Sons, 2010.
3. R. Lewis, L. Deneberg, Data Structures and their Algorithms, Addison-Wesley UK, 1991.
4. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, University Paperback, Perason, 2014.
5. Clifford A. Shaffer, *Data Structures & Algorithm Analysis in C++,* (3e), Dover Publication US, 2011.

ECE2241 Optical Components and Sensors [3 0 0 3]

Course Outcomes:

CO1. Understand fundamental properties of light and operating principles of optical and photonic devices.
CO2. Understand and analyze the principle behind semiconductor optoelectronic sources and detectors and their characteristics.
CO3. Demonstrate an in-depth understanding of the basic mechanism of Opto-electronic components like modulators, couplers, multiplexers, demultiplexers, and polarizers
CO4. Understand the operating principles, and characteristics, of different types of optical sensor
CO5. To demonstrate the design architectures of various optical sensors and their applications.

Syllabus:

Review of Semiconductor device Physics, Semiconductor Opto electronics- Solid State Materials, Emitters, Detectors and Amplifiers, **Semiconductor Emitters**- LEDs, Diodes, SLDs, CCDs, **Semiconductor lasers-** basic Structure, theory and device characteristics, DFB, DBR, Quantum well lasers, Laser diode arrays, VCSEL etc. Photoconductors, photo diodes, PIN , APD ,Photo transistors, solar cells, CCDs, IR and UV detectors.Optical filters, Directional couplers, Dividers, Multiplexers, Phase and Amplitude Modulators, Polarization and polarization controllers, etc. Photonics Signal processing, Nonlinear optics- Frequency Converters, Phase conjugation, optical Correlation. Optical sensing principles (temperature, strain, stress, pressure, refractive index, etc.).Fibre types and materials for optical fibre sensing (silica based, polymer based, etc.). Point sensors (Fibre Bragg gratings, long period gratings, and microfibres/nanowires). Distributed sensors (Brillouin scattering based, Raman scattering based, Rayleigh scattering. Fibre gyroscopes. Fibre-based gas and chemical sensors. Optical fibre sensors for extreme and harsh environments (high temperature and strain, shock, high radiation).Principles and application of optical fibre sensors in medicine and life sciences.

References:

1. J Wilson and J F B J iS Hawkers, *Opto electronics - An introduction*, (2e), Prentice-Hall India, 1993.
2. S. O. Kasap, *Optoelectronics and Photonics: Principles and practices*, Pearson 2012
3. J. C. Palais, *Introduction to optical electronics*, (5e), Prentice Hall, 2004.
4. Jörg Haus, *Optical Sensors -Basics and Applications*, (1e), Weinheim : Wiley-VCH Verlag GmbH & Co, 2010.
5. Jasprit Singh, *Semiconductor opto electronics*, (1e), McGraw-Hill, Inc, 1995.
6. P Bhattacharya, *Semiconductor optoelectronic devices*, (2e), Pearson, 1996.

ECE2242 Fundamentals of telecommunications [3 0 0 3]

Course Outcomes:

By the end of this course, students will be able to
CO1. Understand the working principles of communication system.
CO2. Perform computations and solve switching network problems.
CO3. Apply circuits principles for designing transmitters.
CO4. Analyze the receiver system for fault diagnostics.
CO5. Demonstrate knowledge of signal conditioning.

Syllabus:

Introduction to communication systems: Basic functions, Elements, and Limitations of Communication system. Analog and Digital Signals, their Advantages and Disadvantages. Systems and Applications. Single-Ended signals. Differential signals. Signal properties and Noise. **Sampling theory:** Review of signal coding and modulation. **Switching in networks:** Classification, requirements, and evaluation of blocking probability, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing. **Transmitter:** Signal transfer types. Basic Transmitter block diagram. Data eye measures. Intersymbol Interference. Pre-emphasis in Transmitter. Industry standards, Mipi DPHY, CPHY Lane States and Line Levels. Mipi MPHY. **Receiver:** Timing Margin. Receiver circuit topology. Amplifying Receiver. Sampling Receiver. Input Offset Correction. Demultiplexing. Analog front end. Attenuator. Amplifier Chain. Decision feedback equalizer.

References:

1. Thiagarajan Viswanathan, Manav Bhatnagar, *Telecommunication Switching System and Networks*, (2e), Prentice Hall, 2015.
2. Tony Chan Carusone, David Johns, Kenneth Martin, *Analog Integrated Circuit Design*, (2e), John Wiley & Sons. 2013.
3. Piet Wambacq, Willy M.C. Sansen, *Distortion Analysis of Analog Integrated Circuits*, (1e), Springer, 2011.
4. E. Tlelo-Cuautle, *Integrated Circuits for Analog Signal Processing*, (1e), Springer. 2012.
5. R. Jacob Baker, *CMOS Circuit Design, Layout and Simulation*, (4e), John Wiley & Sons, 2019.
6. Stephen H. Hall, Howard L. Heck, *Advanced Signal Integrity for High Speed Digital Designs*, (1e), John Wiley & Sons, 2009.

ECE2230 SPICE Lab [0 0 2 1]

Course Outcomes:

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

CO1. Simulate semiconductor devices
CO2. Design and analysis of semiconductor devices and their fabrication processes
CO3. Analyze device characteristics to determine important device parameters
CO4. Implement circuits with MOSFET
CO5. Implement circuits with FinFET

Syllabus:
Experiments are carried out on software to study and analyze the characteristics of semiconductor devices to study various device parameters. Also, circuit implementation of these devices is studied on software in this lab..

ECE2231 Computer and Processor Architecture Lab [0 0 2 1]

Course Outcomes:

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

CO1. Describe the function, types, and hierarchies of memory in computer architecture design.

CO2. Implement a simple bus structure.
CO3. Implement a simple pipeline.
CO4. Implement assembly language programming.

Syllabus:
An Introduction to Computer Architecture, Microprocessor, Assembly language programming, and Verilog. Experiments to be performed using 80x86 / Arm / OpenSPARC.

ECE2270 **Project based learning lab-II** **[0 0 2 1]**

Syllabus:
Based on planning and designing of the solution. Evaluation will be based on report and presentation.

OPEN ELECTIVES

ECE0001 **Introduction To Communication Systems** **[3 0 0 3]**

Optical Fiber Communications: Types of Optical Fibers, Numerical Aperture, Time Delay and Group Delay, Concept of V number, Attenuation and Dispersion (dispersion shifted and dispersion flattened fibers), Macro and Micro Bending, Pulse Broadening, Optical Sources and Detectors, Optical Communication System. Satellite Communications: Satellite orbits, Keplers laws, speed, period, angle of elevation, orbital effects in communication satellites, launching of a satellite, Earth Station technology, Space Segment, Modern Trends in Satellite Communications.

References:

1. J. M. Senior, *Optical Fiber Communications- Principles and Practise*, (3e), Pearson Education India, 2010.
2. R.P. Khare, *Fiber Optics and Optoelectronics*, (1e), Oxford University Press, 2004.
3. R. N. Mutagi, *Satellite Communications Principles and Applications*, (1e), Oxford University Press, 2016.
4. Wilbur L. Pritchard et al, *Satellite Communication Systems Engineering*, (2e), Prentice Hall, 1993.

ECE0002 **Introduction To Game Theory** **[3 0 0 3]**

Course Outcomes: At the end of the course, students will be able to:
CO1. Comprehend the foundational principles of strategic decision-making through game theory.
CO2. Analyze complex interactions among rational decision-makers, in evolutionary biology contexts.
CO3. Execute strategic planning and management skills to formulate effective strategies in competitive environments.
CO4. Make decision in Uncertain Environments through understanding concepts like Bayesian Games and Perfect Bayesian Equilibrium.

CO5. Solve problems by analyzing complex strategic interactions, identifying optimal strategies, and evaluating outcomes in scenarios like Cournot Duopoly and Non-Cooperative Bargaining.

CO6. Apply game theory concepts to various fields such as economics, biology, and political science, demonstrating proficiency in modelling strategic interactions and deriving insights applicable to real-world decision-making contexts.

