SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
(AUTONOMOUS)

(Approved by AICTE, New Delhi, Affiliated to JNTUK, Kakinada)

Accredited by NAAC with 'A+' Grade.

Recognised as Scientific and Industrial Research Organisation

SRKR MARG, CHINA AMIRAM, BHIMAVARAM – 534204 W.G.Dt., A.P., INDIA

Regulation: R23	**III / IV - B.Tech. I - Semester**

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE

(With effect from 2023-24 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
B23EC3101	Analog & Digital IC Applications	PC	3	0	0	3	30	70	100
B23EC3102	Antennas and Wave Propagation	PC	3	0	0	3	30	70	100
B23EC3103	Digital Communications	PC	3	0	0	3	30	70	100
#PE-I	Professional Elective-I	PE	3	0	0	3	30	70	100
#OE-I	Open Elective- I	OE	3	0	0	3	30	70	100
B23EC3110	Analog & Digital IC Applications Lab	PC	0	0	3	1.5	30	70	100
B23EC3111	Analog and Digital Communication Lab	PC	0	0	3	1.5	30	70	100
B23BS3101	Soft Skills	SEC	0	1	2	2	30	70	100
B23EC3112	Design of PCB and Antenna Lab(Tinkering Lab)	ES	0	0	2	1	30	70	100
B23EC3113	Evaluation of Community Service Internship	PR	--	--	--	2	--	50	50
		TOTAL	**15**	**1**	**10**	**23**	**270**	**680**	**950**

	Course Code	Course
#PE-I	B23EC3104	CMOS Digital Integrated Circuits Analysis & Design
	B23EC3105	Electronic Measurements & Instrumentation
	B23EC3106	Biomedical Instrumentation
	B23EC3107	Digital System Design
	B23EC3108	Artificial Intelligence
	B23EC3109	MOOCS
#OE-I	Student has to study one Open Elective offered by AIDS or AIML or CE or CIC or CSBS or CSG or CSE or CSIT or EEE or ME or IT or S&H from the list enclosed.	

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3101	PC	3	--	--	3	30	70	3 Hrs.

ANALOG AND DIGITAL IC APPLICATIONS

(For ECE)

Course Objectives: Students are expected to

1.	To design linear and non-linear applications of operational amplifiers.
2.	To analyze the concepts of Active filters and oscillators.
3.	To design the basic applications using 555 IC Timer.
4.	To analyze the concepts of Analog to digital and Digital to Analog converters
5.	To design Combinational & Sequential Logic Design using different ICs.

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

S.No	Outcome	Knowledge Level
1.	**Understand** the basic building blocks of Op-Amp and Illustrate DC and AC performance characteristics of Op-Amp.	K3
2.	**Analyze** linear and non-linear applications of Op-Amp.	K3
3.	**Analyze** different applications of 555 Timer and IC 565.	K4
4.	**Analyze** the operation & characteristics of data converters.	K4
5.	**Examine** various 74XX ICs.	K4

SYLLABUS

UNIT-I (12Hrs)	**Introduction to Operational Amplifier:** Block diagram of Op-Amp, equivalent circuit, Pin diagram, Ideal Op-Amp Characteristics, Basic definitions of Op-Amp parameters, open and closed loop configurations- Inverting, Non-Inverting, Differential Amplifier, Applications of op-amp- Summing, scaling and averaging amplifiers, voltage follower, Differentiators and Integrators, Logarithmic amplifier, Comparators, Schmitt Trigger,: Square wave Generators
UNIT-II (10 Hrs)	**Active filters and Oscillators:** Active filters: Design of First and second order active Low-pass and high pass filters, Bandpass, Bandstop and All Pass Filters, Op Amp Phase Shift oscillator, Wein-bridge oscillator, Quadrature Oscillator, Voltage to current and current to voltage converters.
UNIT-III (12 Hrs)	**Specialized ICs:** Introduction, Block diagram, 555 timer as an Astable and Monostable Multivibrator, Applications of 555 Timer as Monostable multivibrator- Frequency divider, Pulse stretcher, Missing pulse detector, Linear ramp generator, Pulse width modulation, Applications of 555 Timer as Astable Multivibrator- Square wave oscillator, FSK Generator, Schmitt trigger. IC 565: Block diagram of PLL and applications of PLL, IC 566: Functional diagram of voltage controlled oscillator (IC 565).

UNIT-IV (10 Hrs)	**Data Converters:** Introduction, Basic DAC techniques, Different types of DACs- Weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, Different Types of ADCs - Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC, DAC and ADC Specifications.
UNIT-V (10 Hrs)	**Combinational & Sequential Logic Design:** Combinational Logic Design: Decoder (74x138), Priority Encoder (74x148), Multiplexer (74x151), Sequential Logic Design: D flip-flop (IC7474), JK Flip-flop (IC7476), shift register using IC7474, Universal shift Register (IC74X194), 3-bit synchronous up counter using IC 7476, Asynchronous Decade counter using IC 7476.
Textbooks:	
1.	Ramakanth A. Gayakwad, Op-Amps & Linear ICs, 4th Edition, Pearson, 2017.
2.	Wakerly J.F. Digital Design: Principles and Practices, 4th Edition, Pearson India, 2008.
Reference Books:	
1.	D. Roy Choudhury, Linear Integrated Circuits, 2nd Edition, New Age International Private Limited, 2003.
2.	R. P. Jain, Modern Digital Electronics, McGraw Hill Education (India Private Limited), 4th edition, 2012.
3.	Sergio Franco, Design with Operational Amplifiers & Analog Integrated Circuits, 3rd edition, McGraw Hill, 1988.
4.	M. Morris Mano, Digital Design, 3rd Edition, PHI, New Delhi.
e-Resources	
1.	https://www.geeksforgeeks.org/combinational-and-sequential-circuits/

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3102	PC	3	--	--	3	30	70	3hrs

ANTENNAS & WAVE PROPAGATION

(For ECE)

Course Objectives: Students are expected to

1.	Understand the radiation mechanism of antennas and to learn about basic parameters like impedance, gain, directivity, bandwidth, effective length, beam width and radiation pattern etc.,
2.	Derive fields and power radiated by elemental antenna, Half wave dipole, quarter wave monopole and values of their radiation resistance.
3.	Understand the necessity of antenna arrays and to learn about theory of uniform linear arrays, broad side and end fire arrays, non-uniform linear arrays like binomial arrays and pattern multiplication
4.	Acquire knowledge about practical HF, VHF, UHF and Microwave antennas and be able to Design practical antennas.
5.	Acquire knowledge about various antenna measurements and be able to conduct different types of antenna measurements.
6.	Gain knowledge about various types of radio wave propagation like Ground wave, Sky wave, Space wave and be able to design different types of communication links

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

S.No	Outcome	Knowledge Level
1.	**Understand** Radiation mechanism and identify antenna parameters and derive expressions for antenna parameters.	K2
2.	**Analyze** and design Antenna arrays.	K4
3.	**Determine** wire and aperture antennas for different communication applications	K3
4.	**Understand** various antenna measurements and come up with conclusions about antenna parameters and performance.	K2
5.	**Determine** characteristics of radio wave propagation and be able to model different types of communication links for different frequency bands.	K3

SYLLABUS

UNIT-I (10Hrs)	**Fundamentals of Antennas & Radiation from Antennas:** Functions and properties of antennas, antenna parameters, basic antenna elements, radiation mechanism, radiating fields of alternating current element, radiated power and radiation resistance of current element, different types of current distribution on linear antennas, radiated fields, radiated power and radiation resistance of half-wave dipole and quarter – wave monopole, directional characteristics of dipole antennas.
UNIT-II (09 Hrs)	**Linear Arrays:** Uniform linear arrays, field strength of a uniform linear arrays, locations of principal maximum, nulls and secondary maxima, first side lobe level, analysisofbroadsideandend-firearrays,Patternmultiplication,binomialarrays,effect of earth on vertical patterns, Antenna array synthesis– Woodward Lawson method.

UNIT-III (08Hrs)	**HF,VHF & UHF Antennas:** Folded dipole, Yagi-Uda antenna, Log periodic antenna, Loop and Helical Antennas. **Microwaveantennas:**parabolicreflector,feedsystemsforparabolicreflector,hornantennas,slotantennas and impedance of slot antennas, Babine's principle and Micro strip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas – Geometry and Parameters, Characteristics of Microstrip Antennas.
UNIT-IV (10 Hrs)	**Antenna measurements:** Introduction, measurement ranges, antenna impedance measurements, antenna gain and directivity measurement, measurement of radiation pattern, beam width and SLL, Measurements of Polarization, Measurements of Phase, Measurements of Radiation Resistance
UNIT-V (10Hrs)	**Wave propagation:** Types of radio wave propagation, ground wave propagation and Maxwell's analysis of ground wave propagation, wave tilt of ground wave, structure of ionosphere, refractive index of ionosphere, mechanism of wave bending by ionosphere, critical frequency, MUF, Skip distance, range of space wave propagation, effective earth radius, field strength of space wave.

Textbooks:	
1.	EMwavesandRadiatingsystems–byE.C.JORDANandK.G.Balmain–PHI,NewDelhi.
2.	Antenna theory-by C.A. Balanis, Johnwiley.
Reference Books:	
1.	Antennas and Wave Propagation–ByJ.D.Kraus, McGrawhill.
2.	Antennas and wave propagation–byG.S.NRaju, Pearsoneducation.
3.	Antenna and wave propagation–by K.D.Prasad
e-Resources	
1.	https://www.youtube.com/watch?v=wx_tIvaajAI

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3103	PC	3	--	--	3	30	70	3 Hrs.

