Detailed Syllabus of B Tech (ELECTIVES)

For batches admitted in 2023 and onwards

(3rd - 8th semester)

Vetted in

8th Board of Studies

of

Department of

"Electronics and Communication Engineering"

ISLAMIC UNIVERSITY OF SCIENCE AND TECHNOLOGY

AWANTIPORA, J&K, INDIA-192122

For batches admitted in 2023 and onwards

HIGHLIGHTS:

- As per ACITE a minimum of **164** credits (with a minor allowed variation) is to be earned for the completion of B. Tech programme in ECE.
- **Industrial training** (Audit Course) of at least 4 weeks to be taken up at the end of 5th semester (Autumn session). Evaluation will be done in the 6th semester along with courses offered in 6th semester (spring session).
- **Seminar** (in 6th semester) also to be taken as an audit course.
- It is necessary to complete at least 8 credits of *"Open electives",* 8 credits of *"Discipline Centric Electives"* and 6 credits of *"Generic Electives"* during the B. Tech Programme (ECE) in addition to the core and fundamental subjects.
- Open Elective can be a 2-credit course only.
- A student will be eligible to get Under Graduate Degree with **"Honors"** (within ECE) or an additional **"Minor Degree"** (from any other department with SoET, other than ECE), if he/she earns an additional 18 - 20 credits (*as per university order* ***No: IUST DAA/Acad/23/1381, dated 13-07-2023)***, which should be acquired through opting for specialized courses through offline/online (MOOCS) platforms. A CGPA of ≥ 7.5 (as approved in earlier BoS (2018) and consequently approved by Academic Council) should be scored for the award of Honors/ Minor.
- Students interested in pursuing an Honors/Minor Degree have the option to enroll in the Specialization courses. Starting from the third semester onwards, students may enroll in one course per semester as an extra course for the award of Honors/Minor.
- Honors is available to students in the ECE (parent department), while Minor is open to students in sister departments of SOET. Additionally, ECE students interested in pursuing a Minor have the opportunity to choose from available options in other sister department.
- **Discipline Centric** electives are offered to the students of the Department of Electronics and Communication Engineering only. **9 credits** of Discipline Centric electives to be completed during the B. Tech programme
- **Generic electives** are offered to the students of Department of Electronics and Communication Engineering by all other department of School of Engineering and Technology including the Department of Electronics and Communication Engineering. **6 credits** of Generic electives to be completed during the B. Tech programme.
- **Open electives** are offered to the students of Department of Electronics and Communication Engineering by Department outside School of Technology. **8 credits** of Open electives to be completed during the B. Tech programme (ECE)

Complete List of Discipline Centric Elective Courses:

S. No	*Course Code*	*Course Title*	*Hours Per Week*				*Credits*	*Semester*	*Course Category*
			L	*T*	*P*	*S*			
1.	ECE 303E	Computer Organization and Architecture	3	0	0	0	3	V	Discipline Centric (Engineering Science)
2.	ECE 410E	Organic Electronics	3	0	0	1	3	V	Discipline Centric (Professional Core)
3.	ECE 354E	MATLAB	3	0	0	0	3	V	Discipline Centric (Skill)
4.	ECE 450E	Information Theory and Coding	3	0	0	0	3	V	Discipline Centric (Engineering Science)
5.	MTH 4E	Probability and Statistics	3	0	0	0	3	V	Discipline Centric (Basic Science)
6.	ECE 302E	VLSI Technology	3	0	0	0	3	VI	Discipline Centric (Professional Core)
7.	ECE 301E	EDA Tools	3	0	0	0	3	VI	Discipline Centric (Skill)
8.	ECE 455E	Physics of Semiconductor Devices	3	0	0	0	3	VI	Discipline Centric (Basic Science
9.	ECE 358E	Data Communication	3	0	0	0	3	VI	Discipline Centric (Engineering Science)
10	ECE 407E	Op Amps and Linear Integrated Circuits	3	0	0	0	3	VIII	Discipline Centric (Engineering Science)
11	ECE 405E	Mobile Ad hoc Networks	3	0	0	0	3	VIII	Discipline Centric (Professional Core)

12	ECE 451E	System Design	3	0	0	0	3	VIII	Discipline Centric (Professional Core)
13	ECE 404E	Photovoltaic System Design	3	0	0	0	3	VIII	Discipline Centric (Engineering Science

Complete List of Generic Electives Courses:

S. No	*Course Code*	*Course Title*	*Hours Per Week*				*Credits*	*Semester*	*Category*
			L	*T*	*P*	*S*			
1.	ECE 351G	Optimization Techniques	3	0	0	0	3	VI	Generic (Engineering Science)
2.	ECE 457G	Random Processes and Noise	3	0	0	0	3	VI	Generic (Engineering Science)
3.	ECE 403G	Digital Image Processing	3	0	0	0	3	VI	Generic (Engineering Science)
4.	ECE 353G	Computer Networks	3	0	0	0	3	VI	Generic (Engineering Science)
5	ECE 452G	Process Control Instrumentation	3	0	0	0	3	VII	Generic (Engineering Science)
6	ECE 456G	Radar Systems	2	0	2	0	3	VII	Generic (Engineering Science)
7	ECE452G	Wireless sensor Networks	3	0	0	0	3	VII	Generic (Engineering Science)
8	ECE 450G	Artificial Neural Networks And Fuzzy Logic	3	0	0	0	3	VII	Generic (Engineering Science)
9	ECE 402G	Internet of Things(IoT)	3	0	0	1	3	VIII	Generic (Basic Science)
10	ECE 407G	Multimedia Technology	3	0	0	1	3	VIII	Generic (Basic Science)
11	ECE 453G	Cyber Forensics	3	0	0	1	3	VIII	Generic (Skill)

12	ECE 454G	Network Security	3	0	0	0	3	VIII	Generic (Professional Core)
13	ECE 458G	Python	3	0	0	0	3	VIII	Generic (Skill)
14	ECE008O	Wireless Home Solutions	2	0	0	0	2	-	Open (Engineering Science)
15	ECE 011O	Skilling in Optical Fiber Technologies	2	0	0	0	2	-	Open (Skill)
16	ECE 012O	Elements of Photovoltaic Systems	2	0	0	0	2	-	Open (Skill)

For batches admitted in 2023 and onwards

DC ELECTIVES

(Detailed Syllabus)

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 301E	**Electronic Design Automation (EDA) Tools**	**3-0-0-0**

COURSE OBJECTIVES: This course will enable students to understand CAD tools used in electronics for design, analysis and evaluation of various circuit subsystems. The course will provide students with an opportunity to practice on various EDA tools & platforms for electronic design. The students will be exposed to various simulation techniques to analyze the performance and implementation of the simple systems that exist in modern electronics engineering. The course will also enrich the skills by exposing the students to the hardware description languages, printed circuit board design techniques**.**

COURSE OUTCOMES (COs):

CO1	Explain the design aspects/performance metrics of an electronic subsystem
CO2	Design simple printed circuit boards of simple electronics circuits.
CO3	Apply a proper simulation to design under test and evaluate its performance.
CO4	Translate/transform digital subsystems using Hardware Description Language
CO5	Employ various EDA tools to implement and analyze various Electronic subsystems

UNIT I: Definition & importance of EDA Tools, Types of EDA Tools Used in electronic Industry, (Device level, circuit level, System level) General Design Flow in Electronics in ASIC/FPGA

UNIT II: Introduction to ECAD tools e.g KICAD, THD and SMDs, Multilayer PCBs, Design of various circuit CAD Drawings, Circuit examples, Rectifiers – HW/FW, Clippers, Clampers, Voltage Regulator Circuits, Amplifiers, Power Supply & Various IC Based Circuits

UNIT III: An Overview of OS commands. System settings & Configuration. Introduction to UNIX commands. Writing Shell scripts. VLSI design automation tools. An overview of features of practical CAD tools. CADENCE Virtuoso, Agilent's Advanced Design Systems (ADS), Xilinx ISE/ Vivado, Model SIM, Leonardo spectrum, Cortus II, VLSI back end tools

UNIT IV: Circuit simulation using Spice/ Cadence/ADS; circuit description. AC, DC and transient analysis. Advances Spice commands & analysis. Models for diodes, transistors & OP Amps. Digital building blocks. A/D, D/A and sample & hold circuits. Design & Analysis of mixed signals circuit. Evaluation & analysis of various circuit parameters using EDA Tools, Mixed signal circuit modeling and analysis.

UNIT V: VHDL/System Verilog- Introduction, design hierarchy, data types, operators and language constructs. Functional coverage, assertions, interfaces and test bench structures.