Syllabus:

Introduction Examples: Markets/ Politics/ Auctions; **Prisoners' Dilemma**, Best Response and Nash Equilibrium, Dominant Strategies, Stag Hunt – Coordination and Bank Runs. **Multiple Nash Equilibria**, Tragedy of Commons, Cournot Duopoly, Mixed Strategies, Battle of Sexes, Best Response Dynamic, Paying Taxes; **Portfolio Management Game,** Rationality, Choice and Common Knowledge, Iterated Elimination of Domination Strategies, Auction: As a Normal Form Game, Traffic at Equilibrium and Braess's Paradox; **Extensive Form Games,** Strategies in Extensive from Games, Sub Game Perfect Equilibrium, The Art of War, Ultimatum Game, Stackelberg Model, **Bayesian Games,** Bayesian Nash Equilibrium, Yield vs Fight, Bayesian Cournot Game, Bayesian Games with mixed strategies, Auctions, Sealed Bid First Price Auction, Expected Revenue, Bayesian Second Price Auction, Second Price Auction, All Pay Auction; **Evolutionary Biology,** Evolutionary stable Strategy (ESS), Repeated Games, Multiple Equilibriums, Chain-Store Paradox, Non – Cooperative Bargaining; Extensive Form Game with Incomplete Information, Introduction to perfect Bayesian Equilibrium, Obtaining PBE, Gift Game.

References:

1. Martin Osborne, *An Introduction to Game Theory*, (1e), Oxford University Press, 2003.
2. Ken Binmore, *Game Theory*: A *Very Short Introduction*, (1e), Oxford University Press, 2007.
3. Steven Tadelis, *Game Theory: An Introduction*, (2e) Princeton University Press, 2013.
4. Philip D. Straffin, *Game Theory and Strategy*, (1e) Mathematical Association of America, 1993.
5. Joel Watson, *Strategy: An Introduction to Game Theory*, (3e) W.W. Norton & Company, 2013.
6. Roger B. Myerson, *Game Theory: Analysis of Conflict*, (1e) Harvard University Press, 1997.

ECE0003 *Stress Free living [3 0 0 3]

*(in collaboration with Abhigya Club & faculty from Hare Krishna Movement Jaipur)

Course Outcomes:

1. Identify some of the commonly felt problems that individuals, organizations and the society faces
2. Discuss the usefulness of Gita in addressing some of these problems
3. Describe how alternative world views and paradigms of management could be developed with Gita
4. Illustrate Ancient Indian wisdom using Gita as a vehicle

Syllabus:

Spirituality in Business and Workplace: Current Challenges in Business Management & Society, Relevance of Ancient Indian Wisdom for contemporary society, Spirituality in Business, The notion of Spirituality, An introduction to Bhagavad Gita & its relevance.

Perspectives on Leadership & Work: Failed Leadership: Causes & Concerns, Leadership Perspectives in the Gita, Axioms of Work & Performance, The Notion of Meaningful Work. **Perspectives on Individuals:** Mind as a key player in an individual, Meditation as tools for self-management, Yoga as tools for self-management, Role of Yoga in addressing stress & burnout of managers, Self-Management by understanding the world within, Values & their role in Self-management, Shaping the personality through Trigunas. **Perspectives on Life and Society:**Perspectives on Sustainability, Death as a creative destruction process, The Law of Conservation of Divinity, Conclusions.

Reference Books:

1. Prabhupada, His Divine Grace A.C. Bhaktivedanta. *Bhagavad Gita As It Is.* Mumbai: Bhaktivedanta Book Trust, 2009.
2. Prabhupada, His Divine Grace A.C. Bhaktivedanta. *The Science of Self-Realization.* Mumbai: Bhaktivedanta Book Trust, 2002.

ECE0051 Excel Fundamentals for Data Analysis [3 0 0 3]

Course Outcomes:

CO 1. Apply a range of text functions to manipulate and restructure data.
CO 2. Apply logical functions to correct or transform data.
CO 3. Convert a range to a table and work effectively with that table.
CO 4. Demonstrate a range of methods for creating Named Ranges.
CO 5. Employ a range of logical functions to automate performing different operations under different circumstances.

Syllabus:
Data analysis: Overview, data analysis with Excel. Conditional formatting, sorting and filtering data, Cleaning and manipulating text data. Working with numbers and dates. Calculation with named ranges. Automating data validation. Working with Tables. Logical and lookup function. Data visualization and validation.

Reference Books:

1. L. Winston Wayne, Microsoft Excel 2019: Data Analysis & Business Model, PHI.
2. Data Analysis with Excel, tutorialspoint,https://www.tutorialspoint.com/excel_data_analysis
3. Manisha Nigam, Data Analysis with Excel, BPB Publications.

ECE0052 Introduction to Word Processing [3 0 0 3]

Course Outcomes:

CO1. Apply a range of text functions to manipulate and restructure data.
CO2. Apply logical functions to correct or transform data.
CO3. Convert a range to a table and work effectively with that table.
CO4. Demonstrate a range of methods for creating Named Ranges.
CO5. Employ a range of logical functions to automate performing different operations under different circumstances.

Syllabus:

MS Word Basics: Getting Started, Explore Window, Backstage View, Entering Text, Move Around**,** Save Document, Opening a Document, Closing a Document, Context Help, **Editing Documents:** Text Insert/Select/Delete/Move/Copy & Paste/Find & Replace/ Spell Check/ Zoom In-Out/ Special Symbols/ Undo Changes operations. **Formatting Text:** Setting Text Fonts, Text Decoration, Change Text Case, Change Text Color, Text Alignments, Indent Paragraphs, Create Bullets, Set Line Spacing, Borders and Shades, Set Tabs, Apply Formatting. **Formatting Pages:** Adjust Page Margins, Header and Footer, Add Page Numbers, Insert Page Breaks, Insert Blank Page, Cover Pages, Page Orientation. **Working With Tables:** Create a Table, Rows & Columns, Move a Table, Resize a Table, Merging Cells, Split a Table, Split Cells, Add Formula, Borders & Shades. **Advanced Operations:** Quick Styles, Use Templates, Use Graphics, Auto Correction, Auto Formatting, Table of Contents, Preview Documents, Printing Documents, Email Documents, Translate Document, Compare Documents, Document Security, Set Watermark.

Text/Reference Books

1. Al Sweigart, *Word For Dummies*,(1e), Wiley India Pvt Ltd., 2021, ISBN-13: 1119829178.
2. Peter John, *Microsoft Word & Excel 2021 For Beginners & Advanced Learners,* (1e), Wiley India Pvt Ltd, 2016. ISBN-13: 979-8483206361.
3. James Holler, *Microsoft Word 2023: The Most Updated Crash Course from Beginner to Advanced*, Independently published, 2022. ISBN-13: 979-8364609687.

FIFTH SEMESTER

ECE3101 Digital VLSI Design [3 1 0 4]

Course Outcomes:

By the end of this course learners will be able to

1. Understand CMOS device & its characteristics
2. Apply the working principles and characteristics of MOS devices in circuit analysis.
3. Analyze the static and dynamic behaviour of CMOS inverters.
4. Design Combinational & Sequential Circuits using various logic families
5. Design and implement semiconductor memory systems and arithmetic building blocks.

Syllabus:

Overview of VLSI Design: Historical perspective, overview of VLSI design methodologies, VLSI design flow, design hierarchy, VLSI design styles, design quality, Fabrication process flow- basic steps, the CMOS n-Well process. MOS Transistor Theory: Working of MOS devices and their I-V characteristics, Operating regions and currents, DC transfer characteristics, MOS Capacitances, CMOS Latchup, MOS Scaling.MOS Inverter: Resistive-load inverter, Static CMOS Inverter: Static Behaviour: Switching threshold, Noise margins, Dynamic Behaviour: Delay-time definitions, calculation of delay times, logical efforts, Power, Energy & Energy-Delay. Combinational CMOS Logic Circuits: MOS logic circuits with depletion nMOS loads, CMOS logic circuits, complex logic circuits, CMOS transmission gates (pass gates), ratioed, dynamic and pass transistor logic circuits.Sequential MOS logic circuits: Timing Metrics for Sequential Circuits , Static Latches and Registers : Bistable Principle SR latch circuits, clocked latch and flip-flop circuits, CMOS D-latch and edge-triggered flip-flop, Multiplexer based latches, C^2MOS,TSPC,Pipeling using NORA. Semiconductor Memories: Semiconductor Memories, Memory Core, Memory Design, Memory Peripheral Circuitry. Arithmetic Building Blocks: Datapaths in Digital Processor Architectures, Adders, Multipliers, Shifters.