DIGITAL COMMUNICATIONS

(For ECE)

Course Objectives: Students are expected to

1.	To introduce the elementary concepts of digital communication systems.
2.	To get introduced with emphasis on different modulation techniques.
3.	Understand the effect of noise on signal transmission.
4.	To learn about optimum detection and probability of error.
5.	To compare the performance of two digital modulation techniques and introduce the elementary concept of spread spectrum modulation system.

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

S.No	Outcome	Knowledge Level
1.	**Analyze** the basic concepts of sampling and digital communication systems.	K4
2.	**Analyze** the concepts of binary and M-ary modulation techniques.	K4
3.	**Apply** the knowledge of signals & systems and evaluate the performance of various filters in the presence of noise.	K3
4.	**Compute** the probability of error of basic digital modulation techniques to evaluate their optimal performance.	K3
5.	**Analyze** the error performance of two digital modulation techniques and understand the concept of spread spectrum communication system.	K4

SYLLABUS

UNIT-I (10Hrs)	**Digital Representation of Analog Signal:** Sampling, Digital representation of analog signal: Quantization of signals, Quantization error, Pulse Code Modulation, Companding, T1 Digital system, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation
UNIT-II (10 Hrs)	**Digital Modulation and Transmission:** Binary Phase-Shift Keying, Differential Phase-Shift Keying, Differentially Encoded PSK (DEPSK), Quadrature Phase-Shift Keying (QPSK), M-ary PSK, Binary Frequency Shift Keying, Comparison of BFSK and BPSK, M-ary FSK, Minimum Shift Keying (MSK)
UNIT-III (10 Hrs)	**Mathematical Representation of Noise:** Some Sources of Noise, Frequency-domain representation of Noise, Spectral Components of Noise, Response of a Narrowband Filter to Noise, Effect of a Filter on the Power Spectral Density of Noise, Linear Filtering, Noise Bandwidth, Narrowband representation of noise, Power Spectral Density of Quadrature Components

UNIT-IV (10 Hrs)	**Optimal Reception of Digital Signal:** A baseband Signal Receiver, Probability of Error, Optimum Receiver for both Baseband and Pass band-Calculation of optimum filter Transfer function, Matched filter, Probability of Error of the Matched Filter, Correlator, Calculation of Probability error of PSK, FSK , QPSK and its Comparison.
UNIT-V (10 Hrs)	**a) Noise in Pulse Code Modulation and Delta Modulation Systems**: PCM Transmission, Calculation of Signal-to-Noise Ratio in PCM, Delta Modulation (DM) Transmission, Calculation of Signal-to-Noise Ratio in DM, Comparison of PCM and DM. **b) Introduction to Spread Spectrum Modulation:** Direct Sequence (DS) Spread Spectrum, Use of Spread Spectrum with Code Division Multiple Access (CDMA), Ranging using DS Spread Spectrum, Frequency Hopping Spread Spectrum, Generation & Characteristics of PN Sequence.

Textbooks:	
1.	Principles of Communication Systems by Herbert Taub, Donald LSchilling and Goutam Saha, 3rd edition, Tata McGraw- Hill Publications, 2008 NewDelhi.
2.	Digital Communications by Simon Haykins JohnWiley,2005
Reference Books:	
1.	Digital and Analog Communication Systems Sam Shanmugam, John Wiley,2005.
2.	Modern Analog and Digital Communications by B.P.Lathi, Oxford reprint, 3rd Edition, 2004.
e-Resources	
1.	https://mrcet.com/downloads/digital_notes/ECE/III%20Year/DIGITAL%20COMMUNICATIONS.pdf
2.	https://www.iare.ac.in/sites/default/files/iare-dc%20lecture%20notes%20final.pdf

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3104	PE	3	--	--	3	30	70	3 Hrs.

CMOS DIGITAL INTEGRATED CIRCUITS ANALYSIS AND DESIGN

(For ECE)

Course Objectives: Students are expected to

1.	To understand MOSFET fundamentals, analyze scaling effects, and apply VLSI design and inverter principles.
2.	To understand MOSFET fabrication, analyze layout design, and apply scaling in logic circuits.
3.	To understand switching behavior, analyze timing delays, and apply power dissipation concepts in CMOS circuits.
4.	To understand sequential circuits, analyze timing constraints, and apply clocking techniques.
5.	To understand memory circuits, analyze SRAM/DRAM, and apply efficient storage designs.

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

S.No	Outcome	Knowledge Level
1.	**Discuss** MOSFETs, examine their characteristics, and develop inverters using VLSI design methodologies.	K2
2.	**Study** fabrication, assess layouts, and design scaled logic circuits.	K3
3.	**Explain** switching dynamics, evaluate delay effects, and design CMOS inverters with power optimization.	K3
4.	**Describe** MOS logic, evaluate delays, and design efficient clocking schemes.	K2
5.	**Describe** memory types, evaluate designs, and develop optimized storage circuits.	K2

SYLLABUS

UNIT-I (12Hrs)	**Introduction MOS Inverters (Static Characteristics):** The Metal Oxide Semiconductor (MOS) Structure, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances, VLSI Design Methodologies and Design Flow, Introduction to Inverters, Resistive-Load Inverter, Inverters with n-type MOSFET Load and CMOS Inverter, Numerical.
UNIT-II (10 Hrs)	**Fabrication of MOSFETs and Layout Design Concepts:** Introduction, Fabrication Process Flow: Steps, The CMOS nwell Process, Layout Rules, Full-Custom Mask Layout Design. **Combinational Logic Circuits and Layouts:** NAND2 gate and NOR2 gate, Boolean functions of multiple input variables, Introduction to full-custom and semi-custom design approaches.

UNIT-III (10 Hrs)	**Switching Characteristics and Interconnect Effects:** Introduction, Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitic, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.
UNIT-IV (10 Hrs)	**Sequential MOS Logic Circuits:** Introduction, Behaviour of Bi-stable Elements, The SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop, Sequencing static circuits, Sequencing Methods, Max-Delay Constraints, Min-Delay Constraints, Time Borrowing, Clock Skew, Problems on Max and Min Delay Constraints at design level.
UNIT-V (10 Hrs)	**Semiconductor Memories:** Introduction, Static Read-Write Memory (SRAM) Circuits, Dynamic Reas-Write Memory (DRAM) Circuits.
Textbooks:	
1.	Sung-Mo (Steve) Kang, Yusuf Leblebigi, "CMOS Digital Integrated Circuits Analysis and Design", Tata McGraw-Hill Education, 2003.
2.	Neil Weste and David Harris,"CMOS VLSI Design", Pearson Education, 3rd Edition, 2006.
Reference Books:	
1.	Essentials of VLSI Circuits and Systems by Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2.	Digital Integrated Circuits, Jan M. Rabaey, Anantha Chandrakasan and orivoje Nikolic,2nd edition, 2016
e-Resources	
1.	https://onlinecourses.nptel.ac.in/noc21_ee09/preview

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3105	PE	3	--	--	3	30	70	3 Hrs.

ELECTRONICMEASUREMENTS AND INSTRUMENTATION

(For ECE)

Course Objectives: Students are expected to

1.	Select the instrument to be used based on the requirements.
2.	Understand and analyze the different types of transducers.
3.	Understand the design of oscilloscopes for different applications.
4.	Understand the principle of operation and working of various types of bridges for measurement of parameters
5.	Understand and analyze different signal generators and analyzers.

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

S. No	Outcome	Knowledge Level
1.	**Evaluate** basics of measurement systems, principle of basic meter	K4
2.	**Design** different transducers for measurements of different parameters.	K3
3.	**Examining** a signal / waveform with different oscillators.	K3
4.	**Use** bridges of many types and measure appropriate parameters.	K3
5.	**Evaluate** how a signal can be generated using different types of meters.	K4

SYLLABUS

UNIT-I (10Hrs)	**Qualities of Measurements:** Introduction, Measurement standards, Performance characteristics of instruments, Static characteristics, Accuracy, Resolution, Precision, expected value, Error, Sensitivity. Errors in Measurement, Types of static errors-Gross errors, systematic errors, Instrumental errors, Observational errors, Random errors, Sources of error, Statistical analysis, Dynamic Characteristics-speed of response, Fidelity, Lag and Dynamic error. DC Voltmeters, AC voltmeters, True RMS Responding voltmeter, Electronic Multi meter.
UNIT-II (10Hrs)	**Transducers:** Active & passive transducers: Resistance, Capacitance, inductance; Resistive Transducer, Unbounded resistance wire Strain gauge, bonded resistance wire straingauge,Semiconductorstraingauge,LinearVariableDifferentialTransducer, Piezo electric transducers, Resistance Thermometers, Thermo couples, Thermistors.
UNIT-III (10Hrs)	**Oscilloscopes:** CRT features, Block diagram of oscilloscope, vertical amplifier, horizontal deflection system, sweep, trigger pulse, delay line. Dual beam CRO, Dual traceoscilloscope,samplingoscilloscope,digitalstorageoscilloscope,Lissajous Method of frequency measurement, standard specifications of CRO, CRO probes.