TEXT BOOKS:

1. M.J.S. Smith, “Application Specific Integrated Circuits”, Pearson, 2008.

REFERENCE BOOKS:

1. M.H.Rashid, " I ntroduction to PSpice using OrCAD for circuits & electronics", Pearson, 2004
2. S.Sutherland, S. Davidmann, P.Flake, " System Verilog for Design", (2/e) Springer, 2006

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 302E	**VLSI Technology**	**3-0-0-0**

COURSE OBJECTIVE: This course aims to providing detailed knowledge in VLSI design process starting from digital design, hardware descriptive languages, RTL, synthesis & simulation, verification.

COURSE OUTCOMES (COs):

CO1	To understand the fabrication process of IC Technology
CO2	To Lear the MOS process technology
CO3	Analysis of the physical Design Process of VLSI
CO4	To be aware about the trends in Semiconductor technology & its impact on Scaling & Performance

UNIT I

Crystal growth & wafer preparation, Processing considerations: Chemical cleaning, getting the thermal Stress factors etc. Epitaxy - Vapors phase Epitaxy, Basic Transport processes & reaction kinetics, doping & auto doping, equipments, & safety considerations, buried layers, epitaxial defects, molecular beam epitaxy, equipment used, film characteristics, SOI structure.

UNIT II

Oxidation-Growth mechanism & kinetics, Silicon oxidation model, interface considerations, orientation dependence of oxidation rates thin oxides. Oxidation technique & systems dry & wet oxidation, Masking properties of SiO2. Diffusion -Diffusion from a chemical source in vapor form at high temperature, diffusion from doped oxide source, diffusion from an ion implanted layer.

UNIT III

Lithography -Optical Lithography: optical resists, contact & proximity printing, projection printing, electron lithography: resists, mask generation. Electron optics: roster scans & vector scans, variable beam shape. X-ray lithography: resists & printing, X- ray sources & masks. Ion lithography.

UNIT IV

Etching - Reactive plasma etching, AC & DC plasma excitation, plasma properties, chemistry & surface interactions, feature size control & apostrophic etching, ion enhanced & induced etching, properties of etch processing. Reactive Ion Beam etching, Specific etches processes: poly/ polycide, Trench etching.

UNIT V

Metallization - I, Problems in Aluminium Metal contacts, IC BJT - From junction isolation to LOCOS, Problems in LOCOS + Trench isolation, More about BJT Fabrication and Realization, , MOSFET - Metal gate vs. Self-aligned Poly-gate, CMOS Technology

TEXT BOOKS:

1. S. M. Sze, “Modern Semiconductor Device Physics”, John Wiley & Sons, 2000.

REFERENCE BOOKS:

2. B.G. Streetman, “Solid State Electronics Devices”, Prentice Hall, 2002.|

3. Chen, “VLSI Technology” Wiley, March 2003.

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 303E	**Computer Organization & Architecture**	**3-0-0-0**

COURSE OBJECTIVE: To grasp the fundamental organizational and architectural aspects of a digital computer. To scrutinize performance concerns in processor and memory design within a digital computer. To comprehend diverse data transfer techniques employed in digital computers.

COURSE OUTCOMES (COs)

CO1	Demonstrate concepts of parallelism in hardware/software
CO2	Discuss memory organization and Register Organization
CO3	Describe I/O organization.
CO4	Interpret various modes of data transfer

UNIT I: Register Transfer and Micro-operations: Introduction and comparison of Computer Architecture & Organization, Computer Registers, Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit.

UNIT II: Basic Computer Organization and Design: Control Organization – Hard wired and micro programmed control. Instruction Codes, Computer Instructions, Instruction Cycle, Memory-Reference Instructions, Input-Output and Interrupt, Control Memory, Address Sequencing.

UNIT III: Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Program Control, Decimal Arithmetic Unit.

UNIT IV: Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access.

TEXT BOOKS:

1) M Mano, "Computer System and Architecture", PHI
2) W. Stallings, "Computer Organization & Architecture", PHI

REFERENCE BOOKS:

1) J. P. Hayes, "Computer Architecture and Organization", McGraw Hill
2) J. L Hennessy and D. A. Patterson, "Computer Architecture: A quantitative approach", Morgon Kauffman, 1992
3) Computer Systems Organization and Architecture, John D. Carpinelli, Pearson Education Inc

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE305E	**Antenna Systems and Design**	**3-0-0**

COURSE OUTCOMES (COs)

CO1	Understanding of the basic principles of antennas.
CO2	Ability to design basic antenna systems for specific applications, including both theoretical and practical aspects of antenna design.
CO3	Develop practical skills in constructing and testing antenna systems, considering factors such as materials, frequency range, and real-world constraints.
CO4	Using simulation tools like CST, HFSS, or MATLAB to model and evaluate the performance of various antenna designs.

Unit I-Antenna System Fundamentals: Introduction to Antennas, Applications in modern communication; Fundamental Parameters, Radiation pattern, gain, directivity, efficiency, Beamwidth, bandwidth, polarization; Antenna Impedance and Matching, Input impedance, Reflection coefficient, VSWR and return loss; Link Budget and Friis Equation, Power density.

Unit II-Antenna Arrays: Introduction to Arrays, Advantages over single antennas; Array Types Linear, planar, circular, and phased arrays; Array Factor and Pattern Multiplication, Uniform and non-uniform arrays, Array factor derivation and graphical interpretation.

Unit III-Microstrip Antennas: Microstrip Antenna Basics, Structure and working principle, Advantages and limitations, Patch Shapes and Types, Rectangular, circular, elliptical, and other shapes, Feeding Techniques, Microstrip line, Design Parameters.

Unit IV-CST Studio Suite Design and Analysis: Introduction to CST Studio Suite, Interface and modules, Basic Modelling Techniques, Microstrip Patch Antenna Simulation

Unit V-Antenna Fabrication: Overview of fabrication techniques, Materials Used in Antenna Fabrication, Conductive materials, Dielectric substrates, Adhesives and laminates, Basic Tools and Equipment, PCB etching tools, Soldering equipment.

TEXT BOOKS:

1. "Antenna Theory: Analysis and Design" by Constantine A. Balanis
2. "Antennas for All Applications" by John D. Kraus and Ronald J. Marhefka
3. "Introduction to Antennas" by R. S. Elliot
4. "Antennas: From Theory to Practice" by Jim O'Callaghan
5. "Fundamentals of Antennas: A Practical Approach" by Shiban K. Koul

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 350E	**Operational Amplifiers & LIC**	**3-0-0-0**

COURSE OBJECTIVE: To develop the skills to build, test, diagnose and rectify the Op-Amp based electronic circuits.

COURSE OUTCOMES (COs):

CO1	To have Knowledge of various Amplifiers
CO2	To know the basic Applications of Op Amps
CO3	To have knowledge about Comprators & their applications
CO4	Be familiar with PLL
CO5	Be familiar with filters

UNIT I: Differential Amplifier (DA), Configurations, Circuit and analysis of DA, Methods of Enhancing input impedance, Common mode and different mode signals, Common mode Rejection Ratio (CMMR), output offset voltage, input offset current, input bias current, Operational amplifier- Band width, frequency response, Slew rate.

UNIT II: Basic applications of Op amp- IC 741 (integrator, differentiator, voltage follower, Inverting and Noninverting amplifier), Input and output impedance of Inverting amplifier, Instrumentation amplifier, Electronic Analog Computation, Logarithmic and antilogarithmic amplifiers, Digital to analog converters (DAC)-Binary weighted and R/2R ladder, Analog to digital converters (ADC)-Flash type, Successive approximation, counter type and single slope, dual slope.

UNIT III: Comparators, Applications of comparators, Regenerative comparators (Schmitt-trigger) , Square wave and triangular wave generators, pulse generators, voltage time-base generators, Step(Stair-case) generators, analog multipliers, Precision ac/dc converters, Sample and hold systems, Clippers , Clampers and Peak detectors.

UNIT IV: Phase locked loop, Basic building block, Operation of loop components, VCO, SE/NE 656, 555 timer, 555 timer as oscillator configuration, Wein-bridge oscillator, Phase shift oscillator, Crystal oscillator. Astable multivibrator, Frequency Synthesizer with types Sinusoidal oscillators- general form of

UNIT V: Active filters, low pass, high pass, band pass & band reject filters and their analysis, Operational Transconductance Amplifier (OTA) and applications, current mirrors.

TEXT BOOKS :

1) OP- Amp and Linear Integrated Circuits by R. A. Gayakward PHI Ltd.

REFERENCE BOOKS:

1) Electronic Principles by Albert Paul Malvino, Fourth Edition, McGraw-Hill International Editions
2) Integrated Electronics By Milliman and Halkias, McGraw hill Book company
3) Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Drisiol, Gayakward, PHI Private Ltd.

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 353E	**Advanced Microcontroller Programming**	**3-0-0-0**

COURSE OBJECTIVE: The primary learning objectives of an Advanced Microcontroller Programming and Interfacing course would focus on empowering students to comprehend and apply advanced principles related to microcontroller-based systems.