References:

1. S. M. Kang & Y. Leblebici, CMOS digital Integrated circuits design and analysis, Tata McGraw Hill, 3rd edition, 1996.
2. Weste, N. H. E., & Harris, D. M. (2010). CMOS VLSI Design: A Circuits and Systems Perspective (4th ed.). Pearson.
3. Rabaey, J. M., Chandrakasan, A., & Nikolić, B. (2003). Digital Integrated Circuits: A Design

ECE3102 Analog and Digital Communication [3 1 0 4]

Course Outcomes:

By the end of this course learners will be able to

1. Compute the relevant parameters of given modulation scheme.
2. Compare & contrast different modulation schemes.
3. Investigate pulsed modulation system and analyse their system performance.
4. Analyse the behaviour of a communication system in presence of noise.
5. Explore emerging trends and technologies in the field of communication systems.

Syllabus:

Unit 1: Introduction & review: Elements & limitations of communications systems, signals & spectra, transmission media, historical perspective & societal impact, standards organizations & standards. Unit 2: Analog Communication: Linear & exponential continuous wave modulation, modulators & transmitters,

frequency conversion & demodulation. Analog communication systems. Unit 3: Digital Communication: Baseband digital transmission, sampling & pulse modulation, digitization techniques for analog messages, channel coding, Bandpass digital transmission. Unit 4: Noise: Review of probability theory, random variables, random processes. Random signals & noise, performance evaluation of communication systems corrupted by noise. Unit 5: Modern Applications & Case studies: Cordless systems, satellite communication, FM radio broadcasting, DTH broadcasting, IEEE & ITU wireless standards.

References:

1. A. Bruce Carlson, Paul B. Crilly, Janet C. Rutledge, Communication Systems, 4e, Mc Graw Hill, 2002.
2. Behrouz A. Forouzan, Data Communications and Networking, 5e, McGraw-Hill, 2013.
3. Simon Haykin and and Michael Moher, Communication Systems, (4e), John Wiley, 2009.
4. B. P. Lathi & Z. Ding, Modern Digital and Analog Communication Systems, Oxford, 2010.
5. Herbert Taub, Donald L. Schilling, and Goutam Saha, Principles of Communication Systems, (3e), McGraw Hill, 2008.

ECE3130 IC Design Lab [0 0 2 1]

Lab Outcomes

By the end of the lab, students should be able to:

1. Demonstrate current-voltage characteristics for MOS for understanding device working.
2. Observe DC and transient response of CMOS logic gates .
3. Design and simulate CMOS circuits at both schematic and layout levels.
4. Perform timing and power analysis of circuits.
5. Design layout of CMOS circuits.

Syllabus:

IC Design Lab syllabus focuses on providing hands-on experience in designing, simulating, and analyzing CMOS-based circuits using industry-standard VLSI tools. The lab begins with an introduction to EDA tools enabling students to familiarize themselves with schematic, spice code and layout environments. Fundamental CMOS concepts, including the design and analysis of inverters and basic logic gates, are covered. Students learn to implement combinational and sequential circuits. The lab emphasizes power analysis, timing analysis, and optimization techniques for low-power designs. By the end of the course, students acquire proficiency in CMOS circuit design and simulation, with a strong understanding of performance, power, and layout considerations.

ECE3131 Communication System Lab [0 0 2 1]

Lab Outcomes

By the end of this course learners will be able to

1. Compute the relevant parameters of given modulation scheme.
2. Analyse and compare different analog modulation and demodulation schemes to improve skill set and for better employability
3. Investigate effect of sampling rate on PCM system.
4. Demonstrate different digital passband communication schemes and equip with design skills to apply in communication system and to foster the needs of entrepreneurship.

Syllabus:

Elements & limitations of communications systems, signals & spectra, transmission media. Linear & exponential continuous wave modulation & demodulation. Baseband digital transmission, sampling, digitization techniques for analog messages. Effect of noise in communication system.

ECE3170 Project-Based Learning 3 [0 0 2 1]

Syllabus:

Based on project implementation and execution. Evaluation will be based on report/draft and presentation.

FLEXI CORE

ECE3120 Antennas [3 0 2 4]

Course Outcomes:

By the end of this course learners will be able to

1. Explain the fundamental concepts of radiation mechanisms, current distribution, and antenna parameters.
2. Derive and analyze vector potentials, wave equations, and far-field radiation patterns, and apply duality and reciprocity theorems.
3. Analyze the radiation characteristics of linear wire and loop antennas, including dipoles and circular loops, and evaluate their performance in different regions.
4. Design and synthesize antenna arrays such as uniform, broadside, end-fire, planar, and circular arrays, and assess their radiation patterns.
5. Compare the structural and performance characteristics of special antennas, including folded dipole, Yagi-Uda, log-periodic, and aperture antennas, based on Babinet's and Huygens's principles.
6. Illustrate the propagation of electromagnetic waves through ground wave, space wave, and ionospheric propagation, and interpret their effects on radio wave communication.

Syllabus:

Introduction: Radiation Mechanism, current distribution, Antenna parameters. Vector potentials: Electric and magnetic vector potentials, solutions for wave equations, far-field radiation, Duality theorem, Reciprocity theorem. Linear wire Antennas: Infinitesimal, small and finite dipole Antennas, Region separation, Half wave length dipole. Loop Antennas: Small circular loop Antenna, circular loop with constant current, Ferrite loop. Antenna Arrays and other types of antennas: Two element array, N-element array – uniform, broadside, ordinary end-fire, Non-uniform Amplitude Arrays, planar and circular arrays. Qualitative study of Folded dipole, long wire, V, Rhombic, Helical, Yagi Uda, log-periodic, Aperture antennas, and horn Antennas, Babinet's principle, Huygens's principle, Rectangular and Circular Microstrip Patch antenna, Quality Factor, Bandwidth, Efficiency. Antenna Measurements: Propagation of EM waves: Ground wave Propagation, Space Wave Propagation, Troposphere and ionosphere propagation and its effect on Radio Waves.

References:

1. C. A. Balanis, Antenna Theory, (3e), John Wiley & Sons, New Delhi, 2010.
2. J. Kraus, Antenna and wave Propagation, (4e), Tata McGraw – Hill, New Delhi, 2010.
3. K. D. Prasad, Antenna and Wave Propagation, (3e), Satya Prakashan, New Delhi, 2009.
4. F. E. Termen, Radio Engineering, (1e), Tata McGraw – Hill, New Delhi, 1995.

ECE3121 Microcontrollers & its applications [3 0 2 4]

Course Outcomes:

By the end of this course learners will be able to

1. Describe architecture and operation of Microcontroller 8051.
2. Foster ability to understand the design concept of Microcontroller.
3. Design various applications using its peripherals.
4. Analyze the data transfer information through serial and parallel ports.
5. Applying the concepts of an in-depth knowledge on real time applications.
6. Develop application programs using assembly and C Languages.

Syllabus:

Microcontroller Basics: Difference between microprocessor and microcontroller, architectural considerations, CPU, memory sub system, I/O sub system, control logic. Architecture of MCS-51 microcontroller. Memory structure, different registers (SFR's), addressing modes. Timing Diagram, timing diagram for execution cycle. Programming: Concept of assembler directives, editor, linker, loader, debugger, simulator, emulator. Instruction set, basic programming using 8051 instructions. Introduction to embedded-C, Integrated Development Environment (IDE), cross compiler, ISP, software delay generation. I/O Programming: I/O programming, interfacing with simple switch, LED. Seven segment interfacing techniques. Programming with alphanumeric LCD and matrix keypad.On-Chip Peripheral Interfaces: Programming with on-chip Timers, Counters, UART, RS485 transceiver. I2C and SPI protocols. Interrupts, interrupt execution sequence, programming with software and hardware interrupts.External Interfaces: Analog to digital convertor, interfacing with external serial and parallel ADC's, Digital to analog convertor (DAC), interfacing with DAC, Interfacing with stepper motor and DC motor.RISC Microcontrollers: Introduction to AVR series microcontrollers. Introduction to ARM7 microcontroller (LPC2148).