UNIT-IV (8Hrs)	**Bridges:** Measurement of inductance- Maxwell's bridge, Anderson bridge. Measurementofcapacitance-SchearingBridge.Wheatstonebridge.WienBridge, Errors and precautions in using bridges.
UNIT-V (10Hrs)	**Signal Generator:** Introduction, fixed frequency AF oscillator, variable frequency AF oscillator,BasicStandardsignalgenerator,AFsineandsquarewavesignal generators,FunctionGenerators,Squarepulse,Randomnoise,sweep,Arbitrary Wave form. Introduction to Wave Analyzers, Harmonic Distortion Analyzers.
Textbooks:	
1.	Electronic instrumentation, second edition-H.S.Kalsi,TataMcGrawHill,2004.
2.	ModernElectronicInstrumentationandMeasurementTechniques–A.D.Helfrickand, D.W.Cooper,PHI,5th Edition,2002.
Reference Books:	
1.	Electronic Instrumentation &Measurements-David A.Bell, PHI,2ndEdition,2003.
2.	ElectronicTestInstruments,AnalogandDigitalMeasurements-RobertA.Witte, PearsonEducation,2nd Ed.,2004.
e-Resources	
1.	https://nptel.ac.in/courses/108/105/108105153/

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3106	PE	3	--	--	3	30	70	3 Hrs.

BIO-MEDICAL INSTRUMENTATION

(For ECE)

Course Objectives: Students are expected to

1.	To provide a foundational understanding of human physiological systems and the basic principles of biomedical instrumentation.
2.	To impart knowledge on the measurement of physiological parameters and the use of various biomedical sensors and transducers.
3.	To familiarize students with modern diagnostic and therapeutic equipment, imaging systems, biotelemetry, and safety standards in medical instrumentation.

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

S.No	Outcome	Knowledge Level
1.	**Demonstrate** a foundational understanding of the anatomy and physiology of the human body.	K2
2.	**Apply** knowledge of different techniques used for measuring various physiological parameters.	K3
3.	**Explain** modern imaging techniques employed in medical diagnosis and identify the diverse therapeutic equipment utilized in the biomedical field.	K2
4.	**Understand** and apply bio-telemetry principles for transmitting bioelectrical variables.	K3
5.	**Analyze** patient safety measures and evaluate recent advancements in the medical field.	K4

SYLLABUS

UNIT-I (12Hrs)	**Introduction:** Factors to be considered in the design of medical instrumentation systems, Basic objectives of medical instrumentation system, Physiological systems of human body, Sources of Bioelectric potentials: Resisting and Action Potentials, Propagation of Action Potentials, The Bioelectric Potentials. Electrodes: Electrode theory, Bio Potential Electrodes, Biochemical Transducers, Introduction to bio-medical signals
UNIT-II (10 Hrs)	**The Cardiovascular System**: The Heart and Cardiovascular System, The Heart, Blood Pressure, Characteristics of Blood Flow, Heart Sounds, Cardio Vascular Measurements, Electrocardiography, Measurement of Blood Pressure, Measurement of Blood Flow and Cardiac output, Plethysmo graphy, Measurement of Heart Sounds, Event detection, PQRS & T-Waves in ECG, the first & second Heart beats, ECG rhythm analysis, the di-crotic notch in the carotid pulse detection of events and waves, analysis of exercise ECG, analysis of event related potentials, correlation analysis of EEG channels, correlation of muscular contraction.

UNIT-III (12 Hrs)	**Patient Care & Monitory and Measurements in Respiratory System**: The elements of Intensive Care Monitory, Diagnosis, Calibration and reparability of Patient Monitoring equipment, other instrumentation for monitoring patients, pacemakers, defibrillators, the physiology of respiratory system, tests and instrumentation for mechanics of breathing, respiratory theory equipment, analysis of respiration**.**
UNIT-IV (10 Hrs)	**Bio telemetry and Instrumentation for the Clinical Laboratory:** Introduction to bio telemetry, Physiological parameters adaptable to bio telemetry, the components of bio telemetry system, implantable units, applications of telemetry in patient care – The blood, tests on blood cells, chemical test, automation of chemical tests.
UNIT-V (10 Hrs)	**X-ray and radioisotope instrumentation and electrical safety of medical equipment:** Generation of Ionizing radiation, instrumentation for diagnostic X-rays, special techniques, instrumentation for the medical use of radioisotopes, radiation therapy - Physiological effects of electrical current, shock Hazards from electrical equipment, Methods of accident prevention, Modern Imaging Systems: Tomography, Magnetic Resonance Imaging System, Ultrasonic Imaging System, Medical Thermo graphy.
Textbooks:	
1.	Biomedical Instrumentation and Measurements C.Cromwell,F.J.Weibell,E.A.Pfeiffer – Pearson education.
2.	Biomedical Signal Analysis – Rangaraj, M. Rangayya – Wiley Inter Science – JohnWilley & Sons Inc.
Reference Books:	
1.	Hand Book of Bio-Medical Instrumentation – R.S. Khandpur, TMH.
2.	Introduction to Bio-Medical Engineering – Domach, Pearson.
3.	Introduction to Bio-Medical Equipment Technology – Cart, Pearson.
e-Resources	
1.	https://nptel.ac.in/courses/108105101

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3107	PE	3	--	--	3	30	70	3 Hrs.

DIGITAL SYSTEM DESIGN

(For ECE)

Course Objectives: Students are expected to

1.	To introduce the fundamental concepts of Verilog Hardware Description Language (HDL).
2.	To enable students to model digital systems using gate-level, dataflow, behavioral, and switch-level abstractions.
3.	To develop skills for writing Verilog code for combinational and sequential digital circuits and to verify designs using test benches and simulation tools.

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

S.No	Outcome	Knowledge Level
1.	**Understand** the language constructs and programming fundamentals of Verilog HDL.	K2
2.	**Choose** the suitable abstraction level for a particular digital design	K3
3.	**Construct** Combinational and sequential circuits in different modelling styles using Verilog HDL	K3
4.	**Design** and synthesize combinational and sequential logic circuits	K4
5.	**Analyze** and Verify the functionality of digital circuits/systems using test benches.	K4

SYLLABUS

UNIT-I (12Hrs)	**Introduction to Verilog HDL and Gate Level Modelling:** Verilog as HDL, Levels of Design Description Basics of Concepts of Verilog, Data Types, System Task, Compiler directives, modules and ports. AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flipflops with Gate Primitives, Delay.
UNIT-II (10 Hrs)	**Behavioural Modelling:** Introduction, structured processors, procedural assignments, timing controls, conditional statements, multi-way branching, loops, sequential and parallel blocks, generate blocks, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in Behavioral model.
UNIT-III (12 Hrs)	**Modelling at Data flow Level:** Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in dataflow model, Switch Level Modelling: Introduction, Basic Transistor Switches, CMOS Switch, Bi-directional Gates, Time Delays with Switch Primitive delays.

UNIT-IV (10 Hrs)	**FSM Design:** Functions, Tasks, User-defined, Primitives: Introduction, Function, Tasks, User-Defined Primitives (UDP), FSM Design (Moore and Mealy Machines), Encoding Style: From Binary to One Hot. Introduction to Synthesis, Synthesis of combinational logic, Synthesis of sequential logic with latches and flip-flops, Synthesis of Explicit and Implicit State Machines
UNIT-V (10 Hrs)	**Components Test and Verification:** Test Bench – Combinational Circuits Testing, Sequential Circuits Testing, Test Bench Techniques, Design Verification, Assertion Verification
Textbooks:	
1.	Samir Palnitkar, "Verilog HDL A Guide to Digital and Synthesis" ,2nd Edition, Pearson Education,2006.
2.	Michael, D. Ciletti, "Advanced digital design with the Verilog HDL", Pearson Education India,2005.
Reference Books:	
1.	Padmanabhan, Tripura Sundari -Design through Verilog HDL, Wiley, 2016
2.	S. Brown, Zvonko – Vranesic, Fundamentals of Digital Logic with Verilog Design, TMH, 3rdEdision 2014.
3.	J. Bhasker, A Verilog HDL Primer 2nd edition, BS Publications, 2001.
e-Resources	
1.	https://nptel.ac.in/courses/117105080

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3108	PE	3	--	--	3	30	70	3 Hrs.

ARTIFICIAL INTELLIGENCE

(For ECE)

Course Objectives: Students are expected to

1.	To introduce the foundational concepts and problem-solving methods in Artificial Intelligence.
2.	To familiarize students with knowledge representation, reasoning, and learning paradigms.
3.	To equip students with AI tools and techniques to solve real-world engineering problems.

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

S.No	Outcome	Knowledge Level
1.	**Understand** the concepts of computational intelligence like machine learning.	K2
2.	**Ability** to get the skill to apply machine learning techniques to address the real time Problems in different areas	K3
3.	**Understand** the Neural Networks and its usage in machine learning application	K2
4.	**Apply** principles and algorithms evaluate models generated from data	K3
5.	**Apply** the algorithms to a real-world problem.	K4

SYLLABUS

UNIT-I (12 Hrs)	What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What are AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System, Characteristics And Issues In The Design Of Search Programs, Additional Problems. Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.
UNIT-II (12 Hrs)	Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.
UNIT-III (10 Hrs)	Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays' Theorem, Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory
UNIT-IV (8 Hrs)	Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts, CYC

UNIT-V (12 Hrs)	Game Playing: Overview, And Example Domain: Overview, Mini Max, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models: Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI

Textbooks:	
1.	Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2.	Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd
Reference Books:	
1.	Nils J. Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann Publishers.
2.	Dan W. Patterson, *Introduction to Artificial Intelligence and Expert Systems*, Prentice-Hall.
e-Resources	
1.	https://nptel.ac.in/courses/106106179

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3110	PC	--	--	3	1.5	30	70	3 Hrs.