COURSE OUTCOMES (COs):

CO1	To have knowledge about applications and architecture of ARM microcontroller
CO2	To understand the Instructions of ARM.
CO3	To know about OS basics and various tasks & processes taking place in OS
CO4	To have knowledge about Integration & testing of Embedded systems

UNIT I: Introduction to ARM 32 bit microcontroller:Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence

UNIT II: ARM Cortex M3 Instruction Sets and Programming: Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming.

UNIT III: RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment

TEXT BOOKS:

1. Embedded Systems: Introduction to Arm(r) Cortex(tm)-M Microcontrollers: 1: by Jonathan Valvano (Author)

REFERENCE BOOKS:

1. TI Tiva ARM Programming For Embedded Systems: Programming ARM Cortex-M4 TM4C123G with C (Mazidi & Naimi ARM Book 2)
2. Microcontroller Programming (8051, PIC, ARM7 ARM Cortex): by T. Bansod (Author), Pratik Tawde (Author)

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 354E	**MATLAB**	2-0-2-0

COURSE OBJECTIVE: It is designed to give students a basic understanding of MATLAB, including popular toolboxes

COURSE OUTCOMES (COs):

CO1	Model different signals or systems in MATLAB.
CO2	Find the response of different systems both in continuous and discrete time domains.
CO3	Generate plots and export the results for use in reports and presentations.
CO4	Program scripts and functions.

UNIT I: Introduction: Basics of MATLAB, Overview of different windows, Applications of MATLAB, Basic operations in MATLAB.

UNIT II: Arrays: Creating 1 D & 2D Arrays, Multi-dimensional Arrays in MATLAB,Indexing of Arrays in MATLAB, Operations performed on Arrays. Plotting Arrays in MATLAB.

UNIT III: Simulink: Overview of different tool boxes in Simulink, representation of an operation using Simulink Blocks.

UNIT IV: Continuous Time Signals and System in MATLAB: Representation of different continuous time signals & Systems in MATLAB and their simulations. Transfer function in MATLAB and its solutions for different inputs. Solution of a differential equation in MATLAB/Simulink. RC/RL Circuit simulations in MATLAB using Transfer function or differential Equation Model

UNIT V: Discrete Time Signals and System in MATLAB: Representation of different discrete time signals & Systems in MATLAB and their simulations. Transfer function of discrete time systemin MATLAB/Simulink and its solutions for different inputs. Solution of a difference equation in MATLAB/Simulink.

TEXT BOOKS:

1) Introduction to MATLAB and Simulink – A project approach, O Beucher & M. Weeks
2) MATLAB – A quick introduction for Scientists & engineers, Rudra Pratap

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 355E	**Computer Networks**	**3-0-0-0**

COURSE OBJECTIVE: To establish connections between devices and facilitate seamless communication and data exchange among them. · Resource sharing: Networking facilitates the sharing of hardware, software, and data resources among linked devices, optimizing resource utilization and promoting collaboration.

COURSE OUTCOMES (COs):

CO1	To have Knowledge of various basic concepts of Computer Network
CO2	To know the processes taking place at various network Layers
CO3	Having Knowledge about Routing Algorithms and Transport Protocols
CO4	Be familiar with different security issues and challenges in a computer network

UNIT I: Introduction to Computer Networks: LAN, WAN, MAN. Network Topologies. Network Hardware: Routers, Switches, Bridges, Hubs. High Speed Networks, Public switched Networks. Open System Interconnection (OSI) model of a network, TCP/IP model.

UNIT II: THE DATA LINK LAYER: Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols - HDLC, the data link layer in the internet. THE MEDIUM ACCESS SUBLAYER: Channel allocations problem, multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth

UNIT III : THE NETWORK LAYER: Network layer design issues, routing algorithms, Congestion control algorithms, Internetworking, the network layer in the internet (IPv4 and IPv6), Quality of Service.

UNIT IV: THE TRANSPORT LAYER: Transport service, elements of transport protocol, Simple Transport Protocol, Internet transport layer protocols: UDP and TCP.

UNIT V: THE APPLICATION LAYER: Domain name system, electronic mail, World Wide Web: architectural overview, dynamic web document and http. APPLICATION LAYER PROTOCOLS: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet.

TEXT BOOKS:

1. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, India.

REFERENCE BOOKS:

1. Behrouz A. Forouzan (2006), Data communication and Networking, 4th Edition, Mc Graw-Hill, India.
3. Kurose, Ross (2010), Computer Networking: A top down approach, Pearson Education, India

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 450E	Information Theory & Coding	3-0-0-0

Course Objective: To comprehend the information theoretic behavior of a communication system. To explore various source coding techniques for data compression. To grasp different channel coding techniques and their capabilities. To develop a fundamental understanding of data communication and networking concepts.

COURSE OUTCOMES (COs)

CO1	Familiarity with the basics concepts of Information and Information Models
CO2	Having knowledge of Source Coding and various Algorithms
CO3	Familiarizing eith Communication Channels
CO4	To have knowledge about Error Control and to know the methods to control error

UNIT I: Information Theory: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model for Information Sources, Entropy and Information rate of Mark off Sources

UNIT II: Source Coding**:** Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon Fano Encoding Algorithm, Source coding theorem, Prefix Codes, Kraft McMillan Inequality property KMI, Huffinan codes

UNIT III Information Channels: Communication Channels, Discrete Communication channels Channel Matrix, Joint probabilty Matrix, Binary Symmetric Channel, System Entropies. Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel. Binary Erasure Channel, Muroga's Theorem.

UNIT IV Error Control Coding: Methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array.

UNIT V Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction. Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm.

TEXTBOOK:

1. Digital andAnalog Communication Systems, K. Sam Shanmugam, John Wtley India Pvt Ltd, 1996.
2. Digital Communication, Simon Haykin, John Wtley India Pvt Ltd, 2008.

REFERENCE BOOKS:

1. Information Theory and Coding, Hari Bhat, Ganesh Rao, Cengage, 2017.

2. lTC and Cryptography, Ranjan Bose, TMH, II edition, 2007
3. Principles of Digital Communication, J. Das, S.K. Mullick, P. K. Chatterjee, Wiley, 1986-Technology &Engineering
4. Error Correction Coding, Todd K Moon, Wiley Std. Edition, 2006

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 451E	**System Design**	**3-0-0-0**

COURSE OBJECTIVES: to create a plan for a software or hardware system that meets the needs and requirements of a customer or user.

COURSE OUTCOMES (COs):

CO1	To have Knowledge of Digital Systems for designing
CO2	To understand Sequential Logic Circuit designing
CO3	To understand subsystem Designs
CO4	To understand and implement VHDL language for system design

UNIT I: Interconnect: The Wire, Interconnect Parameter, Electrical And Spice Wire Model, RLC Parasitic, Signal Integrity And High Speed Behavior Of Interconnects: Ringing, Cross Talk And Ground Bounce. Layout Strategies At IC And Board Level For Local And Global Signals, Power Supply Decoupling.

UNIT II: Designing of sequential logic circuit: Static And Dynamic Latches And Registers, Design And Optimization Of Pipelined Stages, Timing Issues In Digital Circuits, Synchronous And Asynchronous Design Styles, Interface Between Synchronous And Asynchronous Blocks, Concept Of Meta-Stability.

UNIT III: System hardware decomposition: Data Path And Control Path, Register Transfer Level Description, Control Path Decomposition (Interfacing With FSM), Pitfalls of Decomposition, Control Flow And Data Flow Pipelines, Communication Between Subsystems, Control Dead Locks.

UNIT IV: Subsystem design: Logic Design Consideration For Arithmetic Building Blocks: Adders, Multipliers, Shifters Logic Design Consideration For Memory Architecture: Address Decoder, Sense Amplifier, Voltage Reference, Drivers/Buffers, Timing And Control Shared Memory Data Hazards And Consistency

UNIT V: Design for test: Introduction, Test Procedure, Issues in Design for Testability, Ad-Hoc Testing, Scan-Based Test, Boundary Scan Design, Built-In-Self Test (BIST), Test Pattern Generation, Fault Models, Automatic Test Pattern Generation (ATPG).

TEXT BOOKS :

1. Digital System Design with VHDL By Mark Zwolinski

REFERENCE BOOKS:

1. Digital Systems by **Ronald Tocci**
2. Digital principles and Applications **By Malvino Leach and Saha**
3. **Digital Fundamentals** By F***loyd***

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 452E	**Radar System**	**3-0-2-0**

COURSE OBJECTIVE: To cover the foundational principles and components of radar systems, and to conduct an in-depth analysis of radar system functionalities.

COURSE OUTCOMES (COs)

CO1	Understand basic operation of radar.
CO2	Understand Doppler effect and its relevance to radars.
CO3	Based on Doppler shift, different types of radars and their utility.
CO4	Radar tracking operation and its evolution.