References:

1. 8051 Microcontroller Architecture, Programming and Application Kenneth J.Ayala PHI Learning New Delhi, July 2004, ISBN: 978-1401861582
2. Microcontroller Theory and Application Ajay V.Deshmukh McGraw Hill, New Delhi, 2011, ISBN-9780070585959
3. The 8051 Microcontroller and Embedded system Using Assembly and C Muhammad Ali Mazidi. Janice GillispieMazidi.Roli n D.Mckinlay Pearson /Prentice Hall,, 2nd edition, Delhi,2008, ISBN 978-8177589030
4. Microprocessors and Microcontrollers Sunil Mathur, JeebanandaPanda PHI Learning,NewDelhi, 2016,ISBN :978-81-203-5231-5
5. Microprocessors and Microcontrollers: Architecture programming and System Design Krishna Kant PHI Learning New Delhi, 2016,ISBN:978-81-203-4853-0

SIXTH SEMESTER

ECE3201 Optical Communication [3 1 0 4]

Course Outcomes:

By the end of this course learners will be able to

1. Understand basic laws of optical physics for lifelong learning and encouraging entrepreneurship. Distinguish between the various modes of operation of Optical fibres.
2. Identify the various causes for signal degradation. Calculate the various types of losses occurring in transmission of energy.

3. Learn and Classify the construction and characteristics of optical sources and their various performance parameters .
4. Develop the experimental skills needed for optical fibre communication with learn the operation of optical detectors, optical receiver and their noise analysis.
5. Calculate the link budget analysis for performance analysis and hence result in scope of entrepreneurship.
6. Understand the use of analogue and digital links. Describe the various criteria viz. power loss wavelength, SNR, BER analysis, EYE-diagram to be considered for point-to-point link system and power penalty

Syllabus:

Introduction to optical communication: Basic principles of light propagation, Propagation of Light in an Optical Fiber: Ray Model, Numerical aperture, phase-front (wavefront) based study of Total Internal Reflection, Wave Model and its Analysis, V number of an Optical fiber. Signal distortion on optical fibers: Material Dispersion, Intermodal Dispersion, Intermodal Dispersion, Material Attenuation, Microbending, Macrobending, fiber materials, fiber fabrication, Analysis of Signal distortion in optical fibers using OTDR, Practical issues in implementation of fiber link. Optical Sources: Introduction of Optical sources. Light Emitting Diode: Quantum Efficiency, material, electrical and spectral characteristics, modulation. Lasers: Introduction to Laser, Spontaneous emission, Absorption, Stimulated emission, Different type of lasers: ruby laser, He-Ni laser, semiconductor laser. Optical Receiver: Photon detector, Photo Diodes, Photo detector and its noise Analysis, Optical Receiver, Digital data transmission in optical domain, SNR, BER analysis, Performance Analysis and the EYE-diagram, Receiver Sensitivity Degradation, Fiber Optic link Design, power penalty.

Text books/ Reference books:

1. G.P Agrawal , "*Fiber optics communication"*, third edition, John Wiley & sons,2002 .
2. Keiser, "*Optical Fiber Communication"*, fourth edition, Mc Graw Hill, 2017.
3. M.N. Islam (Ed), "*Raman Amplifiers for communications"*, Springer-verlag, New York, 2003.
4. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 3rd Edition, 2008.

ECE3210 Professional Practice [0 0 0 1]

Professional Practice: The evaluation will be done after successful completion of training on professional development, soft-skill development, aptitude development, technical skill development etc.

ECE3201 Optical Communication Lab [0 0 2 1]

Lab outcomes:

1. Apply basic laws of optical physics for lifelong learning and encouraging entrepreneurship.
2. Apply principle of conversion of light energy to electrical energy, optical detectors and develop the experimental skills needed in scope of entrepreneurship.
3. Understand the use of OTDR trace and Identification of Splice & Connector joints and their losses also fault location (distance) in the optical fibre.
4. Hands on training on Splicing of optical fibres, and calculation of splicing loss, components, isolator, coupler etc.

Syllabus:

Optical Fiber: Study various types of Optical fibers, optical sources and their radiation patterns, understand use of OTDR for various optical measurements and link analysis, study transmission and reception of analog and digital signals on an optical fiber link, determine the numerical aperture and attenuation constant of fibers. Study of Optical Laser Source, Optical Power Meter,
Variable Optical Attenuator, Optical connector certification system, attenuation in optical fiber through, Splice & Connector joints and their losses, Identification of fault location (distance) in the optical fiber, Measurement of fibre losses of single mode fibre due to bending, study the operation of optical fusion splicer, wavelength separation properties of a WDM coupler, study the isolation properties
of optical isolators, circulators

ECE3231 Advanced System Design Lab [0 0 2 1]

Lab Outcomes:

1 Generating optimized gate-level netlist and Standard Design Constraints.
2 Familiarization with chip Floorplan and standard cell placement techniques.
3 Familiarization with clock tree synthesis, and detail routing.
4 Familiarization with physical verification and power analysis

Syllabus:

The student will implement one complete circuit from RTL to GDSII. This flow is a vital process in digital chip design, converting a high-level hardware description (RTL) into a manufacturable layout (GDSII). It encompasses key stages such as RTL synthesis, design optimization, floor planning, placement, clock tree synthesis, routing, and physical verification. Each step ensures the design meets functional, timing, power, and area requirements. Labs focusing on this process provide hands-on experience with industry-standard tools.

ECE3270 Project Based Learning 4 [0 0 2 1]

Based on application of the project. Evaluation will be based on the outcomes of the project in the form of research articles or draft, IPR, app/product development. A+ grade may be awarded for SCOPUS indexed publication or published patent or functional product/prototype/app development etc. A departmental PBL evaluation committee will evaluate the outcomes of the PBL courses and to award grades based on the merit of the project.

PROGRAM ELECTIVES

PROGRAM ELECTIVE-II

ECE 3140 Digital Signal Processing [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Recall the concepts of signals, systems and Z transform and analysis of signals in time and frequency domain
2. Classify and analyse response of LTI system
3. Relate and apply the concepts of Discrete Fourier Transform to diverse engineering problems
4. Understand and implement discrete time systems such as FIR and IIR structures
5. Acquire the skills to design IIR filters and FIR filters using multiple techniques
6. Understand and interpret frequency domain sampling, signal reconstruction and multi-rate DSP

Syllabus:

Review of signals and systems: Time and frequency analysis of signals and systems. Transform Analysis of LTI Systems: The frequency Response of LTI systems, Inverse system, All- Pass system, Minimum Phase system, Linear systems with Generalized Linear Phase. Frequency domain sampling and reconstruction of discrete time signals: Discrete-Time Processing of continuous- Time Signals,

Continuous- Time Processing of Discrete-Time Signals, Changing the Sampling Rate Using Discrete Time Processing. Discrete Fourier transform: Introduction, properties of the DFT, use of DFT in linear filtering, filtering of long data sequences, DFT as linear transformation, Computation of DFT, Decimation-in- Time and Decimation–in–frequency Algorithms. Implementation of discrete time systems: Structures for FIR systems– Direct form, cascade form, Frequency sampling and lattice structures. Structures for IIR systems – Direct form, cascade and parallel form. Design of IIR filters and digital FIR filters: Classical design by impulse invariance, bilinear transformation and matched Z- transform, characteristics and design of commonly used filters – butterworth. Chebyshev, elliptical.

Reference Books

1. J.G. Proakis, D.G. Manolakis, D. Mimitris, Introduction to Digital Signal Processing, Prentice Hall, India 2003.
2. Sanjit K. Mitra, Digital Signal Processing A Computer Based Approach, 4e, Mc Graw Hill Education, 2013
3. I. feachar & Jervis, Digital Signal Processing: A Practical approach, Pearson education, Asia, 2003.
4. L.R. Rabiner & D.J. Gold, Theory and applications of digital signal processing Prentice Hall, India 1988.
5. Tarun Kumar Rawat, Signals and Systems, Oxford University Press, 2010.