ANALOG AND DIGITAL IC APPLICATIONS LAB

(For ECE)

Course Objectives:

1	This laboratory course enables students to get practical experience in design, assembly, and evaluation of Analog and digital integrated circuits & its applications. They will use Multisim to test their electronic designs.

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

S.No	Outcome	Knowledge Level
1	**Design** circuits using Analog ICs for various applications.	K4
2	**Demonstrate** various applications using Digital ICs.	K4
3	**Simulation** and Design of analog Integrated Circuits & digital Integrated Circuits.	K4

SYLLABUS

	Hardware
1	Design of OP AMP Applications – (Implementation of Mathematical functions)
2	Schmitt Trigger Circuits – using IC 741
3	IC 741 Waveform Generators
4	Active Filter Applications – LPF, HPF (first order)
5	IC 555 Timer-Astable Multivibrator Circuits.
6	Basic circuit of a flash type A/D converter
7	RC Differentiator & RC Integrator
	Software
1	Design of OP AMP Applications – (Implementation of Mathematical functions)
2	Schmitt Trigger Circuits – using IC 741
3	IC 741 Waveform Generators
4	Active Filter Applications – LPF, HPF (first order)
5	IC 555 Timer-Astable Multivibrator Circuits.
6	Basic circuit of a flash type A/D converter
7	Design and simulate 8*1 Multiplexer using IC74LS153D.
8	Design and simulate 4 to 2 Priority Encoder using IC74LS08D.
9	Design and simulate shift register using IC74LS194.

Reference Books:

1	Lab manual.
2	Op-Amps and Linear Integrated Circuits" – Ramakant A. Gayakwad

3	"Design with Operational Amplifiers and Analog Integrated Circuits" – Sergio Franco
4	D. Roy Choudhury, Linear Integrated Circuits, 2nd Edition, New Age International Private Limited, 2003.
e-Resources	
1	https://www.youtube.com/watch?v=yt1Fwrc8ysk

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3111	PC	--	--	3	1.5	30	70	3 Hrs.

ANALOG AND DIGITAL COMMUNICATION LAB

(For ECE)

Course Objectives:

1	The purpose of this course is to provide the student with a practical perspective of various analog and digital communication modules.
2	To be familiar with different types of experiments like pre-emphasis, de-emphasis and DSB-SC waveform generators.
3	This lab focuses on the fundamental concepts of Sampling, Pulse modulation, and Digital modulation techniques.

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

S.No	Outcome	Knowledge Level
1	**Design** and implement modulation and demodulation circuits for various analog and digital modulation techniques.	K4
2	**Construct** the circuit and study the characteristics of different transmitter and receiver circuits such as Harmonic generator, pre-emphasis and de-emphasis.	K3
3	**Design**, implement and verify the theoretical concepts of sampling practically.	K4
4	**Analyze** and implement analog to digital converters like PCM, DM.	K4
5	**Analyze** analog and digital modulation techniques using MATLAB tools.	K4

LIST OF EXPERIMENTS

1	Amplitude Modulation and Demodulation. (Hardware implementation)
2	Balanced Modulator (Hardware implementation)
3	Harmonic Generator (Hardware implementation)
4	Pre-Emphasis and De-Emphasis. (Hardware implementation)
5	Design of Active Band Pass Filter (Hardware implementation)
6	Design of Twin-T Network (Hardware implementation)
7	Verification of Sampling Theorem (Hardware implementation)
8	Pulse Code Modulation (Hardware implementation)

9	Differential Pulse Code Modulation (Hardware implementation)
10	Delta Modulation (Hardware implementation)
11	Frequency Shift Keying (Hardware implementation)
12	Phase Shift Keying (Hardware implementation)
13	Frequency Modulation and Demodulation (MATLAB Simulation)
14	Pulse modulation techniques (MATLAB Simulation)
15	Digital Modulation Techniques (MATLAB Simulation)
Reference Books:	
1	Lab manual.
2	Principles of Communication Systems, H.Taub and D.L.Schilling, McGraw Hill,1971
3	Contemporary Communication Systems Using MATLAB, by Gerhard Bauch, JohnG Proakis, and Masoud Salehi
4	Digital Communication Theory, techniques and applications, R.N.Mutagi.
e-Resources	
1	https://in.mathworks.com/matlabcentral/fileexchange/25293-matlab-for-digitalcommunication
2	https://www.mathworks.com/products/communications.html

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23BS3101	SEC		1	2	2	30	70	3 Hrs.

SOFT SKILLS

(For AIDS, CIC, CSIT, CSD, ECE and EEE)

Course Objectives:

1	To familiarise students with soft skills and how they influence their professional growth.
2	To build/refine the professional qualities/skills necessary for a productive career and to instill confidence through attitude building.

Course Outcomes:

S.No	Outcome	Knowledge Level
1	Interpret the essence of key soft skills such as creativity & problem solving, emotional intelligence, leadership qualities, etc.	K2
2	Outline interview essentials for graduate-job prospects.	K2
3	Apply presentation skills in academic and professional settings.	K3
4	Demonstrate knowledge about domain specific industry and the prospective workplace.	K2

SYLLABUS

1	**INTRODUCTION** Introduction to soft skills, definition and meaning, importance and need in personal and professional settings; soft skills vs. hard skills; personality development.
2	**INTRA-PERSONAL AND INTER-PERSONAL COMMUNICATION** Significance of Inter & Intra-Personal Communication; SWOT Analysis; Goal Setting – Guidelines for Goal Setting; Emotional Intelligence; Creativity & Problem Solving; Stress and Time Management; Leadership & Team Work; Building a positive attitude, Social Consciousness.
3	**WRITTEN COMMUNICATION** Resume Preparation: Common resume blunders, Tips for betterment, Resume Review; Report Writing; Writing an SOP (Statement of purpose).
4	**PRESENTATION SKILLS** Importance of Presentation Skills; JAM; Essential guidelines for Group Discussions; Debates; Role Plays; PPTs etc.
5	**INTERVIEW SKILLS** Employability Skills: Knowing about Selection Process; Interview Skills, types of Interviews, E-Interviews, Do's and Don'ts of Interviews, FAQs, Mock Interviews; Awareness about Industries; Importance of researching the prospective workplace.

Text Books:

1	Sherfield, M. Robert et al, Cornerstone Developing Soft Skills,(4th edition), Pearson Publication, New Delhi, 2014.

2	Alka Wadkar, Life Skills for Success,(1st edition), Sage Publications India Private Limited, 2016.
3	Soft Skills : Know Yourself and Know the World by Dr. K. Alex, S. Chand & Company Ltd., New Delhi, 2009.
Reference Books:	
1	Sambaiah.M. Technical English, Wiley Publishers India. New Delhi. 2014.
2	Gangadhar Joshi, From Campus to Corporate, SAGE TEXT, 2015.
3	Alex.K, Soft Skills, 3rd ed. S. Chand Publication, New Delhi, 2014.
4	Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principle and Practice, Oxford University Press, 2009.
5	Emotional Intelligence by Daniel Goleman, Random House Publishing Group, 2012.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3112	ES	--	--	2	1	30	70	3 Hrs.

DESIGN OF PCB AND ANTENNA LAB(Tinkering Lab)

(For ECE)

Course Objectives:

1	To provide knowledge in Printed Circuit Board design using CAD tools for electronic circuits
2	Understand the fundamental concepts of electromagnetic (EM) wave generation and propagation
3	Evaluate the phase and group velocity in various transmission media.
4	Analyze and visualize radiation patterns of different types of antennas including dipole, monopole, reflector, planar, and array antennas.
5	Investigate the performance characteristics such as gain, directivity, VSWR, and bandwidth of various antennas (Yagi-Uda, Helix, etc.).
6	Perform radio wave propagation and path loss calculations in different propagation environments.

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

S.No	Outcome	Knowledge Level
1	**Design** schematics and PCB layouts using CAD tools and verify their functionality.	K4
2	**Demonstrate** the generation and characteristics of electromagnetic waves in practical scenarios.	K2
3	**Calculate** the phase velocity and group velocity in guided and free-space media.	K2
4	**Plot** the radiation patterns of dipole, monopole, and uniform linear array antennas.	K4
5	**Analyze** the performance of Yagi-Uda and Helix antennas in terms of gain, bandwidth, and radiation pattern.	K4
6	**Calculate** path loss in various environments and interpret radio wave propagation characteristics.	K2

LIST OF EXPERIMENTS

PCB

1	Inverting Amplifier& Non-Inverting Amplifier using op-amp
2	Full-wave Rectifier
3	AstablemultivibratorusingIC555
4	MonostablemultivibratorusingIC555
5	Wien bridge Oscillator
6	Full-Adder using half-adders
7	4-bitMODNcounterusingD-Flipflops

8	Automatic Streetlight control
ANTENNA	
1	Generation of EM-Wave
2	Impedance Matching using Smith Chart
3	Calculation of phase and group velocity calculation
4	Plot of Radiation pattern of dipole antenna
5	Plot of Radiation pattern of monopole antenna
6	Plot of Radiation pattern of Uniform Linear Array
7	Measurement of radiation pattern of planar antennas
8	Measurement of radiation pattern of reflector antennas
9	Analysis of co-polarization and cross polarization
10	Performance analysis of Yagi -Uda antenna
11	Performance analysis of Helix antenna
12	Radio wave propagation path loss calculations
Reference Books:	
1	Lab manual.