UNIT-I: Simple Pulse Radar: Radar equation, range performances and minimum detectable signal, receiver noise SNR; integration of radar pulses; integration efficiency and loss; radar cross section of targets with examples of simple targets; PRF & range ambiguity, Radar system losses; radar frequencies;

UNIT-II: Continuous Wave Radar: Doppler's shift; CW Radar with IF amplification; FM radar; Conventional pulse Radar with Super-Heterodyne receiver, multiple frequency CW radar (block diagram and description), Operation and performance etc.

UNIT-III: Moving Target Indication (MTI) & Pulse Doppler Radar (PDR): Doppler's shift applied to pulse radar; butterfly effects, delay line cancellers; MTI with power amp, Pulsed Doppler Radar with operational Block functions, Frequency Modulated CW Radar

UNIT-IV: Radar Tracking: Introduction and types of tracking Radar, Block diagram and functions of Tracking Radar, Radar Tracking systems

UNIT-V: Radar Beacons: Introduction to Synthetic aperture radar (SAR), applications of SAR, Radar displays, Radar RF Sources, Radar RF Modulators, Radar Transmitters

LIST OF EXPERIMENTS TO BE DONE:

1) To find the radial velocity of a moving target using Doppler effect
2) To find the distance of moving target/stationary target from the radar
3) To find out the time period if simple pendulum using Doppler radar
4) To find out rpm of a fan at some distance D from the radar
5) To find out the frequency of a buzzer in presence of various clutter noises.

TEXT BOOKS:

1. Skolnik MI, Radar Systems, Pearson Publications,3rd Ed.

REFERENCE BOOKS:

1. Raju GSN, Radar Engineering.
2. Kulkarni M, Radar Engineering, Umesh Publications, New Delhi
3. Sharma, KK., Radar, Sonar and Navigation engineering, Katsons Publications, New Delhi

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 455E	**Physics of semiconductor devices**	**3-0-0-0**

COURSE OBJECTIVES: TO apply the knowledge of semiconductors to illustrate thefunctioning of basic electronic devices and demonstrate the switching and amplification Application of the semiconductor devices.

COURSE OUTCOMES (COs):

CO1	To become familiar with energy bands, k space diagram, kronig penny model, types of semiconductors and drift and diffusion mechanism in semiconductors
CO2	To understand basic concepts of Fermi energy level. To visualize electric fields and carrier concentrations in intrinsic and extrinsic semiconductor
CO3	To understand working of PN junction, hetereojunction, graded junctions and abrupt junctions
CO4	To understand construction, working and operating characteristics of different optical devices
CO5	To understand construction, working and operating characteristics of different microwave and power devices

UNIT I: Energy Bands and Energy Gap, Allowed and Forbidden Energy Bands, Formation of Energy Bands, The Kronnig Penny model, The k space diagram, The Energy Band and the Bond Model, Drift Current, Statistical Laws, The Fermi Dirac Probability Function, The Distribution Function and the Fermi Energy. Carrier Concentration at Thermal Equilibrium, Equilibrium Distribution of Electrons and Holes, The n0 and p0 Equations, The Intrinsic Carrier Concentration, The Intrinsic Fermi-Level Position ,Dopant Atoms and Energy Levels.

UNIT II: The Extrinsic Semiconductor, Equilibrium Distribution of Electrons and Holes, The n0p0 Product, degenerate and Nondegenerate Semiconductors, arrier-Transport Phenomena, Career drift: Drift Current Density , Mobility Effects, Conductivity, Velocity Saturation, Carrier Diffusion, Diffusion Current Density, Total Current Density PN Junction, Heterojunctions, Abrupt Junctions, Graded junctions ,Depletion Region, IV Characteristics , Shockley;s equation. Generation and recombination process, Junction Capacitance, Junction Breakdown, Tunnelling, Avalanche breakdown. Transient behavior of pn junctions, Fast recovery Diode, Charge storage diode.

UNIT III: Devices: Metal-Semiconductor and Semiconductor: Heterojunctions, The Schottky Barrier Diode, characteristics and Junction properties. Optical Devices: pn junction Solar cells, conversion efficiency and solar concentration. Photodetectors: Photodiode, PIN photodiode. LEDS, Generation of light, Laser Diodes: Device structure and Characteristics.

UNIT IV: Semiconductor Microwave and Power Devices: Tunnel diode, Gunn Diode, Impatt Diode. Thyristors, basic characteristics, DIAC and TRIAC, Unijunction transistor construction and working, VI characteristics, UJT as relaxation oscillator. SBS and SUS, Varactor diode.

TEXT BOOKS:1. Donald A Neaman, Semiconductor Physics and Devices: Basic Principles,TMH

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 404E	**Photovoltaic System Design**	**3-0-0-0**

COURSE OBJECTIVES: To develop a comprehensive technological understanding in solar PV system components. To provide in-depth understanding of design parameters to help design and simulate the performance of a solar PV power plant.

COURSE OUTCOMES (COs)

CO1	To have Knowledge of photovoltaic systems
CO2	To know MTP& Buck Boost & Flyback converters
CO3	To have knowledge of Photovoltaic modules – series & parallel
CO4	Be familiar stand alone and grid PV systems

UNIT I: Introduction to photovoltaic systems, advantages, review of semiconductor physics-Energy bands, charge carriers, charge carrier transport, photovoltaic cell characteristics and equivalent circuit, effect of temperature and irradiance, open circuit and short circuit and peak power parameter.

UNIT II: Cell efficiency, STC, fill factor of photovoltaic modules, Maximum power point tracking (MPPT) Techniques- open circuit voltage, short circuit current, perturb and observe, incremental conductance. Input impedance of Buck, Boost and Buck-Boost converters. Flyback converters.

UNIT III: Photovoltaic modules, series and parallel connection, Mismatch in series and parallel connection, Hot spots and use of bypass diodes in modules, design and structure, wattage of modules, I-V equation and output power.

UNIT IV: Stand-alone and grid-tied PV systems, Batteries-Capacity, C-rate, Energy and power density, classification, losses, parameters, PV inverters, charge controllers, PV wire sizing.

UNIT V: Atmospheric effects, Air mass, energy with atmospheric effects, Solar radiation, sun-earth movement, angle of sunrays on solar collector, sun tracking-single axis and dual axis.

TEXT BOOKS:

1. Solar Photovoltaic's - Fundamentals- 3rd Edition, Chetan Singh Solanki, PHI

REFERENCE BOOKS:

1.Photovoltaic Power System-First Edition, Weidong Xiao, John Wiley

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 405E	**Mobile Adhoc Networks**	**3-0-0-0**

COURSE OBJECTIVES: To understand aspects of ad hoc networks, from design through performance issues to application requirements.

COURSE OUTCOMES (COs)

CO1	Having knowledge about Adhoc networks
CO2	Having knowledge about MAC
CO3	Having knowledge about Network Protocols
CO4	Having knowledge about cross layer design and integration

UNIT I Introduction: Introduction to Ad Hoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Ad Hoc Mobility Models: - entity and group models.

UNIT II Medium access protocols: MAC Protocols: design issues, goals and classification. Contention based protocols, reservation based protocols, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT III Network protocols: Addressing issues in ad hoc network, Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Power/ Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

UNIT IV End -to - end delivery and security: Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT V Cross layer design and integration: Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective, Cooperative networks:- Architecture, methods of co-operation, co-operative antennas, Integration of ad hoc network with other wired and wireless networks.

TEXT BOOKS:

1) C.Siva Ram Murthy and B.S.Manoj, ―Ad hoc Wireless Networks Architectures and protocols, 2 nd edition, Pearson Education. 2007

2) Charles E. Perkins, ―Ad hoc Networking‖, Addison – Wesley, 2000

REFERENCE BOOKS:

1) Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, ―Mobile adhoc networking, Wiley-IEEE press, 2004.

2) Mohammad Ilyas, ―The handbook of adhoc wireless networks, CRC press, 2002.

3) T. Camp, J. Boleng, and V. Davies ―A Survey of Mobility Models for Ad Hoc Network

4) Research, Wireless Communication and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 406E	**Wireless Sensor Networks**	**3-0-0-0**

COURSE OBJECTIVES: To understand the basics of Ad-hoc & Sensor Networks. To learn various fundamental and emerging protocols of all layers.

COURSE OUTCOMES (COs)

CO1	Familiarity with the basics of Ad hoc networks and Wireless Sensor Networks
CO2	Analyze the sensor node architecture and their operation
CO3	Design and apply suitable routing algorithm based on the network and user requirement
CO4	Be familiar with different security issues and challenges in of Ad hoc networks and Wireless Sensor Networks

UNIT I-Introduction and Architecture: Introduction to Adhoc and Wireless sensor networks –definition, characteristics, applications, challenges. Characteristics of wireless channel, Enabling Technologies for Wireless Sensor Networks. Difference between WSN and IOT. Single node architecture – Hardware Components, Energy Consumption of sensor nodes.