ECE 3141 Semiconductor Device Fabrication [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to:

1. Explain the fundamental properties of semiconductor materials and their role in device fabrication.
2. Apply photolithography, etching, doping, and deposition techniques in the fabrication process.
3. Analyze the physical principles and processes involved in the fabrication of semiconductor devices.
4. Evaluate the performance of fabricated devices and identify sources of defects.

Syllabus:

Introduction to semiconductor: Overview of semiconductors: intrinsic and extrinsic materials, Crystal structures and properties of silicon and compound semiconductors, defects in crystal, cleanroom substrates processing technology. Thermal oxidation, RTP and furnaces, laser and spike processing. Doping and implantation. Lithography : Fundamentals of lithography: masks, resist materials, and exposure techniques, contrast, process, photoresist, direct write, EBL, proximity, etc. Oxidation and diffusion, ion implantation. Basics of thin film deposition, PVD (sputtering, evaporation), Epitaxial growth, LPCVD, PECVD, crystallization/recrystallization. Wet etching, Dry etching, Metallization and wire bonding. Device isolation and packaging, Device technology (CMOS, GaAs FET, silicon photonics) Integrated circuit manufacturing (yield, DOE, SPC, etc). Electrical characterization of devices: I-V and C-V measurements, Techniques for analyzing device performance and defects, Reliability testing.

References

1. S. M. Sze and Kwok K. Ng, *Physics of Semiconductor Devices*, Wiley.
2. Stephen Campbell, *The Science and Engineering of Microelectronic Fabrication*, Oxford University Press.
3. Sorab K. Ghandhi, *VLSI Fabrication Principles: Silicon and Gallium Arsenide*, Wiley.
4. Gary S. May and Simon M. Sze, *Fundamentals of Semiconductor Fabrication*, Wiley.

ECE 3142 Nanophotonics [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Basics of integrated photonics,
2. Building blocks of photonic circuits and their properties
3. Understand devices and general concepts used in nano-optics, nano-photonics and nano-optoelectronics.
4. Understand nanoscale and near-field optics, optical near-field probes, plasmonics and semiconductor quantum structures.
5. Implementation strategies of photonic devices in communication

Syllabus:

Introduction, History of integrated photonics: technologies and components. Maxwell's equations and boundary conditions at the interfaces, reflection and transmission, near-field and far-field. Optical waveguide theory, effective mode index, mode dispersion and light confinement. Light propagation in absorbing media: energy loss and heating. Light dispersion in nanophotonic waveguides: variation theorem, energy and group velocities. finite element method, finite difference time domain method and other methods based on finite differences. Scanning near-field optical microscopy. Modern integrated nanophotonics: Silicon photonics All-optical and electro-optical modulators. Integrated photodetectors: light-to-voltage conversion. Guiding light at the deep-subwavelength scale: metal optics and plasmonics. Propagating and localized plasmonic modes in nanostructures. Confinement of photons and electrons. Propagation through a classically forbidden zone: tunnelling. Localization under a periodic potential: Band gap. Nanoscale confinement of electronic interactions: Quantun confinement effects, nanoscale interaction dynamics, nanoscale electronic energy transfer. Cooperative emissions. Fabrication And Applications Of Photonic Crystals And Devices Thermal, mechanical and chemical properties of optical materials; Optical coatings and methods; Optical Filters; Surface quality of optical components. Choices of materials in photonic crystals: semiconductors, amorphous, and polymers, fabrication of photonic crystals structures (1-D, 2-D); Couplers; Waveguides; Photonic crystals fibres; Tunable Photonic crystal filter; High-Q cavites.

References

1. Prasad, Paras N. *Nanophotonics*. John Wiley & Sons, 2004.
2. Ohtsu, Motoichi, Kiyoshi Kobayashi, Tadashi Kawazoe, Takashi Yatsui, and Makoto Naruse. *Principles of nanophotonics*. CRC Press, 2008.
3. Gaponenko, Sergey V. *Introduction to nanophotonics*. Cambridge University Press, 2010.
4. Rigneault, Hervé, Jean-Michel Lourtioz, Claude Delalande, and Ariel Levenson, eds. *Nanophotonics*. Vol. 102. John Wiley & Sons, 2010.
5. Novotny, Lukas, and Bert Hecht. *Principles of Nano-optics*, Cambridge University Press, 2012.
6. National Research Council. *Nanophotonics: accessibility and applicability*. 2007.

PROGRAM ELECTIVE-III

ECE 3143 Design for Testability [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Understand the concepts of VLSI testing and design for testability for Built-in Self-Test.
2. Apply the concepts of fault modelling and collapsing for optimal fault coverage in digital circuits and memories.

3. Apply various fault simulation and detection methods for digital circuits and memories.
4. Apply various test pattern generation methods for fault testing in digital circuits and memories.
5. Examine controllability and observability of digital circuits.
6. Evaluate different methods for test response compaction.

Syllabus:

Introduction: Verification vs Testing, Need for testing, Level of testing, Cost of testing, Roles of testing. Fault modelling: Stuck at Faults, Bridging Faults; Fault collapsing; Transistor (switch) faults. Fault Simulation: Deductive, Parallel and Concurrent Fault Simulation, Critical Path Tracing. SCOAP Controllability and Observability: significance and calculation of SCOAP measures. ATPG for Combinational Circuits: D-Algorithm, PODEM, Random pattern generation, Boolean difference symbolic method, Path sensitization method. Scan chain: Concept of scan chains for serial testing. ATPG for Sequential Circuits: Time frame expansion, Nine-valued logic, Drivability, Complexity of ATPG, Test generation system. Compaction Techniques: General Aspects of Compaction Techniques; Ones-Count, Transition Count and Parity Check Compression; Syndrome Testing; Signature Analysis. Memory Testing: Fault models, March tests. Built-In Self-Test (BIST) concept: BIST pattern generation, BIST response compaction, Aliasing definition. BIST Architecture.

References:

1. M. Bushnell and V. Agrawal, Essentials of Electronic Testing for Digital, Memory, and Mixed-Signal VLSI Circuits, Kluwer Academic Publishers, 2000.
2. M. Abramovichi, M. Breuer and A. Friedman, Digital Systems Testing and Testable Design, IEEE Press, 1999.
3. L. T. Wang, C. W. Wu and X. Wen, VLSI Test Principles and Architectures, Elsevier, 2006

ECE 3144 Radar & Satellite Communication [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Evaluate key radar parameters and interpret their physical significance.
2. Describe the functioning of radar receiver and interpret the effect of these parameters on detection for development of analytical skills
3. Evaluate the link budget parameters using radar equation & explain the types of radar for employability enhancement.
4. Apply the Kepler laws of motion to compute the key satellite/orbital parameters.
5. Evaluate the link budget/link design parameters for a satellite communication link for enhancing employability.
6. Explain the functioning of satellite subsystems & applications of satellites.

Syllabus:

Introduction to Radar: Introduction, block diagram, applications, radar frequencies, different types of radar, basic pulsed radar system, radar equation, system losses. Radar Transmitter: Introduction, radar RF source. Radar Receiver: Introduction, radar receiver noise, and Duplexers: Introduction types, used in modern radar, Radar Display Units: Introduction, types of scope. Navigation: Introduction, history, methods of navigation. Satellite Communications: The Origin of satellite communications, brief history of satellite communications, advantages and disadvantages, current status of satellite communication, active and passive satellites. Satellite Subsystems: Introduction, satellite subsystems, altitude and orbit control system, telemetry, tracking and command, communication subsystem, communication subsystem components. Earth Station Technology: Introduction, earth station design requirements, earth station antenna design, earth station sub-system, tracking monitoring and control. Satellite link design: Transmission equation, noise at the receiver, G/T ratio for earth stations, uplink equation. Satellite Applications: Introduction, satellite for earth observation, satellite for weather forecast, satellite for

scientific studies, and satellite for military applications, direct broadcast satellite system, very small aperture terminal, global positioning system.