Regulation: R23	**III / IV - B.Tech. II- Semester**

ELECTORINCS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE

(With effect from 2023-24 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
B23EC3201	VLSI Design	PC	3	0	0	3	30	70	100
B23EC3202	Digital Signal Processing	PC	3	0	0	3	30	70	100
B23EC3203	Microprocessors & Microcontrollers	PC	3	0	0	3	30	70	100
#PE-II	Professional Elective-II	PE	3	0	0	3	30	70	100
#PE-III	Professional Elective-III	PE	3	0	0	3	30	70	100
#OE-II	Open Elective- II	OE	3	0		3	30	70	100
B23EC3218	VLSI Design Lab	PC	0	0	3	1.5	30	70	100
B23EC3219	Microprocessors & Microcontrollers Lab	PC	0	0	3	1.5	30	70	100
B23EC3220	Machine Learning Lab	SEC	0	1	2	2	30	70	100
B23AC3202	Research methodology and IPR	AC	2	--	--	--	30	--	30
B23MC3201	Employability skills	MC	2	--	--	--	30	--	30
		TOTAL	**22**	**1**	**8**	**23**	**330**	**630**	**960**

	Course Code	Course
#PE-II	B23EC3204	Advanced Digital Logic Design and Prototyping on FPGA
	B23EC3205	Embedded Systems with ARM Cortex M3
	B23EC3206	Data Communication & Computer Networks
	B23EC3207	Radar Engineering
	B23EC3208	Machine Learning
	B23EC3209	Smart and Wireless Instrumentation
	B23EC3210	MOOCS-II
#PE-III	B23EC3211	Digital VLSI Layout Design
	B23EC3212	Real Time Operating Systems
	B23EC3213	Cryptography & Network Security
	B23EC3214	Microwave Engineering
	B23EC3215	Analog IC Design
	B23EC3216	Soft Computing Techniques
	B23EC3217	MOOCS-III
#OE-II	Student has to study one Open Elective offered by AIDS or AIML or CE or CIC or CSBS or CSG or CSE or CSIT or EEE or ME or IT or S&H from the list enclosed.	
*Mandatory Industry Internship /Mini Project of 08 weeks duration during summer vacation		

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3201	PC	3	--	--	3	30	70	3 Hrs.

VLSI DESIGN

(For ECE)

Course Objectives: Students are expected to

1.	To acquire knowledge on IC fabrication, MOS transistors, inverters and CMOS technology**.**
2.	To understand MOS/Bi-CMOS design processes, design rules, and layout methodologies**.**
3.	To understand MOS circuit characteristics, delay analysis, and scaling limitations**.**
4.	To study CMOS combinational and sequential logic design, including static and dynamic circuits**.**
5.	To understand FPGA design, architecture, and testability methods.

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

S.No	Outcome	Knowledge Level
1.	**Understand** IC technology, MOS transistor characteristics, inverter design, and CMOS vs. Bi-CMOS comparison.	K2
2.	**Analyze** MOS/Bi-CMOS circuit design rules, stick diagrams, and layout techniques**.**	K3
3.	**Analyze** MOS circuit parameters, delays, capacitances, and scaling effects on device performance.	K3
4.	**Understand** CMOS combinational and sequential circuits using static and dynamic logic.	K2
5.	**Understand** FPGA design concepts and testability techniques like scan design and BIST**.**	K3

SYLLABUS

UNIT-I (10Hrs)	**Introduction**: Introduction to IC Technology, Fabrication process: NMOS, PMOS and CMOS. Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Transconductance, Output Conductance and Figure of Merit. NMOS Inverter, Pull-up to Pull down Ratio for NMOS inverter driven by another NMOS Inverter, and through one or more pass transistors, Alternative forms of pull-up, The CMOS Inverter, Latch-up in CMOS circuits, Comparison between CMOS and Bi-CMOS technology.
UNIT-II (10 Hrs)	**MOS and Bi-CMOS Circuit Design Processes**: MOS Layers, Stick Diagrams, General observations on the Design rules, Lambda based Design rules, 2µm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2µm Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND, NOR and CMOS inverter.

UNIT-III (10 Hrs)	**Basic Circuit Concepts**: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances. **Scaling of MOS Circuits**: Scaling models, Scaling factors for device parameters, Limitations of Scaling on substrate doping, Miniaturization, Interconnect and contact Resistance, Sub-threshold currents and current density.
UNIT-IV (10 Hrs)	**CMOS Combinational and Sequential logic circuit design**: **Static CMOS Design**: Complementary CMOS and its static properties, Ratioed logic, Pass Transistor Logic-Design of logic gates. **Dynamic CMOS Design**: Basic principles, Issues in dynamic logic- charge leakage, charge sharing, Static latches and registers- Latches versus registers, the bistability principle, SR-Flip flops, Multiplexer based latch, Master-slave-edge triggered register.
UNIT-V (10 Hrs)	**FPGA Design**: FPGA design flow, Basic FPGA architecture, FPGA Technologies, Introduction to FPGA Families: Xilinx XC4000 **Test and Testability**: Design for Testability-Path sensitization, Scan Design Techniques-Scan path, Level sensitive scan design (LSSD), Boundary scan test (BST) and Built-In-Self Test.
Textbooks:	
1.	Essentials of VLSI Circuits and Systems by Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2.	Digital Integrated Circuits, Jan M. Rabaey, Anantha Chandrakasan and orivoje Nikolic,2nd edition, 2016
Reference Books:	
1.	FPGA Based System Design- Wayne Wolf, Pearson Education, 2004, Technology and Engineering
2.	CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill Education,2003.
e-Resources	
1.	https://www.engineersgarage.com/vlsi-technology-an-overview/
2.	https://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.htm
3	https://www.powershow.com/viewfl/e5a26-ZDc1Z/Lecture_4_Design_Rules_Layout_and_Stick_Diagram_powerpoint_ppt_presentation
4	https://nptel.ac.in/courses/117106092

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3202	PC	3	--	--	3	30	70	3 Hrs.

DIGITAL SIGNAL PROCESSING

(For ECE)

Course Objectives: Students are expected to

1.	This course introduces students to the basic concepts in digital signal processing and system design with emphasis on the digital filter design.
2.	To provide the student with an ability to compute Discrete Fourier Transform and efficient DFT computation of a time domain signal.
3.	To impart basic filter design concepts of IIR and FIR filters.
4.	To have an insight on various DSP applications and Multirate signal processing concepts.

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

S.No	Outcome	Knowledge Level
1.	**Illustrate** DT signals, systems and their significance and analyze DT-LTI systems using Z-Transform and realize system structures.	K3
2.	**Analyze** DT signals using DFT along with FFT algorithms	K3
3.	**Design** of IIR type of Digital filters as per the specifications	K3
4.	**Design** of FIR type of Digital filters as per the specifications.	K3
5.	**Discuss** briefly about DSP applications and understand basic concepts of multirate signal processing.	K2

SYLLABUS

UNIT-I (10Hrs)	**Discrete-Time Signals and Systems:** Introduction to Digital Signal Processing, Basic elements of a DSP system, Advantages of Digital SP over Analog SP, Discrete-time signals and systems, DT-LTI systems described by Linear constant–coefficient difference equations, Properties & Analysis of DT-LTI systems, Discrete linear convolution, Frequency domain representation of DT Signals and Systems, Review of the Z-transform, Properties, Inverse Z-transform, Analysis of DT LTI systems in Z-Domain, Unilateral Z-transform, Realization of Digital Filters, Direct-I, II, cascade and parallel forms.
UNIT-II (10 Hrs)	**Discrete Fourier Transform (DFT) and Fast Fourier Transform Algorithms (FFT):** Frequency analysis of discrete time signals, DFS, DTFT, Properties of DTFT, DFT, Properties of DFT, Circular and linear convolution of sequences using DFT, Efficient computation of DFT, Radix-2 Decimation-in-Time (DIT) & decimation-in-Frequency (DIF) FFT Algorithms, Inverse DFT using FFT

UNIT-III (8Hrs)	**Design of IIR Digital Filters: General** considerations in Filter design, Butterworth Analog filter approximations, Frequency response specifications; Design of IIR Butterworth digital filters from analog filters, Bilinear Transformation Method, Impulse Invariance Technique, and Low-pass filter Design examples.
UNIT-IV (8 Hrs)	**Design of FIR Digital Filters:** Characteristics of FIR Digital Filters, Design of Linear Phase FIR digital Filters using Windows, Effect of Window selection & filter length on filter frequency response, Design examples, Comparison of IIR and FIR Filters.
UNIT-V (10 Hrs)	**DSP Applications and Fundamentals of Multirate Digital Signal Processing:** Overview of DSP applications, DTMF signal detection, Spectral analysis of sinusoidal signals using FFT, Subband coding of speech signals, Finite precision arithmetic effects. Introduction to Multirate DSP, Basic sampling rate alteration devices: up sampler, down sampler, Time and Frequency domain characterization of up/down samplers, Interpolator and decimator.