UNIT II- Physical Layer & Medium Access Protocols: WSN-Protocol Stack. Physical Layer and Transceiver Design Considerations, Technologies MAC protocols for WSN: challenges, goals and classification. Contention, Reservation and hybrid protocols. Network Architecture Optimization goals, Gateway, Sink concepts in sensor networks. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPER LAN.

UNIT III- Network and Transport Layer Protocols: Routing Protocols: Design issues, goals and classification- Proactive Vs Reactive routing, Data Centric, Flat Based, Hierarchical, Geographical and QoS Based Routing Algorithms, Transport Layer: Issues in designing, Adhoc transport layer protocols.

UNIT IV- Infrastructure Establishment and Security: Time synchronization, Localization, Power Management, Topology Management Techniques, Clustering, Security issues in Adhoc networks, sensor networks, network security attacks and challenges, secure routing protocols.

UNIT V- Sensor Network Platforms and Tools: Sensor Node hardware – Classification, Berkeley motes, Operating Systems and Execution Environments, Programming challenges, Node level software platforms, Dynamic Reprogramming, Simulators,

TEXT BOOKS:

1. Ian F. Akyildiz and Mehmeet Can Vuran, “Wireless Sensor Networks” Willey.

REFERENCE BOOKS:

1. Dargie & C Poellabauer,”Fundamentals of Wireless Sensor Networks”
2. Holger Karl & Andreas Willig “Protocols and Architectures for Wireless Sensor Networks”, J Willey.
3. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks - An Information Processing Approach”, Elsevier

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 409E	**Applied Information and Network Security**	**2-0-2-0**

COURSE OBJECTIVES: Understanding of security architectures and their practical implications and technical aspects of managing information security and protecting IT assets

CO1	Comprehend cryptographic concepts and develop deeper understanding of most popular symmetric and asymmetric cryptosystems.
CO2	Comprehend and apply ECC in developing Public Cryptosystems .
CO3	Explain and evaluate Security offered at different Levels in a layered model.
CO4	Understand the process of capturing and analysing Network traffic using popular tools

UNIT I: Review of basic Cryptography: Cryptographic principles, concepts, and Terrminology, Mathematical background of Cryptography, Symmetric and Asymmetric key Cryptography, Hash Functions, ElGamal ,RSA, Diffie-Hellman, Digital Signature and Hash functions, Crypto analysis.

UNIT II: Elliptic Curve Cryptography: Elliptic Curve Mathematics, ECs over Reals, Prime Fields, and binary fields, Encryption and decryption on EC Groups, EC based key exchange and Digital Signatures, Discrete Logarithm on Elliptic Curves and its comparison with other public key cryptosystems

UNIT III: Network Security: Security at Network layer IpSec Protocol, Transport layer Security, SSL/TLS Protocol, IEEE 802.11 Wireless LAN Security, Firewalls :Principle ,types and its application.

UNIT IV: System Monitoring : Basic Security Monitoring Tools, Sniffers, monitoring of network communication using Ethereal, Wireshark, Snort, Tcp dump and other tools, Role of CERT-In.

PS: (Unit IV shall be done in the lab)

TEXT BOOKS:

1. Cryptography and Network Security: Principles and Practices by William Stallings, Pearson Publication.
2. Fundamentals of Information Systems Security, 4th Edition, by David Kim and Michael G. Solomon. Jones and Bartlett Learning.

REFERENCE BOOKS:

3. Applied Information Security – A Hands on Approach, David Basin Patrick Schaller Michael Schläpfer.

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 410E	**Organic Electronics**	**3-0-0-0**

COURSE OBJECTIVE: This course will help students to understand the physics and fundamental material properties of organic electronic materials. The students will acquire a general background in the field of organic electronics and optoelectronic.

COURSE OUTCOMES (COs):

CO1	To understand the basics of organic materials and organic electronic devices
CO2	To understand the physics of organic semiconductors
CO3	to understand the charge transport and energy levels in organic electronic materials
CO4	To become familiar with electronic and photonic processes involved in molecular solids
	To understand the functioning of organic LEDs, organic solar cells and organic TFTs

UNIT I: Introduction: Introduction to organic electronics, limitations of conventional electronics, advantages of organic electronics, review of quantum mechanics general comparison of inorganic versus organic devices

UNIT II: Electronic structure of organic molecules: Atomic and molecular orbitals, LCAO, bonding and anti-bonding orbitals, orbital hybridization, HOMO and LUMO levels, conjugated molecules, organic semiconductor physics, energy levels in a molecule,

UNIT III: Photophysics of organic M[R1] olecules: Electronic transitions, excitons, and energy transfer; charge generation and recombination mechanisms, polaron, optical processes, radiative lifetime, transport and injection, absorption/emission in a molecule.

UNIT IV: Electronic conduction in organic solids: Conductivity (carrier concentration versus mobility), carrier generation, hopping transport, transport in organic semiconductors, mobility measurements, traps, multiple trap release model, grain-boundary potential barrier model, Gaussian disorder model

UNIT V: Organic Devices: Organic LEDs, organic thin film transistors, organic solar cells, selected examples in current research

TEXT BOOKS:

1. “Organic Semiconductors” H. Meier, Verlag Chemie GmbH, 1974.

REFERENCE BOOKS:

1. “Physics of Organic Semiconductors” Wolfgang Brütting, John Wiley & Sons Canada
3. “Organic Electronics: Materials, Manufacturing, and Applications”, Hagen Klauk, John

Wiley & Sons
4. "Organic Electronics: Materials, Processing, Devices and Applications", Franky So, CRC Press,

E-RESOURCES

https://youtube.com/playlist?list=PLtCXw_RzWB3gjVjK5FAxLJUIEFng8VPOj&si=D2jI4uhOhUQKFl9H

For batches admitted in 2023 and onwards

Course Code:	**Course Title:**	**L-T-P-S**
ECE 457E	**Random Processes and Noise**	**3-0-0-0**

COURSE OBJECTIVE: Equip students with the theoretical foundation and practical skills necessary to analyze, model, and manage random processes and noise across various disciplines, fostering the ability to address real-world challenges in fields such as communication systems, signal processing, and engineering.

COURSE OUTCOMES (COS):

CO1	To provide mathematical background and sufficient experience to the students regarding probability theory.
CO2	To introduce students to the basic methodology of "probabilistic thinking" and apply it to problems.
CO3	To understand basic concepts of Probability theory and Random Variables, how to deal with multiple Random Variables
CO4	To understand the difference between time averages and statistical averages
	To teach students how to apply sums and integrals to compute probabilities, and expectations

UNIT I: Set theory, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, and Independent Events, Bernoulli's trials. Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete and Continuous.

UNIT II: Distribution and Density functions, Properties, Binomial, Uniform, Exponential, Gaussian, and Conditional Distribution and Conditional Density function and its properties, problems. Operation on One Random Variable: Expected value of a random variable, function of a random variable, moments about the origin, central moments, variance and skew, characteristic function, moment generating function.

UNIT III: Multiple Random Variables, Joint Distribution Function and Properties, Joint density Function and Properties, Marginal Distribution and density Functions, conditional Distribution and density Functions, Statistical Independence, Distribution and density functions of Sum of Two Random Variables.

UNIT IV: The Stochastic process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Statistical Independence and concept of Stationarity: First-Order Stationary Processes, Second-Order and Wide-Sense Stationarity, Nth-Order and Strict-Sense Stationarity, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes

UNIT V: The Power Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function, the Cross-Power Density Spectrum and Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

TEXT BOOKS:

1. Probability, Random Variables & Random Signal Principles -Peyton Z. Peebles, TMH, 4th Edition, 2001.
2. Probability and Random Processes-Scott Miller, Donald Childers, Elsevier, 2012

REFERENCE BOOKS:

1. Theory of probability and Stochastic Processes-Pradip Kumar Gosh, University Press
2. Probability and Random Processes with Application to Signal Processing - Henry Stark and John W. Woods, Pearson Education, 3rd Edition.
3. Probability Methods of Signal and System Analysis- George R. Cooper, Clave D. MC Gillem, Oxford, 3rd Edition, 1999.
4. Statistical Theory of Communication -S.P. Eugene Xavier, New Age Publications 2003
5. Probability, Random Variables and Stochastic Processes Athanasios Papoulis and S.Unnikrishna Pillai, PHI, 4th Edition, 2002.

Online Source:

1. https://archive.nptel.ac.in/courses/117/105/117105085
2. https://www.engineeringonline.ncsu.edu/course/ece-514-random-processes

For batches admitted in 2023 and onwards

GENERIC ELECTIVES

(Detailed Syllabus)

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 351G	Optimization Techniques	3-0-0-0

COURSE OBJECTIVES: to assign values, from the allowed domain, to the unknowns such that the objective function is optimized and all constraints are satisfied.