REFERENCES:

1. M. I. Skolnik, Introduction to Radar Systems, (3e), McGraw Hill, 2003.
2. T. Pratt, C. W. Bostian, J. E. Allnutt, Satellite communication system, (2e), John Wiley and Sons (2002).
3. P. Z. Peebles Jr., Radar Principles, (1e), John Wiley, 1998.
4. E. Byron, Radar: Principles, Technology, Applications, (1e), Prentice- Hall education, 1992.
5. D. Barton, Radar system analyses and Modelling, (2e), Artech house, 2005.
6. D. Roddy, Satellite communications, (4e), McGraw-Hill international edition, 2017.

ECE3145 Control Theory [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Develop mathematical models for dynamic systems using differential equations and transfer functions.
2. Analyze the time-domain and frequency-domain performance of control systems.
3. Design and implement PID controllers and compensatory for desired system performance.
4. Understand and apply state-space methods for system analysis and design.

Syllabus:

Introduction to Control Systems: Definitions and examples of control systems, Open-loop vs. closed-loop systems, Applications of control systems in engineering. Mathematical Modelling of Systems: Differential equations of physical systems, Transfer function and block diagram representation, Signal flow graphs and Mason's gain formula, State-space representation of systems. Time-Domain Analysis: Transient and steady-state response, Standard test signals: Step, ramp, impulse, and sinusoidal inputs, Time-domain specifications: Rise time, settling time, peak overshoot, Stability analysis: Routh-Hurwitz criterion. Frequency-Domain Analysis: Frequency response and Bode plots, Nyquist criterion and polar plots, Gain margin, phase margin, and bandwidth, Nichols charts and stability margins. Control System Design: PID controllers: Proportional, integral, and derivative control. State-Space Analysis: State-space representation: State variables and dynamic equations, Controllability and observability, State feedback control and observer design, Stability using Lyapunov methods.

References:

1. Ogata, K. (2010). Modern Control Engineering (5th ed.). Prentice Hall. ISBN: 978-0136156734
2. Nise, N. S. (2020). Control Systems Engineering (8th ed.). Wiley. ISBN: 978-1119721406Focuses on intuitive concepts and practical applications.
3. Kuo, B. C., & Golnaraghi, F. (2017). Automatic Control Systems (10th ed.). McGraw-Hill Education. ISBN: 978-1259643835.Offers an in-depth approach to modern and classical control theory.
4. I. J. Nagrath, M. Gopal (2007), Control System Engineering, (4e),John Wiley & Sons.

PROGRAM ELECTIVE-IV

ECE 3240 VLSI Physical Design [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Identify the goal, objective, constraints and graphs for various phases of Physical Design Process
2. Apply VLSI Physical design algorithms for circuit partitioning
3. Recommend floorplan and placement for digital circuits with estimation of wirelength
4. Assess circuit and clock routing based on routing algorithms
5. Apply VLSI Physical design algorithms for layout generation and compaction
6. Understand design verification, tape-out and DFT-DFM principles

Syllabus:

VLSI Physical Design Introduction: VLSI Design Process, difficulties in Physical design, Graph theory; Circuit Partitioning: Problem definition, cost functions and constraints, Partitioning algorithms; Floorplanning: Problem definition, cost functions and constraints, Floorplanning algorithms; Placement: Problem definition, cost functions and constraints, Placement algorithms; Routing: Problem definition, cost functions and constraints, Global routing algorithms, Channel routing algorithms, switchbox routing, Clock Tree Synthesis and Routing; Layout generation and Compaction: Layout generation, layout compaction. Physical design verification and tape-out: Methods for physical design verification, Overview of tape-out process, Introduction to Design for Testability (DFT) and Design for Manufacturability (DFM) principles.

References:

1. Naveed Sherwani, “Algorithms for VLSI Physical Design Automation” (3e) Kluwer Academic Publishers. 2002
2. S.H. Gerez, “Algorithms for VLSI Design Automation”, John Wiley & Sons, 2008
3. C. J. Alpert, D. P. Mehta, S. S. Sapatnekar, “Hand Book of Algorithms of Physical design Automation”, CRC press, 2009
4. S. M .Sait, H. Youssef, “VLSI Physical design automation theory and Practice”, World Scientific Publishing, 1999

ECE 3241 Wireless Communication [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Identify the basic operational procedures related to the wireless systems.
2. Describe the modern wireless communication systems and the signalling techniques.
3. Classify appropriate techniques and software tools for testing important parameters involved in wireless communication.
4. Compare the network concepts of modern communication systems for skill development.
5. Apply logical methods for cellular systems to have employability in communication sector.
6. Demonstrate knowledge of communication services to have better prospects of entrepreneurship

Syllabus:

Introduction to wireless channels and wireless networks: wireless channel as a random linear time varying system, Wireless channel modeling, WLAN Topologies, WLAN Standards. Outdoor Propagation Models- Longley Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Indoor Propagation Models, Ericsson Multiple Breakpoint Model. Wireless Systems: Radio interface, Protocols, Authentication and security in GSM, Concept of spread spectrum, Fading and diversity techniques, Maximal Ratio Combining, RAKE Receiver, Wireless channel capacity, ergodic capacity and outage capacity. Recent Trends: Introduction to Wi-Fi, WiMAX, ZigBee Networks, Software Defined Radio, UWB Radio, Wireless Adhoc Network and Mobile Portability, MIMO systems, Security issues and challenges in a Wireless network.

References:

1. Upena Dalal, Wireless Communication, (1e), Oxford University Press, 2009.
2. T. S. Rappaport, Wireless Communication: Principles and Practice, (2e), Pearson, 2010.
3. Andreas. F. Molisch, Wireless Communications, (2e), John Wiley – India, 2013.
4. William Stallings, Wireless Communications & Networks, (2e), Pearson, 2005

ECE 3242 Digital Image Processing [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Understand fundamentals of digital image processing and representation of images in spatial and transform domain
2. Apply digital image manipulation and mathematical operations
3. Apply image enhancement restoration techniques for improving quality of images
4. Evaluate use of image processing filters
5. Apply morphological operations and segmentation for image processing
6. Apply techniques for compression and decompression on digital images for different application requirements

Syllabus:

Fundamentals of digital image processing: image perception, sensing and acquisition, sampling and Quantization, image representation, basic relationship between pixels. Image enhancement and restoration: grey level transformation, Histogram processing, Image arithmetic, Spatial smoothing and sharpening filters, Laplacian filters, Frequency domain smoothing and sharpening filters, Homomorphic filtering, Image restoration. Image transforms: Fourier transform, Cosine Transform, Wavelet transform. Image Compression Algorithms and standards: Image compression standards, Lossless and lossy compression. Morphological processing and segmentation: Preliminaries, erosion, dilation, Hit-And-Miss transformation, Basic Morphological Algorithms; Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation; Color image processing: Color Fundamentals, Color Models, Pseudo color Image Processing, processing basics of full color image processing; Applications: Character recognition, Biomedical Image processing, Watermarking, multi-resolution analysis, video processing.

References:

1. R. C. Gonzalez, R. E. Woods, "*Digital Image Processing" ed. 4 - Pearson Education 2018*.
2. S. Sridhar, Digital Image Processing. Oxford University Press, 2011
3. W. K. Pratt, "*Digital Image Processing"* John Willey, Ed. 4, 2007
4. A.K. Jain, "*Fundamentals of Digital Image Processing"* PHI, New Delhi, Ed. 1, reprint 2015.

PROGRAM ELECTIVE-V

ECE 3243 Microwave Engineering [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Recall the concepts and fundamentals of electromagnetic field theory
2. Understand the concepts of guided structures like transmission line and apply the concepts to calculate various parameters of transmission Line using Smith Chart
3. Explain different types of waveguides and their respective modes of propagation Understand the working of ferrite and non-ferrite based microwave passive components and apply knowledge to form scattering matrix

4. Understand the performance of specialized microwave tubes such as klystron, reflex klystron, magnetron and Travelling wave tube
5. Recognize the limitations of existing vacuum tubes and understand the operation of solid state devices at various microwave frequencies

Syllabus:

Introduction to Transverse Electric, Transverse Magnetic and Transverse Electromagnetic waves in conducting planes, characteristics of TE, TM and TEM waves, wave impedance, attenuation, TE, TM and TEM waves. Transmission line equations & solutions, reflection and transmission coefficient, standing wave and standing wave ratio, line impedance and admittance, impedance matching, using stub line, application of smith chart in solving transmission line problems. Rectangular and circular waveguides-theory and analysis, characteristics of TE and TM mode and excitation of wave guides. Passive components: Resonators, Directional Couplers, E-plane Tee, H-plane Tee and Hybrid Tee, Hybrid ring, Attenuators, Circulator, Faraday rotation principle, Isolators. Microwave active Devices: Limitations of conventional vacuum tube devices. Two cavity klystron: Re-entrant cavities, velocity modulation process, bunching process. Reflex klystron: Velocity modulation, power output and efficiency and electronic admittance. Traveling wave tube: Slow wave structure, amplification process, convection current, axial electric field, wave modes and gain consideration. Magnetron: Mode of oscillation, Types of Magnetron, Strapping and Rising Sun Magnetron. Microwave diodes and transistors: Tunnel diode, Varactor diode, Gunn diode, IMPATT diode, Microwave transistors and FETs.