Textbooks:	
1.	Alan V. Oppenheim, Ronald W. Schafer, ―Digital Signal Processing‖ – PHI Ed., 2006
2.	John G. Proakis, D.G. Manolakis, ―Digital Signal Processing: Principles, Algorithms and Applications‖, 3rd Ed., PHI, 1996
Reference Books:	
1.	Digital Signal Processing: A Computer-based Approach by Sanjit K. Mitra, McGraw-Hill
2.	Essentials of Digital Signal Processing by B.P lathi ,Roger A. Green, Cambridge University Press, 2014
e-Resources	
1.	https://nptel.ac.in/courses/117102060
2.	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3203	PC	3	--	--	3	30	70	3 Hrs.

MICROPROCESSORS AND MICROCONTROLLERS

(For ECE)

Course Objectives: Students are expected to

1.	To understand the architecture of 8086/8088 Microprocessor and acquire knowledge about microprocessors and study the Architectures of 16-bit Microprocessors.
2.	To be familiar with 8086 assembly language programming.
3.	To understand the architecture of 8051 Microcontroller and the fundamental concepts of Microcontrollers and their architecture
4.	To acquire the knowledge on interrupts, timers, and interfacing with various peripherals configure and develop programs to interfacing peripherals
5.	To study the concepts of ARM processors and their architecture.

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

S.No	Outcome	Knowledge Level
1.	**Understand** the fundamental concepts of Microprocessor and illustrate the architecture of microprocessor and their operation.	K3
2.	**Demonstrate** programming skills in assembly language for Microprocessors.	K3
3.	**Illustrate** the architecture of Microcontroller and their operation.	K3
4.	**Analyze** various interfacing techniques and apply them for the design of Microcontroller-based systems.	K4
5.	**Demonstrate** ARM processor's internal structure and operational mechanisms.	K3

SYLLABUS

UNIT-I (10Hrs)	**Intel 8086 Microprocessor Architecture:** Introduction to INTEL 16-bit Microprocessor, Internal Architecture and Functional description of Intel 8086 Microprocessor, Memory segmentation and physical memory address generation, Status flags and machine control flags of 8086, Minimum mode and Maximum mode pin description.
UNIT-II (10 Hrs)	**8086 Microprocessor Programming:** Register array of 8086 and function of each register, Data addressing modes of 8086 with examples, assembler directives, Instructions, Basic 8086 assembly language programs using data transfer instructions, Arithmetic instructions and string manipulation instructions
UNIT-III (10 Hrs)	**Intel 8051 Microcontroller:** Microprocessors & Microcontrollers Comparison, Overview of 8051 Microcontroller, Internal Block Diagram of 8051, Pin diagram of 8051, Memory Organization, Internal RAM Memory Structure, addressing modes, Classification of Instructions & basic 8051 Assembly Language Programs using Data Transfer and arithmetic Instructions.

UNIT-IV (10 Hrs)	**8051 Microcontroller Timers/counters and Interfacing** Basics of interrupts, 8051 interrupt structure, Timers and Counters, 8051 timers/counters, special function registers, programming 8051 timers in assembly language. **Interfacing to 8051:** External Memory RAM & ROM interfacing, I/O Port Operation, A/D and D/A Convertors, Stepper motor interfacing and LCD Interfacing.
UNIT-V (10 Hrs)	**ARM Architecture:** ARM Processor fundamentals, ARM Architecture – Registers, CPSR, Pipeline, exceptions and interrupts interrupt vector table, Architecture Revisions ARM Processor Families, Introduction to the ARM Instruction Set– Data processing, Branch instructions, load store instructions, Introduction to Thumb instruction set.
Textbooks:	
1.	Microprocessors: The 8086/8088, 80186/80286, 80386/80486 and the PentiumFamily .NileshB.Bahadure, Phi Learning Pvt.Ltd.,2010
2.	The 8051 Microcontroller and Embedded Systems using assembly and C- Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D.Mc Kinlay;PHI,2013/ Pearson, 2013
Reference Books:	
1.	ARM System Developer's Guide.pdf - Google Drive
2.	The 8051 Microcontroller by Kenneth J. Ayala
3.	A.K Ray, K.M.Bhurchandhi, Advanced Microprocessor and Peripherals", Tata McGraw Hill Publications, 2000.
e-Resources	
1.	http://elearn.psgcas.ac.in/nptel/courses/video/108105102/108105102.html

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3204	PE	3	--	--	3	30	70	3 Hrs.

ADVANCED DIGITAL LOGIC DESIGN AND PROTOTYPING ON FPGA

(For ECE)

Course Objectives: Students are expected to

1.	To introduce fundamentals of Digital logic design.
2.	To develop Verilog/VHDL code for ALU, FSM designs and simulate it using Electronic Design Automation (EDA) tools for digital design implementation.
3.	To develop Finite State Machines for practical world examples.
4.	To provide theoretical and practical insights on FPGA board architecture, interfacing and programming.
5.	To develop Digital custom IP-core and prototype FPGA based systems for specific applications.

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

S.No	Outcome	Knowledge Level
1.	**Demonstrate** the fundamental concepts of Advanced digital logic design.	K2
2.	**Develop** Verilog/VHDL code for ALU and FSM designs.	K3
3.	**Design** FSMs for real-time applications.	K4
4.	**Interpret** the concepts of FPGA architecture, interfacing and programming	K2
5.	**Relate** and interface several custom IP cores for FPGA-based system prototyping	K3

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Advanced Digital Logic Design:** Review of digital logic fundamentals, Advanced arithmetic circuits, Sequential circuits. **LAB:** Basic Arithmetic Circuits, Implement the basic ALU circuit in Verilog/VHDL, Simulate and verify the functionality of the ALU circuit using a simulation tool (e.g., ModelSim/Synopsys VCS), Design and Implementation of a 4-bit ALU, Priority Encoder and Decoder (8-to-3, 3-to-8) using a simulation tool Xilinx Vivado.
UNIT-II (10 Hrs)	**Advanced Digital Logic Design development using Verilog/VHDL:** Introduction to Mealy and Moore machine FSM designs, State encoding, Real-time examples. **LAB:** Different FSM design in Verilog e.g. Sequence detector, Design of Sequence Detector using Mealy and Moore FSMs(Example: Detect sequence "1011")
UNIT-III (10 Hrs)	**Advanced FSM digital design used in real world:** Learning one of the examples of advanced FSM. e.g. Vending machine, Traffic Light, Elevators, Alarm clock, ATM machine. Parallel FSMs, **Low Power FSMs,** Optimized FSM in Verilog/VHDL. **LAB:** Simulate and verify the functionality of the real-world FSM example using a simulation tool (e.g., ModelSim / Synopsys VCS)

UNIT-IV (10 Hrs)	**FPGA Architecture and Programming:** - Overview of FPGA architecture, FPGA programming methodologies (JTAG, Serial, etc.), Introduction to FPGA development boards and programming interfaces. **LAB:** Write Verilog code to blink LEDs and control switches on the FPGA board, Program the FPGA board using vendor-specific tools (Vivado, Quartus, etc.)
UNIT-V (10 Hrs)	**Advanced FPGA Components and IP Cores and Prototyping:** Learning Custom IP core development, IP integration and customization, Introduction to FPGA vendor-specific IP cores, learning about FPGA prototyping methodologies and Debugging FPGA designs. **LAB:** Hands-on FPGA projects to reinforce concepts learned throughout the course, Students will design, implement, and prototype FPGA-based systems for various applications.
Textbooks:	
1.	Digital Design and Computer Architecture" by David Money Harris and Sarah L. Harris.
2.	FPGA Prototyping by Verilog Examples" by Pong P. Chu
Reference Books:	
1.	FPGA Based systems Design and practice" by Ming-Bo Lin
2.	FPGA-Based Implementation of Signal Processing Systems" by Roger Woods, John McAllister, and Gaye Lightbody
e-Resources	
1.	https://www.intel.com/content/www/us/en/support/programmable/support-resources/fpga-training/overview.html

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3205	PE	3	--	--	3	30	70	3 Hrs.

EMBEDDED SYSTEMS WITH ARM CORTEX-M

(For ECE)

Course Objectives: Students are expected to

1.	To introduce the fundamentals of embedded systems and ARM Cortex-M architecture.
2.	To familiarize students with the instruction set and programming techniques for ARM Cortex-M.
3.	To understand exception handling, interrupts, and peripheral interfaces.
4.	To explore low-power design techniques, debugging, and RTOS implementation.
5.	To develop hands-on skills in programming ARM Cortex-M microcontrollers for embedded applications.