COURSE OUTCOMES (COs):

CO1	Analyze any real-life system with limited constraints and depict it in a model form.
CO2	Convert problem into mathematical model.
CO3	Solve mathematical model manually as well as using software resources.
CO4	Understand variety of problems such as assignment, transportation, travelling salesman etc.
CO5	Solve sequencing problems by processing 'n' number of jobs on 'm' number of machines and find out optimal solution using dynamic programming.

UNIT I: Linear Programming: Introduction to optimization, Linear Programming problem (LPP). Formulation of LPP, Graphical Solution of LPP, Simplex Method, Artificial Variables, Big-M Method, Revised Simplex Method (RSM).

UNIT II: Transportation Problems: Formulation, Solution of Balanced Transportation Problem. Finding initial basic Feasible Solutions in North-west corner rule, least cost method and Vogoles approximation method. Degeneracy in Transportation Problems, Max – Type Transportation Problems, UV-Method / Modi Method.

UNIT III: Assignment Problems: Introduction and Mathematical Formulation, Hungarian Method, Assignment Model Formulation, Hungarian method for optimal solution; solving unbalanced problems; Max – Type assignment Problems, Routing Problems, travelling salesman problem and assignment.

UNIT IV: Sequencing Models: Solution of sequencing problem, processing n jobs through two machines, processing n jobs through three machines, Processing two jobs through m machines.

UNIT V: Dynamic Programming: Introduction to Dynamic programming problems, Characteristics and applications of Dynamic Programming, Mathematical formulation and optimal Solution of Dynamic Programming problems.

TEXT BOOKS:

1. P. SankaraIyer, Operations Research, Tata McGraw Hill 2008

REFERENCE BOOKS:

1. A.M. Natarajan, P.Balasubramani, A. Tamilarasi, Operations, Pearson Education, 2005.

2. Brownlee, Statistical Theory and Methodology in Science & Engineering, John Wiley &Sons.
3.Walpole R.E., Introductionto Mathematical Statistics, Macmillan publications.
4. Meyer, Data Analysis for Scientists & Engineers, John Wiley & Sons.

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 352G	Process Control & Instrumentation	3-0-0-0

COURSE OBJECTIVES: Expose students to the advanced control methods used in industries and research.

COURSE OUTCOMES (COs):

CO1	To understand basic principles and need of Modern control Systems
CO2	To understand the need for modulation. To understand the generation, detection of Amplitude Modulation Techniques and also perform the mathematical analysis associated with these techniques.
CO3	To understand special control Techniques in Advanced Process control and understand Control Analysis
CO4	To understand various computational techniques in control Processes

UNIT I: Modern Control System: System Models Examples, Building blocks of state space models, Canonical forms, State equation and its solution, Properties of the state transition matrix, Special cases, Modelling Discrete-time systems with delay operators. Stability modelling energy of the system in terms of quadratic functions, Lyapunov's criterion for continuous- and discrete-time systems. Design in State Space State feedback control for controllable canonical form, State feedback control in general, State feedback for discrete-time systems, Computational algorithms and their complexity, Output feedback control. Full-order and reduced-order observers, Physical aspects of control system design in state space.

UNIT II: Advanced Process Control: Review of Systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances. Transient response. Block diagrams. Special Control Techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, Smith predictor, internal model control. Multivariable Control Analysis: Introduction to state-space methods, , Control degrees of freedom analysis and analysis, Interaction, Bristol arrays, Niederlinski index - design of controllers, Tuning of multivariable controllers.

UNIT III: Computational techniques in Control Engineering: Control Systems Analysis – Linear State-space models and solutions of the state equations, Controllability, Observability, Stability, Inertia, and Robust Stability, Numerical solutions and conditioning of Lyapunov and Sylvester equations. Control Systems Design – Feedback stabilization, Eigenvalue assignment, Optimal Control, Quadratic optimization problems, Algebraic Riccati equations, Numerical methods and conditioning, State estimation and Kalman filter.

UNIT IV: Advanced Applied Process Control: Control relevant process modelling and identification: Model applications, types of models, empirical dynamic models, model structure considerations, model identification. Identification examples: SISO furnace parametric model identification, MISO parametric model identification, MISO non-parametric identification of a non-integrating process, MIMO identification of an integrating and non-integrating process, design of plant experiments, conversion of model structures.

UNIT V: Virtual Instrumentation Virtual Instrumentation: Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques,

graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming. VI programming techniques: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

TEXT BOOKS:

1. Coughnowr, D., " Process Systems Analysis and Control ", 3rd Edn., McGraw Hill, New York, 2008.
2. H.H. Willard, Merrit and Dean, "Instrumental Methods of Analysis", 5th Edn., 1974.

REFERENCE BOOKS:

1. Marlin, T. E., " Process Control ", 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", 2nd Edn., John Wiley, New York, 1997.
3. Jason L. Speyer, Walter H.Chung,"Stochastic Processes, Estimation, and Control",PHI Ltd (2013).

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 355G	Embedded System Design	3-0-0-0

COURSE OBJECTIVES: Ability to Perform effectively as entry level Embedded Systems professionals. Develop and maintain applications written using Embedded C.

COURSE OUTCOMES (COs)

CO1	Classify Embedded systems for major application areas
CO2	Design Embedded systems for advanced controllers to real-life situations.
CO3	Design interfacing of the systems with other data handling / processing systems.
CO4	Appreciate engineering constraints like energy dissipation, data exchange speeds etc.

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

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

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

UNIT IV: RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems

UNIT V: Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling. Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

TEXT BOOKS:

1. A. S. Berger, Embedded Systems Design: An Introduction to Processes, Tools and Techniques, CMP Books.

REFERENCE BOOKS:

1. Q. Li and C. Yao, Real-Time Concepts for Embedded Systems, CMP Books.
2. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing, and System Design, PE.
3. Mazidi, The 8051 Microcontroller and Embedded Systems, PE.

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 356G	Image Analysis and Pattern Recognition	3-0-0-0

COURSE OBJECTIVES: To give to the students notions of the analytic approach to image segmentation and pattern recognition problems through both theory and application motivated examples.

COURSE OUTCOMES (COs)

CO1	Apply the definitions of the image classification and analysis problem to common problems in computer vision.
CO2	Explain the basics of object recognition and image search, object detection techniques, motion estimation, object tracking in video using convolutional filters.
CO3	Implement learning algorithms for supervised and unsupervised tasks.
CO4	Describe and model data to solve problems in regression and classification

UNIT I: Introduction to image classification and analysis problems, Image features, Convolutional image processing, Image registration and motion analysis, Mathematical morphology, discrete geometry and combinatorial optimization, Shape analysis and feature extraction.

UNIT II: Bayes Decision Theory: Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features. Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case.

UNIT III: Unsupervised learning and clustering: Criterion functions for clustering; Algorithms for clustering: K- Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation- Maximization method for parameter estimation; Maximum entropy estimation.

UNIT IV: Sequential Pattern Recognition: Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMMs. Non-parametric techniques for density estimation: Parzen-window method; K-Nearest Neighbour method

UNIT V: Dimensionality reduction: Fisher discriminant analysis; Principal component analysis; Factor Analysis. Linear discriminant functions: Gradient descent procedures; Perceptron; Support vector machines. Non-metric methods for pattern classification: Non-numeric data or nominal data; Decision

trees: CART

TEXT BOOKS:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.

REFERENCE BOOKS:

1. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.
2. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 401G	Advanced Computer Architecture	3-0-0-0

COURSE OBJECTIVE: To identify performance related parameters. To learn the different multiprocessor issues. To expose the different types of multicore architectures. To understand the design of the memory hierarchy.

COURSE OUTCOMES (COs):

CO1	Parallel processing and pipelining and implementation of pipelining
CO2	To understand data and data network mechanisms
CO3	To understand loosely and tightly coupled microprocessors
CO4	To understand multithreaded processors

UNIT I: Overview of Parallel Processing and Pipelining Processing, study and comparison of uni-processors and parallel processors, Conventional and Explicitly Parallel Instruction Computing (EPIC) architecture, Constraints of conventional architecture.

UNIT II: Principles and implementation of Pipelining, Classification of pipelining processors, Pipeline Architecture, Study and comparison of processors with and without pipelining, General pipelining reservation table, Pipelining hazards and resolving techniques.

UNIT III: Data buffering techniques, Job sequencing and Collision, Advanced pipelining techniques, loop unrolling techniques, out of order execution, software scheduling, trace scheduling, Predicated execution, Speculative loading, Register Stack Engine, Software pipelining. SIMD Computer Organization Masking and Data network mechanism, Inter PE Communication, Interconnection networks of SIMD, Static Vs Dynamic network, cube hyper cube and Mesh Interconnection network.

UNIT IV: Microprocessor Architectures, study and comparison of Loosely and Tightly coupled multiprocessors. Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping.

UNIT V: Study of Architecture of Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions, Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming.