REFERENCES:

1. S. Y. Liao, Microwave Devices and Circuits, Prentice Hall, 2004.
2. D. M. Pozar, Microwave Engineering, John Wiley & Sons, 2004.
3. J. Ryder, Network lines and Fields, Prentice Hall, 1999.
4. Jordan & Balmain, Electromagnetic waves and Radiating System, Prentice Hall, 1968.

ECE 3244 Embedded Systems [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Review the basic concepts of Embedded Systems, Communication Protocols and Real time Operating System.
2. Describe the architectures, structural and software requirements of Embedded Systems and their roles in real life applications.
3. Design Embedded System’s firmware using ARM programming and apply these programming skills for solving various microcontroller-based problems and interfacing different peripheral devices.
4. Identify and apply the knowledge of real-time operating systems for real life embedded systems and hence develop the employability skills.
5. Investigate the effects and various issues related to real time operating systems like scheduling, deadlock avoidance, inter process communications, etc. in embedded system design.

Syllabus:

ARM Architecture and Instruction Set: ARM Design Philosophy, Registers, PSR, Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Instruction Set: Data Processing Instructions, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions. ARM Programming Model: Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Interrupts, Software Interrupt Instructions, Exception handling. ARM Programming using High Level Language: Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating-Point Arithmetic, Assembly Code using Instruction

Scheduling, Register Allocation, Conditional Execution and Loops. Memory Management: Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation, Access Permissions, Content Switch. Integer and Floating-Point Arithmetic on ARM: Double precision Integer Multiplication, Division, Square roots, Endian Reversal and Bit Operations, Random Number Generation, DSP on ARM – FIR filters, IIR filters.

Reference:

1. S. Furber, ARM System-on- Chip Architecture, Second Edition, Pearson Education, 2000.
2. Yifeng Zhu, Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C, E-Man Press LLC; 2nd ed. edition (15 October 2015).
3. J. R. Gibson, ARM Assembly Language-an Introduction, Dept. of Electrical Engineering and Electronics, The University of Liverpool, 2007.
4. Frank Vahid, Tony Givargis, “Embedded System Design: A unified Hardware/Software approach”, John Wiley and Sons, 1999
5. Abraham Silberschaltz, Peter Baer Galvin, Greg Gagne ,“Operating System Concepts” , 9th edition, 2013.
6. Muhammad Ali Mazidi, ARM Assembly Language Programming Architecture: Volume (ARM books), MicroDigitalEd.com, 2016.

ECE 3245 Advanced Error Control Codes [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Apply common source coding techniques
2. Apply and analyse different Linear block codes and their decoding
3. Apply and evaluate cyclic block codes and their decoding
4. Analyse the given problem using convolutional & LDPC codes block codes and perform their decoding
5. Understand the concept of turbo codes

SYLLABUS:

Coding: Introduction, code efficiency, Shannon theorem, capacity of Gaussian channel, Bandwidth and S/N trade off Shannon-Fano coding, Huffman coding, LZ coding, Error control coding, Automatic Repeat Request and Forward error correction codes, Block codes and convolutional codes: Introduction to groups and vector spaces; Generator and parity check matrices, Dual codes, Hamming codes, General properties of linear codes and different coding bounds, Ring and finite fields, Encoding and decoding of cyclic codes, BCH codes and RS codes-construction, properties and decoding, Trellis representations of convolutional codes and decoding using Viterbi algorithm; Iterative Codes: LDPC Codes, Tanner graph, Cycles, irregular codes, Message-passing decoder and density evolution; Turbo Codes.

References:

1. R. Bose, *Information Theory, Coding and Cryptography,* (2e), Tata McGraw Hill, 2001.
2. W.E Ryan and S Lin, Channel Codes-Classical and Modern, Cambridge University Press,2009
3. R.W Yeung, Information Theory And Network Coding, Springer, 2008.
4. F.J. MacWilliams and N.J.A Sloane, The Theory of Error-Correcting Codes, Elsevier Science, 1988
5. D Lun and T Ho, Network Coding - An Introduction, Cambridge University Press, 2008.

PROGRAM ELECTIVE-VI

ECE 3246 Low Power VLSI Design [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Understand the need for low-power VLSI chips and identify sources of power dissipation in digital integrated circuits.

2. Analyze the impact of device physics, technology scaling, and innovations on power dissipation in CMOS and FinFET devices.
3. Apply circuit-level power reduction techniques, including design of Flip-Flops, latches, dynamic logic families, and adiabatic logic.
4. Implement logic-level power reduction techniques, such as state machine encoding, logic encoding, and bus power reduction strategies.
5. Design low-power architectures and systems by leveraging switching activity reduction, voltage scaling.

Syllabus:

Introduction: Need for Low Power VLSI chips, Sources of power dissipation in Digital Integrated circuits. Overview of the importance of low-power circuit design in CMOS and FinFET technologies. Device & Technology Impact on Low Power: Physics of power dissipation in CMOS devices & FinFET Devices; Dynamic and static power dissipation, Transistor sizing & gate oxide thickness; Impact of technology Scaling and Device innovation. Power estimation, Simulation and Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis. Circuit level Power reduction techniques: Power consumption in circuits; Design of Flip Flops and Latches; Low Power Dynamic logic families & adiabatic logic families. Logic level Power reduction techniques: logic encoding, state machine encoding, reduction of power in address and data buses. Low power Architecture and Systems: Power and performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design. Emerging trends in low-power circuit design with CMOS and FinFET, Optimization techniques for minimizing power consumption in advanced semiconductor designs

Reference Books

1. G. K. Yeap, "*Practical Low Power Digital VLSI Design*", KAP, 2002.
2. Rabaey, Pedram, "*Low power design methodologies*" Kluwer Academic, 1997.
3. K. Roy, Sharat Prasad, "*Low Power CMOS VLSI Circuit Design*" Wiley, 2000.
4. Samar K. Saha. FinFET Devices for VLSI Circuits and Systems. Taylor and Francis Group, 2020.

ECE 3247 Computer Networks [3 0 0 3]

Course Outcomes:

By the end of this course learners will be able to

1. Explain the fundamentals of communication networks and their layered architecture.
2. Apply link-layer protocols to solve medium access control problems in a given network scenario.
3. Analyze switching mechanisms and their performance in various network scenarios.
4. Design routing strategies and evaluate network performance for the given network scenario.
5. Evaluate transport protocols and congestion control mechanisms in modern networks.

Syllabus:

Communication Networks basics: Introduction to computer networks and Internet, Introduction to Data Network and ISO-OSI protocol, Fundamentals of Physical Layer and different modes of data communication. Unit-II: Link layer ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches. Unit-III: Switching Concepts Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing. Unit-IV: Network layer Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing. Unit-V: Transport layer. Connectionless transport - User

Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call. Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service. Unit-VI: Application layer Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts. Unit-VII: Advanced Networking Concepts Open Flow switching, SDN and NFV, Network slicing, cognitive Networks, Security Essentials.

References:

1. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.
2. Data and Computer Communications - William Stallings.
3. Data Networks - Dimitri Bertsekas and Robert G. Gallager.
4. Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.

ECE 3248 System-on-Chip Design [3 0 0 3]

Course Outcomes:

By the end of the course, students will be able to

1. Explain various types of processor architectures used in System-on-Chips (SoCs).
2. Analyze system-level modeling platforms for designing SoC systems.
3. Discuss basic domain-specific and application-specific SoCs for diverse applications.
4. Explain storage mechanisms in SoCs and their impact on system performance.
5. Discuss IoT-specific SoC architectures and their role in improving IoT applications.