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

S.No	Outcome	Knowledge Level
1.	**Explain** the characteristics of embedded systems and ARM Cortex-M architecture.	K3
2.	**Develop** assembly and C programs for ARM Cortex-M using Thumb-2 instruction set.	K3
3.	**Implement** exception handling and interrupt-driven applications.	K4
4.	**Analyze** memory management techniques and low-power design methods.	K4
5.	**Demonstrate** debugging techniques and RTOS-based embedded system design.	K4

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Embedded Systems:** Overview of Embedded Systems: Characteristics, Applications, and Challenges, RISC Design Philosophy, Embedded System Hardware Components: Processors, Memory, and Peripherals, Design Considerations: Performance, Power Consumption, Cost, and Reliability, Basics of Embedded Software Development, ARM Processor Families.
UNIT-II (10 Hrs)	**Cortex-M3 Architecture:** Introduction to Cortex-M Series, Block Diagram of Cortex-M3. Registers, Special Registers, Operation Mode, The Memory Map, Advantages of Thumb-2 Instruction Set, Pipeline in Cortex M3.
UNIT-III (10 Hrs)	**Exceptions and Interrupts Handling:** Interrupts vs Exceptions, Exception Types, Definitions of Priority, Nested Vectored Interrupt Controller (NVIC), Interrupt/Exception Sequences: Stacking, Nested Interrupts, Interrupt latency, Advanced Interrupt-Handling Features, Direct Memory Access (DMA).

UNIT-IV (10 Hrs)	**Instruction Set and Programming** Instruction Syntax, Use of Suffixes, Instruction Set, C vs. Assembly in Embedded Systems, The Interface between Assembly and C, CMSIS, Organization of CMSIS, Benefits of CMSIS.
UNIT-V (10 Hrs)	**Advanced ARM Cortex-M Topics:** SYSTICK Timer Operations in ARM Cortex-M, Low Power Design Techniques for Embedded Systems, Debug Host Interface, DP Module, AP Module, and DAP, Debug Modes, Debugging Features, Trace Interface, Trace System in the Cortex-M3, Introduction to RTOS for Embedded Systems.
Textbooks:	
1.	ARM System Developer's Guide: Designing and Optimizing System Software" – Andrew Sloss, Dominic Symes, Chris Wright.
2.	The Definitive Guide to ARM Cortex-M3" – Joseph Yiu
Reference Books:	
1.	Embedded Systems: Introduction to ARM Cortex-M Microcontrollers" – Jonathan W. Valvano
2.	ARM Assembly Language Programming & Architecture" – William Hohl
e-Resources	
1.	https://developer.arm.com
2.	https://developer.arm.com/documentation/ddi0337
3.	https://www.keil.com

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3206	PE	3	--	--	3	30	70	3 Hrs.

DATA COMMUNICATIONS AND COMPUTER NETWORKS

(For ECE)

Course Objectives: Students are expected to

1.	To introduce the Fundamentals of data communication networks
2.	To familiarize with the fundamental concepts of computer networking and network engineering reference models.
3.	To introduce basic concepts of multiplexing techniques, switching techniques.
4.	To understand error control and flow control mechanisms
5.	To familiarize with different multiple access protocols such as ALOHA, CSMA.
6.	To familiarize algorithms. with different networking devices and congestion control
7.	To familiarize with TCP and UDP header formats.

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

S.No	Outcome	Knowledge Level
1.	**Apply** concepts of OSI model and TCP/IP protocol stack in understanding data communication	K3
2.	**Apply** switching mechanisms, multiplexing techniques and error and flow control mechanisms for reliable data communication.	K3
3.	**Apply** multiple access protocols, channel allocation strategies, and the working principles of IEEE 802 standards in networking scenarios to ensure network connectivity	K3
4.	**Analyze** the operation of different network devices, routing, congestion control algorithms, IP protocol and IP addressing.	K4
5.	**Analyze** the performance of transport layer and application layer protocols	K4

SYLLABUS

UNIT-I (11 Hrs)	**Data Communication Fundamentals:** Introduction to data communication, Data Representation, Data Transmission, Modes of Data Transmission, Introduction to computer networks, Line Configuration, Topology, Transmission mode, Categories of Networks-LAN, MAN, WAN. **Layered architecture:** Protocol Hierarchies, Design issues of layers, Connection Oriented and Connectionless services; Reference Models-The OSI Reference Model, The TCP/IP Reference Model.
UNIT-II (11 Hrs)	**Physical layer: Signals** and Encoding-Manchester and differential Manchester Encoding, Transmission Media, Multiplexing-Frequency Division Multiplexing, Time Division Multiplexing, Switching-Circuit Switching, packet switching techniques.

	Data link layer: Design issues of Data link layer, Error Detection and Correction: Types of errors, Error Detection (Parity, CRC, Checksum) Error correcting (using Hamming distance), Elementary Data link protocols, Sliding window protocols, HDLC.
UNIT-III (8 Hrs)	**Medium access sublayer**-The Channel allocation problem, Multiple Access Protocols-ALOHA, Carrier Sense Multiple Access protocols (CSMA, CSMA/CD); IEEE standard for 802 LANs- 802.3, Personal Area Network: Bluetooth, Wireless LANs- Wifi 802.11 architecture.
UNIT-IV (8 Hrs)	**Network Layer:** Virtual circuit and Datagram subnet, Network devices, Routing Algorithms-Distant vector routing algorithm, link state routing algorithm, Congestion Control algorithms- General principles of Congestion Control, Congestion prevention policies. The Leaky bucket algorithm and Token bucket algorithm, The Network Layer in the Internet- The IP Protocol(IPV4, IPV6), IP Addresses.
UNIT-V (7 Hrs)	**Transport Layer:** The Transport layer Service, Elements of Transport protocols, The Internet Transport Protocols- UDP, TCP. **Application Layer**: The Domain Name System, Electronic mail, The World Wide Web.

Textbooks:	
1.	Data Communications and Networking by Behrouz A.Forouzan, 2nd edition, Tata McGraw Hill
2.	Computer Networks — Andrew S Tanenbaum, 3rd Edition, PearsonEducation/PHI.
Reference Books:	
1.	An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education
2.	Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson
3.	Data Communications and Computer Networks by Prakash.C. Gupta, Prentice- Hall of India Pvt. Ltd
e-Resources	
1.	https://www.youtube.com/channel/UCr0Ze4SR3MHXAgz1TvRYL7Q

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3207	PE	3	--	--	3	30	70	3 Hrs.

RADAR ENGINEERING

(For ECE)

Course Objectives: Students are expected to

1.	To provide an ability to apply knowledge of mathematics, science, basic radar equations to measure the range of the stationary objects using Radar.
2.	To provide insight of basic working principles of Radar Transmitter and Receiver.
3.	To introduce different types of Radar systems to measure the Range, angle information etc. of the moving targets.
4.	To introduce different types of tracking Radars and other types of Radar systems.

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

S.No	Outcome	Knowledge Level
1.	**Understand** the basic working principles of Radars and Apply various mathematical equations to measure the actual Range and unambiguous range of the stationary targets from the radar.	K3
2.	**Understand** the basic working principles of some important blocks in Radar receivers.	K3
3.	**Understand** the basic working principles of Radars and Apply various mathematical equations to measure the velocity, doppler shift, blind speeds, etc. of the moving targets from the radar.	K4
4.	**Analyze** various tracking Radars, advantages and limitations of various tracking radars.	K4
5.	**Understand** the basic working principles of some special radars.	K3

SYLLABUS

UNIT-I (10Hrs)	**The Nature Of Radar:** - Introduction, Basic working Principle of Radar, Radar Block Diagram and Operation, List of Applications of Radar, The Simple form of the Radar Range Equation (R_{max}), Reasons to failure of the simple form of the Radar Equation, parameters added to improve the performance of the Radar equation: Integration efficiency, signal to noise ratio, average power, system losses, etc. False alarm and missed detection, Pulse Repetition Frequency, Range ambiguity and Maximum Unambiguous Range, integration of radar pulses, system losses.
UNIT-II (8Hrs)	**Radar Receivers:** Displays and Duplexers: -The basic function of the Radar receiver, Noise Figure and Noise Temperature, Types of Duplexers: Branch type duplexer, Balanced duplexer, Circulator with receiver protector, Balanced Mixer, Radar Displays (Scopes).

UNIT-III (9 Hrs)	**Mti And Pulse Doppler Radar:** Introduction to Doppler Effect, Doppler frequency shift, Simple CW Doppler Radar, Block diagram of a simple pulse radar that extracts the doppler frequency shift of the echo signal from a moving target, Butterfly effect, Coherent and Non-Coherent Moving Target Indication Radar, Delay line Cancellers, Limitations of single delay line cancellers, Blind speeds, Block diagram and working of the original Moving target Detector (MTD) signal processor.
UNIT-IV (9 Hrs)	**Tracking Radars:** Introduction, Types of Tracking Radars, Sequential Lobing, Conical Scan, Amplitude Comparison Monopulse tracking Radar: amplitude-comparison monopulse radar (one angular coordinate), two-coordinate (azimuth and elevation) amplitude- comparison Monopulse tracking radar, Comparison of Sequential/conical scanning tracking Radar and Monopulse Tracking Radar.
UNIT-V (9 Hrs)	**Special Radars:** Basic concepts and Radiation Pattern of a Phased array Radar, Comparison of Passive Aperture Phased Array Radar and Active Aperture Phased Array Radar. Jamming and Anti-Jamming Radars: Basics of Electronic Counter Measures, Repeater. Jamming and Electronic Counter Counter Measures. Basic working Principle of a Direction finder using a rectangular loop antenna and sense finder.