TEXT BOOKS:

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" Mcgraw Hill international Edition.
2. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill References:

REFERENCE BOOKS:

1. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition.
2. Kai Hwang, Scalable Parallel Computing.
3. Harrold Stone, High performance computer Architecture.
4. Richard Y. Kain, Advanced Computer Architecture

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 402G	Internet of Things	3-0-0-0

COURSE OBJECTIVES: To have devices that self report in real-time, improving efficiency and bringing important information to the surface more quickly than a system depending on human intervention.

COURSE OUTCOMES (COs)

CO1	Understand general concepts of Internet of Things
CO2	Recognize various devices, sensors and applications
CO3	Analyze various M2M and IoT architectures
CO4	Evaluate design issues in IoT applications

UNIT I: Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

UNIT II: M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT,

UNIT III: M2M vs IoT An Architectural Overview–Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT.

UNIT IV: IoT Reference Architecture- Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world- Introduction, Technical design Constraints.

UNIT V: Domain specific applications of IoT: Home automation, Industry applications, Surveillance applications, Other IoT application.

TEXT BOOKS:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

REFERENCES BOOKS:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, 1st Edition, VPT, 2014

2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

3. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 407G	Multimedia Technology	3-0-0-0

COURSE OBJECTIVES: To introduce the various aspects of multimedia components like Images, audio, sound and computer graphics and to provide hands-on training in the use of 2D using Image Editing tools with software and 2D animation.

COURSE OUTCOMES (COs)

CO1	Understand the concept of multimedia and its impact on various industries and applications
CO2	Recognize different image formats and understand image color schemes
CO3	Understand temporal relationships and factors affecting synchronization accuracy
CO4	Explain image representation, segmentation, and similarity-based retrieval techniques
CO5	Understand content design and development principles in multimedia

UNIT I: Introduction: Multimedia today, Impact of Multimedia, Multimedia Systems, Components and Its Applications **Text and Audio**: Text: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption; Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI

UNIT II: Image and Video: Image: Formats, Image Color Scheme, Image Enhancement; Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture, and Computer based Animation.

UNIT III: Synchronization: Temporal relationships, synchronization accuracy specification factors, quality of service Storage models and Access Techniques [(4L] Magnetic media, optical media, file systems (traditional, multimedia) Multimedia devices – Output devices, CD-ROM, DVD, Scanner, CCD

UNIT IV: Image and Video Database: Image representation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- k-d trees, R-trees, quad trees; Case studies- QBIC, Virage. Video Content, querying, video segmentation, indexing

UNIT V: Document Architecture and Content Management: Content Design and Development, General Design Principles Hypertext: Concept, Open Document Architecture (ODA), Multimedia and Hypermedia Coding Expert Group (MHEG), Standard Generalized Markup Language (SGML), Document Type Definition (DTD), Hypertext Markup Language (HTML) in Web Publishing. **Multimedia Applications:** Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, media editors.

TEXT BOOKS:

1. Ralf Steinmetz and Klara Nahrstedt , Multimedia: Computing, Communications & Applications ,

Pearson Ed.

REFERENCE BOOKS:

1. Nalin K. Sharda , Multimedia Information System , PHI.

2. Fred Halsall , Multimedia Communications , Pearson Ed.

3. Koegel Buford , Multimedia Systems , Pearson Ed.

4. Fred Hoffstetter , Multimedia Literacy , McGraw Hill.

5. Ralf Steinmetz and Klara Nahrstedt , Multimedia Fundamentals: Vol. 1- Media Coding and Content

Processing , PHI.

6. J. Jeffcoate , Multimedia in Practice: Technology and Application , PHI

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 403G	Digital Image Processing	2-0-1-0

COURSE OBJECTIVES: To understand image analysis algorithms. To expose students to current applications in the field of digital image processing.

COURSE OUTCOMES (COs):

CO1	To introduce the concepts of Digital Image Processing and basic analytical methods to be used in image processing.
CO2	To familiarize students with image enhancement, Compression and restoration Techniques.
CO3	To introduce segmentation and morphological processing techniques.
CO4	Give the students a taste of the applications of the theories taught in the subject.

UNIT I: Digital Image Fundamentals and Transforms: Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar.

UNIT II: Image Enhancement Techniques: Spatial Domain methods: Basic grey level transformation– Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing, sharpening filters – Laplacian filters – Frequency domain filters: Smoothing – Sharpening filters – Homomorphic filtering.

UNIT III: Image Compression: Lossless compression: LZW coding – Bit plane coding- predictive coding- DPCM. Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG, Basics of Vector quantization, Self Organizing Feature Maps.

UNIT IV: Image Segmentation: Point, Line and Edge Detection. Use of Robert, Canny, Sobel, Perwitt and Laplacian of Gaussian operators for edge detection. – Thresholding – Region Based segmentation– Region Growing, Region Splitting and Merging.

List of some basic practicals:

- Simulation and Display of an Image, Negative of an Image(Binary & Gray Scale)
- Implementation of Relationships between Pixels
- Implementation of Transformations of an Image.
- Contrast stretching of a low contrast image, Histogram, and Histogram Equalization.
- Display of bit planes of an Image.

- Display of FFT(1-D & 2-D) of an image.
- Computation of Mean, Standard Deviation, Correlation coefficient of the given Image
- Implementation of Image Smoothening Filters(Mean and Median filtering of an Image)

TEXT BOOK:

1. William K Pratt, Digital Image Processing John Willey (2001)

REFERENCE BOOKS:

1. A.K. Jain, PHI, New Delhi (1995)-Fundamentals of Digital Image Processing.

2. Chanda Dutta Magundar – Digital Image Processing and Applications, Prentice Hall ofIndia, 2000.

3. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing - Pearson Edu 2003.

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 405G	Machine Learning	3-0-0-0

COURSE OBJECTIVES: To be able to formulate machine learning problems corresponding to different applications. To be able to apply machine learning algorithms to solve problems of moderate complexity.

COURSE OUTCOMES (COs):

CO1	Develop an intuition about the problem and problem solving using machine learning
CO2	Get familiar with different machine learning approaches
CO3	Understand approach for machine learning model creation and evaluation
CO4	Understand approaches for model creation and evaluation using neural networks.

UNIT I (Introduction): Machine learning Paradigms: Supervised learning (Classification and Regression Trees, Support vector machines), Unsupervised learning (Clustering), Instance-based learning (K-nearest Neighbor, Locally weighted regression, Radial Basis Function), Reinforcement learning (Learning Task, Q-learning, Value function approximation, Temporal difference learning).

UNIT II (Decision Tree Learning): Decision tree representation, appropriate problems for decision tree learning, Univariate Trees (Classification and Regression), Multivariate Trees, Basic Decision Tree Learning algorithms, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning. Bayesian Learning: Bayes theorem and concept learning, Bayes optimal classifier, Gibbs algorithms, Naive Bayes Classifier.

UNIT III (Artificial Neural Network): Neural network representation, Neural Networks as a paradigm for parallel processing, Linear discrimination, Pairwise separation, Gradient Descent, Logistic discrimination, Perceptron, Training a perceptron, Multilayer perceptron, Back propagation Algorithm. Recurrent Networks.

UNIT IV (Genetic Algorithms): Basic concepts, Hypothesis space search, Genetic programming, Models of evolution and learning, Parallelizing Genetic Algorithms.

UNIT V (Inductive and Analytical Learning): Learning rule sets, Comparison between inductive and analytical learning, Analytical learning with perfect domain theories: Prolog-EBG.

TEXT BOOKS:

1. Mitchell T.M., Machine Learning, McGraw Hill (1997) 2nd ed.
2. Alpaydin E., Introduction to Machine Learning, MIT Press (2010) 2nd ed.

REFERENCE :

1. Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag (2006) 2nd ed.
2.. Michie D., Spiegelhalter D. J., Taylor C. C., Machine Learning, Neural and Statistical Classification. Overseas Press (2009) 1st ed.

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 450G	Artificial Neural Networks and Fuzzy Logic	2-0-2-0

COURSE OBJECTIVES: Design and develop applications using neural networks.

COURSE OUTCOMES (COs):

CO1	To trace the historical developments of Artificial Neural Networks (ANN).
CO2	Understand the basic concepts and models of ANN for solving simple pattern recognition problems.
CO3	Analysis of feed forward and feedback neural networks, involving the key concepts of Back propagation learning and Associative memories.
CO4	To formalize the problem and to solve it by using a neural network.

UNIT I: Introduction to Neural Networks: Organization of the Brain, Biological Neuron, Biological and artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential applications of ANN.

UNIT II: Essentials of Artificial Neural Networks: Artificial Neuron Model, Types of Neuron Activation Function, ANN Architectures, Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.

UNIT III: Single and multilayer feed Forward Neural Networks: Introduction, Perception Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perception Networks, Limitations of the Perception Model. Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Learning Difficulties and Improvements.