Syllabus:

Introduction to system Design, SoCs:Types of Processors Architectures, System Level Modelling Platforms, Domain specific SOCs, SOC Architecture, Application specific SoCs, Storage in SoCs, SOCs Architecture case studies,IoT SoC Architecture

References:

1. Chakravarthi, Veena S. *A practical approach to VLSI system on chip (SoC) design*. Springer International Publishing, 2020.
2. Hoi-jun yoo, Kangmin Lee, Jun Kyoung kim, “Low power NoC for high performance SoC desing”,CRC press, 2008.
3. Vijay K. Madisetti Chonlameth Arpikanondt, “A Platform-Centric Approach to System-on-Chip (SOC) Design”, Springer, 2005.

OPEN ELECTIVES

ECE0001 Introduction to Communication Systems [3 0 0 3]

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

1. Develop the basic modulation techniques for communication and their calculations involved in finding efficiency, spectrum and various important segments using mathematical tool such as Fourier transform etc. for establishment of fruitful communication.
2. Basic concept of fibre optic communications and analysis of complete optical fiber communication and power budget analysis as well.
3. The basic concepts and applications part of Radars on practical systems.

4. Basic understanding of satellite communication and cellular networks, wireless communication & technologies and their analysis in different environmental conditions.

Syllabus:

Introduction to communication system: A general model of communication systems-transmitter, communication channel, receiver, attenuation, noise; Telecommunication systems: Basic Telephone system, signaling tones, DTMF, Cordless Telephones, Private branch Exchange (PBX); Optical fiber communication: fundamental laws of optics, principal of ray propagation, basics of optoelectronics sources and detectors; Satellite communication systems: Principles of Orbital mechanics, Kepler's law of planetary motion, Look angle, Angle of elevation, Basics of Satellite subsystem; Radar Systems: Introduction to Radar systems, Pulse Radar, Duplexer. Radar displays; Wireless Communication Systems: Concept of cellular mobile communication-frequency reuse; Wireless technologies: Wireless LAN, PAN and Bluetooth.

References:

1 "An Introduction to Analog and Digital Communication Systems" by S.S. Haykin, John Wiley & Sons; 2nd revised edition edition.
2 "Communication Systems" by B.P. Lathi, BSP PUBLICATION (2001).
3 G. Kennedy and B. Davis, S.R. M. Prasanna, "Electronic Communication System", Tata McGraw-Hill, 2011.
4 Satellite Communications 2nd Edition by Timothy Pratt Wiley; 2 edition.
5 Introduction to Radar Systems (Irwin Electronics & Computer Enginering) 3rd Edition by Merrill I Skolnik, McGraw-Hill Education; 3 edition.

ECE0002 Introduction to Game Theory [3 0 0 3]

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

1. Understand best response for an agent in a given competitive game scenario.
2. Demonstrate Nash Equilibria for different game scenario that develops strategy making skills among students.
3. Analyse extensive form of game that will enhance employability of students.
4. Illustrate Evolutionary Stable Strategy (ESS) for evolutionary repeated games.

Syllabus:

Introduction Examples: Markets/ Politics/ Auctions; Prisoners' Dilemma, Best Response and Nash Equilibrium, Dominant Strategies, Stag Hunt – Coordination and Bank Runs.
Multiple Nash Equilibria, Tragedy of Commons, Cournot Duopoly, Mixed Strategies, Battle of Sexes, Best Response Dynamic, Paying Taxes; Portfolio Management Game, Rationality, Choice and Common Knowledge, Iterated Elimination of Domination Strategies, Auction: As a Normal Form Game, Traffic at Equilibrium and Braess's Paradox; Extensive Form Games, Strategies in Extensive from Games, Sub Game Perfect Equilibrium, The Art of War, Ultimatum Game, Stackelberg Model, Bayesian Games, Bayesian Nash Equilibrium, Yield vs Fight, Bayesian Cournot Game, Bayesian Games with mixed strategies, Auctions, Sealed Bid First Price Auction, Expected Revenue, Bayesian Second Price Auction, Second Price Auction, All Pay Auction; Evolutionary Biology, Evolutionary stable Strategy (ESS), Repeated Games, Multiple Equilibriums, Chain-Store Paradox, Non – Cooperative Bargaining; Extensive Form Game with Incomplete Information, Introduction to perfect Bayesian Equilibrium, Obtaining PBE, Gift Game.

References:

1. An Introduction to Game Theory, Martin Osborne, Oxford University Press.
2. Game Theory: A Very Short Introduction, Ken Binmore, Oxford University Press.

ECE0003 Stress-free living [3 0 0 3]

(in collaboration with Abhigya Club & faculty from AkshayPatra foundation)

Syllabus:

Introduction, Overview: Objectives and Learning Outcomes, The Science of Relaxation: Benefits of a Calm Mind, **Time Management:** Importance of Time Management, Tools and Techniques, Creating a Balanced Schedule, **Stress Management:** Mindfulness and Meditation, Breathing Techniques, **Enhancing Relationships:** Healthy Communication, Building Strong Relationships, Conflict Resolution, **Lifestyle and Well-Being:** Nutrition and Sleep, Digital Detox, Sustainable Habits

ECE0051 Excel Fundamentals for Data Analysis [3 0 0 3]

Course Outcomes:

1. Apply a range of text functions to manipulate and restructure data.
2. Apply logical functions to correct or transform data.
3. Convert a range to a table and work effectively with that table.
4. Demonstrate a range of methods for creating Named Ranges.
5. Employ a range of logical functions to automate performing different operations under different circumstances.

Syllabus:

Data analysis: Overview, data analysis with Excel. Conditional formatting, sorting nd filtering data, Cleaning and manipulating text data. Working with numbers and dates. Calculation with named ranges. Automating data validation. Working with Tables. Logical and lookup function. Data visualization and validation.

Reference Books:

1. L. Winston Wayne, Microsoft Excel 2019: Data Analysis & Business Model, PHI.
2. Data Analysis with Excel, tutorialspoint, https://www.tutorialspoint.com/excel_data_analysis
3. Manisha Nigam, Data Analysis with Excel, BPB Publications.

ECE0052 Introduction to word Processing [3 0 0 3]

Syllabus:

MS WORD BASICS: Getting Started, Explore Window, Backstage View, Entering Text, Move Around, Save Document, Opening a Document, Closing a Document, Context Help, Hands-on session Exercises. EDITING DOCUMENTS: Text Insert/Select/Delete/Move/Copy & Paste/Find & Replace/ Spell Check/ Zoom In-Out/ Special Symbols/ Undo Changes operations. Hands-on session Exercises. FORMATTING TEXT: Setting Text Fonts, Text Decoration, Change Text Case, Change Text Color, Text Alignments, Indent Paragraphs, Create Bullets, Set Line Spacing, Borders and Shades, Set Tabs, Apply Formatting, Hands-on session Exercises. FORMATTING PAGES: Adjust Page Margins, Header and Footer, Add Page Numbers, Insert Page Breaks, Insert Blank Page, Cover Pages, Page Orientation, Hands-on session Exercises. WORKING WITH TABLES: Create a Table, Rows & Columns, Move a Table, Resize a Table, Merging Cells, Split a Table, Split Cells, Add Formula, Borders & Shades, Hands-on session Exercises. ADVANCED OPERATIONS: Quick Styles, Use Templates, Use Graphics, Auto Correction, Auto Formatting, Table of Contents, Preview Documents, Printing Documents, Email Documents, Translate Document, Compare Documents, Document Security, Set Watermark, Hands-on session Exercises.

References:

1. Al Sweigart, “Word For Dummies”,1st Edition, Wiley India Pvt Ltd., 2021, ISBN-13: 1119829178

1. Peter John , “MICROSOFT WORD & EXEL 2021 FOR BEGINNERS & ADVANCED LEARNERS”, 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 979-8483206361.
2. James Holler , “ Microsoft Word 2023: The Most Updated Crash Course from Beginner to Advanced”, Independently published, 2022. ISBN-13 : 979-8364609687.