UNIT IV: Associative Memories: Paradigms of Associative Memory, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, Architecture of Hopfield Network, Storage and Recall Algorithm, Stability Analysis.

List of some basic Practicals:

- Introduction to Neural Network Toolbox.
- Use of Commands for the Initialization, training and simulation of various Artificial Neural Networks
- Designing of several logical gates (AND, OR, NOT, NAND, XOR, XNOR) using Perceptron
- Implement the Delta Rule for learning the Perceptron
- Designing the XOR gate using Back Propagation Artificial Neural Networks

TEXT BOOKS:

1. S. Rajasekharan, G. A. Vijayalakshmi, ―Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications, PHI Publication, 2004.

REFERENCE BOOKS:

1. John Yen and Reza Langan, ―Fuzzy Logic: Intelligence, Control and Information, Pearson, 2004.

2. Mohamad H. Hassoun, Fundamentals of Artificial Neural Networks, MIT Press.

3. Jian-Kang Wu, ―Neural Networks and Simulation methods, CRC Press.

4. B. Yegnanarayana, ―Artificial Neural Networks‖, Prentice Hall India.

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 453G	Cyber Forensics	3-0-0-0

COURSE OBJECTIVES: To learn investigation tools and techniques, analysis of data to identify evidence, Technical Aspects & Legal Aspects related to cybercrime.

COURSE OUTCOMES (COs):

CO1	Understand the basics of computer forensics
CO2	Analyze and validate forensics data
CO3	To learn to analyze and validate forensics data
CO4	Identify the vulnerabilities in a given network infrastructure

UNIT I: Introduction To Computer Forensics : Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II: Evidence Collection And Forensics Tools : Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT III: **Analysis And Validation** : Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

UNIT IV: Ethical Hacking : Introduction to Ethical Hacking - Foot printing and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats – Sniffing

UNIT V: Ethical Hacking In Web : Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

TEXT BOOKS:

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016.
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015.

REFERENCE BOOKS:

1. John R.Vacca, ―Computer Forensics‖, Cengage Learning, 2005
2. MarjieT.Britz, ―Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
3. AnkitFadia ― Ethical Hacking‖ Second Edition, Macmillan India Ltd, 2006

4. Kenneth C.Brancik ―Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group– 2008.

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 454G	Network Security	3-0-0-0

COURSE OBJECTIVES: Identify the components associated with computer networks. To know cryptographic techniques and how it keeps a computer secure and safe from viruses.

COURSE OUTCOMES (COs):

CO1	To have knowledge about vulnerabilities on a network
CO2	To have knowledge about Secret key and Public Key
CO3	To have knowledge about Hash Functions and the way they work
CO4	To have knowledge about authentication on a network
CO5	To have knowledge about security policies

UNIT I: Introduction: Attacks, Services and Mechanisms, Security Attacks, Security Services, Integrity check, **Secret Key Cryptography:** Block Encryption, DES rounds, S-Boxes IDEA: Overview, comparison with DES, Key expansion, IDEA rounds, Uses of Secret key Cryptography; ECB, CBC, OFB, CFB, Multiple encryptions DES**.**

UNIT II: Hash Functions and Message Digests: Length of hash, uses, algorithms (MD2, MD4, MD5, SHS) MD2: Algorithm (Padding, checksum, passes.) MD4 and 5: algorithm (padding, stages, digest computation.) SHS: Overview, padding, stages.

UNIT III: Public key Cryptography: Algorithms, examples, Modular arithmetic (addition, multiplication, inverse, and exponentiation) RSA: generating keys, encryption and decryption. Other Algorithms: PKCS, Diffie-Hellman, El-Gamal signatures, DSS, Zero-knowledge signatures

UNIT IV: Authentication: Password Based, Address Based, Cryptographic Authentication. Passwords in distributed systems, on-line vs offline guessing, storing. Cryptographic Authentication: passwords as keys, protocols, KDC's Certification Revocation, Interdomain, groups, delegation. Authentication of People: Verification techniques, passwords, length of passwords, password distribution, smart cards, biometrics.

UNIT V: Security Policies and Security Handshake Pitfalls: What is security policy, high and low level policy, user issues? Protocol problems, assumptions, Shared secret protocols, public key protocols, mutual authentication, reflection attacks, use of timestamps, nonce and sequence numbers, session keys, one-and two-way public key based authentication**.**

TEXT BOOKS:

1. Atul Kahate, Cryptography and Network Security, McGraw Hill.

REFERENCE BOOKS:

1. Kaufman, c., Perlman, R., and Speciner, M., Network Security, Private Communication in a public world, 2nd ed., Prentice Hall PTR., 2002.

2. Stallings, W. Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR.,2003.

3. Stallings, W. Network security Essentials: Applications and standards, Prentice Hall, 2000. 5. Cryptography and Network Security; McGraw Hill; Behrouz A Forouzan.

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE xxxG	Numerical Methods in Engineering	3-0-0-0

COURSE OBJECTIVE: Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.

COURSE OUTCOMES (COs):

CO1	Understand the networking problem and its solution and understand the essence of layering mechanism of OSI and TCP/IP network models.
CO2	Explore the data link layer and understand the need of various protocols for efficient communication.
CO3	Understand the addressing mechanism of internet and protocols which help smooth functioning of the today's congested internetworked world.
CO4	Understand the security implications in the modern internet and how they are resolved.
CO5	Modeling real world problems and getting the solution using Numerical Methods.

UNIT I: Finite Differences and Interpolation: Difference Table and its usage. The difference operators Δ, ∇ and the operator E. Interpolation with equal intervals, Newton's advancing difference formula. Newton's backward difference formula. Interpolation with unequal intervals. Newton's divided difference formula. Lagrange's interpolation formula.

UNIT II: Central Differences and Inverse interpolation: The central difference operator δ and the averaging operator μ. Relations between the operators. Gauss forward and backward interpolation formula, Sterling's, Bessel's, Laplace and Everett's formulae, Newton's divided difference formula, Lagrange's inverse interpolation formula

UNIT III: Numerical solution of algebraic and Transcendental Equations and Numerical differentiation &Numerical Integration: Graphic Method, Regula-Fast method, Balzano's Process of bisection of intervals, Newton-Raphson Method and its geometrical significance. Numerical differentiation of a function. Differential coefficient of a function in terms of its differences. Numerical Integration, General Quadrature Formula, Trapezoidal rule, Simpson's one-third and three-eight rules, Weddles' rule, Euler- Maclaurin expansion formula.

UNIT IV: Difference Equations and Numerical Solution of ordinary differential equations: Linear homogeneous and non-homogeneous difference equations of ordern with constant coefficient, and their solution, methods of undetermined coefficient. Numerical solution of ordinary differential equations, Picard's method. Taylors series method, Euler's method, Runge-Kutta Method.

UNIT V: Numerical solution of simultaneous equations and Eigen value problem: Gauss elimination

method, Gauss Jordon method, Gauss-Jacobi and Gauss-Seidel iteration methods, power methods for solving Eigen value problems.

TEXT BOOKS:

1. Jain M.K., Iyengar S.R., Jain R.K., Numerical Methods for Scientists and Engineering, Wiley Eastern Ltd.

REFERENCE BOOKS:

1. Scarborough S.C., Mathematical Numerical Analysis, Oxford and I BH publishing Company.
1. Sastry S.S., Introductory methods in Numerical Analysis, Prentice Hall of India.
2. Jain M.K., Numerical Solution of Differential equations, New Age International Publishers.
3. Stanton R.G., Numerical Methods for Science & Engineering, Prentice Hall of India

For batches admitted in 2023 and onwards

Course Code:	Course Title:	L-T-P-S
ECE 455G	Introduction to Artificial Intelligence	3-0-0-0

COURSE OBJECTIVES: Identify problems where artificial intelligence techniques are applicable. Apply selected basic AI techniques; judge applicability of more advanced techniques.

COURSE OUTCOMES (COs)

CO1	To learn the distinction between optimal reasoning Vs. human like reasoning.
CO2	To understand the concepts of state space representation, exhaustive search, heuristic
CO3	search together with the time and space complexities.
CO4	To learn different knowledge representation techniques.
CO5	Analyze Supervised Learning Vs. Learning Decision Trees

UNIT I: Introduction to AI - Intelligent Agents, Problem-Solving Agents, Searching for Solutions -Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.

UNIT II: Games - Optimal Decisions in Games, Alpha–Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, Logic Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

UNIT-III : First-Order Logic - Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution. Knowledge Representation: Ontological Engineering, Categories and Objects, Events.

UNIT-IV: Planning - Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Hierarchical Planning.

UNIT-V: Probabilistic Reasoning: Acting under Uncertainty, Basic Probability Notation Bayes' Rule and Its Use, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Approximate Inference in Bayesian Networks, Relational and First- Order Probability.

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson.

REFERENCE BOOKS:

1. Artificial Intelligence, 3rd Edn., E. Rich and K. Knight (TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education