Textbooks:	
1.	Introduction to Radar Systems – Merrill I. Skolnik, THIRD EDITION, Tata McGraw-Hill,2001.
2.	Radar Systems and Radio Aids to Navigation-Prof A.K.Sen and Dr.A.B.Bhattacharya
Reference Books:	
1.	Introduction to Radar Systems – Merrill I. Skolnik, Second Edition, Tata McGraw-Hill, 2001.
2.	Radar Engineering and Fundamentals of Navigational Aids, G S N Raju, IK International Publishers, 2008
e-Resources	
1.	https://www.youtube.com/watch?v=7QwmTi4B86U
2.	https://www.geeksforgeeks.org/block-diagram-of-radar/
3.	https://www.geeksforgeeks.org/block-diagram-of-radar/#doppler-frequency-formula

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3208	PE	3	--	--	3	30	70	3 Hrs.

MACHINE LEARNING

(For ECE)

Course Objectives: Students are expected to

1.	To introduce foundational concepts and types of Machine Learning and their real-world applications.
2.	To develop understanding of data preprocessing, feature selection, and exploratory data analysis.
3.	To impart knowledge on supervised and unsupervised learning techniques and their implementation using Python.
4.	To equip students with skills to evaluate and fine-tune machine learning models using various performance metrics and visualization tools.

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

S.No	Outcome	Knowledge Level
1.	**Define** machine learning and its different types and understand their applications.	K2
2.	**Explain** the various techniques involved in pre-processing of data for Data Analysis	K3
3.	**Apply** various supervised learning algorithms including decision trees and k-nearest neighbours (k-NN) etc.	K3
4.	**Implement** unsupervised learning techniques, viz., K-means clustering etc.	K3
5.	**Learn** about various performance metrics and explore them in various applications of implementing Machine learning Algorithms.	K4

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Machine Learning:** What is Machine Learning?, Traditional programming approach vs Machine learning approach, History and Evolution of Machine Learning, Learning by Rote vs Learning by Induction, **Paradigms for ML** - Supervised ML, Unsupervised ML, Reinforcement ML, **Datatypes in ML** - Quantitative data (Continuous, Discrete), Qualitative data (Structured, Semi structured, Unstructured), Nominal data, Ordinal data, Interval data, Ratio data, Stages involved in Machine Learning, Main challenges of ML, Applications of Machine Learning, **IDE's for ML Programming** - Jupyter Notebook, Spyder, PyCharm, Google Colab, R Studio, VS Code, **Basic packages to deal with ML** - Numpy, Scipy, Pandas, Scikit-learn, Matplotlib, Seaborn, **Programming Languages for Machine Learning** - Python, Java, R, JavaScript, C++.

UNIT-II (12 Hrs)	**Explorative Data Analysis (EDA): What** is EDA? Why EDA is important?, **Types of EDA -** Univariate Analysis, Bivariate Analysis, Multivariate Analysis, **Data Cleaning** - Data Acquisition, Analyzing the data Dealing with duplicate data, Dealing with missing values, Dealing with outliers **Scaling and Transformations** - Feature Scaling and Transformation, Univariate nonlinear Transformations, **Dimensionality Reduction** - Principal Component Analysis (PCA),**Feature Engineering** - Handling Categorical attributes (One-Hot-Encoding), **Feature Expansion** - Interactions and Polynomials, **Automatic Feature Selection** - Univariate Statistics, Model-Based Feature Selection, Iterative Feature Selection.
UNIT-III (12 Hrs)	**Supervised Machine Learning:** What is Supervised Machine Learning?, General architecture of Supervised ML, **Types of Supervised ML** - Classification and Regression, **Different Classification Algorithms** - K-Nearest Neighbor (KNN) Classifier, Linear Models, Logistic Regression, Naive Bayes Classifiers, Decision Tree Classifier, **Ensemble learning and Decision Trees** - Voting, Bagging and pasting, Random Forests, AdaBoost, Gradient Boosting, Stacking, Support Vector Classifier (SVC)Neural Networks, **Different Regression Algorithms** - K-Neighbors Regressor, Linear Regression, Ridge Regression, Lasso Regression, Polynomial Regression, Support Vector Regressor (SVR), Decision Tree Regressor, Random Forest Regressor.
UNIT-IV (12 Hrs)	**Unsupervised Machine Learning –** What is Unsupervised Machine Learning?, General architecture of Unsupervised Machine Learning, Challenges in Unsupervised ML, **Clustering** - Introduction to Clustering, Soft clustering vs Hard Clustering, K-Means Clustering algorithm, Centroid-based clustering algorithm, Divisive Clustering and Agglomerative Clustering, DBSCAN.
UNIT-V (12 Hrs)	**Model Evaluation metrics, Fine tuning the model and Visualizations -** **Evaluation Metrics for Classification -** Confusion Matrices, Accuracy, Precision, Recall, F1-Score, Precision-recall curves, ROC (Receiver Operating Characteristics) curves, Confusion Matrix, **Evaluation Metrics for Regression** - R^2, Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), **Evaluation Metrics for clustering** - Adjusted Random Index (ARI), Normalized Mutual Information (NMI), **Cross Validation -** Cross-Validation in scikit-learn, benefits of cross-validation, stratified k-fold cross validation, **Grid Search**- Simple Grid search, Grid search with cross validation, Randomized search, **Visualization** - Univariate Analysis (Bar plot, Box plot, Count plot, Density plot, Histogram, Pieplot), Bivariate Analysis (Pair plot, Scatter plot, Bar plot, Stacked barplot, Multivariate Analysis (Heat Maps).
Textbooks:	
1.	"Introduction to Machine Learning with Python", Andreas C.Muller&Sarah Guido, O'Reilly Publications
2.	"Hands-on Machine Learning with Scikit-Learn, Keras& TensorFlow", Aurelien Geron, O'Reilly Publications

Reference Books:	
1.	“Machine Learning”, Tom M. Mitchell, McGraw-Hill Publication, 2017
2.	“Machine Learning in Action”,Peter Harrington, DreamTech
e-Resources	
1.	https://nptel.ac.in/courses/106106139

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3209	PE	3	--	--	3	30	70	3 Hrs.

SMART AND WIRELESS INSTRUMENTATION

(For ECE)

Course Objectives: Students are expected to

1.	Introduce the concepts and evolution of smart instrumentation and wireless sensor networks.
2.	Familiarize students with node architectures, data acquisition, and signal processing units.
3.	Explain the fundamentals of wireless digital communication used in sensor systems.
4.	Enable understanding of energy sources, harvesting methods, and application areas of smart wireless instrumentation.

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

S.No	Outcome	Knowledge Level
1.	**Analyze** Smart and Wireless Instrumentation with respect to various performance parameters.	K4
2.	**Design** and develop Applications using WSN (Wireless sensor Network).	K4
3.	**Demonstration** of various Node architectures.	K3
4.	**Demonstration** of Fundamentals of wireless digital communication	K3
5.	**Analyze** the power sources, Demonstrate an ability to design strategies as per needs and specifications.	K4

SYLLABUS

UNIT-I (10Hrs)	**Introduction:** Smart Instrumentation (Materials, automation systems, ensign and Sensors, Sensor Classifications, Wireless Sensor Networks, History of Wireless Sensor networks (WSN), Communication in a WSN, important design constraints of a WSN like Energy, Self-Management, Wireless Networking, Decentralized Management, Design Constraints, Security etc.
UNIT-II (8Hrs)	**Node architecture:** The sensing subsystem, Analog to Digital converter, the processor subsystem, architectural overview, microcontroller, digital signal processor, application specific integrated circuit, field programmable gate array (FPGA), comparison, communication interfaces, serial peripheral interface, inter integrated circuit, the IMote node architecture, The XYZ node architecture, the Hog throb node architecture.
UNIT-III (9 Hrs)	**Fundamentals of Wireless Digital Communication:** Basic components, source encoding, the efficiency of a source encoder, pulse code modulation and delta modulation, channel encoding, types of channels, information transmission over a channel, error recognition and correction, modulation, modulation types, quadratic amplitude modulation, signal propagation.

UNIT-IV (9 Hrs)	**Frequency of Wireless Communication:** Development of Wireless Sensor Network based on Microcontroller and communication device-Zigbee Communication device. Power sources- Energy Harvesting Solar and Lead acid batteries-RF Energy /Harvesting-Energy Harvesting from vibration Thermal Energy Harvesting-Energy Management Techniques Calculation for Battery Selection.
UNIT-V (9 Hrs)	**Applications:** Structural health monitoring - sensing seismic events, single damage detection using natural frequencies, multiple damage detection using natural frequencies, multiple damage detection using mode shapes, coherence, piezoelectric effect, traffic control, health care - available sensors, pipeline monitoring, precision agriculture, active volcano, underground mining.
Textbooks:	
1.	Fundamentals of wireless sensor networks : theory and practice - WaltenegusDargie, Christian Poellabauer, A John Wiley and Sons, Ltd., Publication.
2.	Smart Sensors, Measurement and Instrumentation ,Subhas Chandra Mukhopadhyay, Springer Heidelberg, New York, Dordrecht London, 2013.
Reference Books:	
1.	UvaisQidwai, Smart Instrumentation: A data flow approach to Interfacing“, Chapman & Hall; 1st Edn, December 2013.
2.	Wireless Sensor Networks: Architectures and Protocols, Edgar H. Callaway Jr. and Ed gar H. Callaway.
e-Resources	
1.	https://nptel.ac.in/courses/106105160

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3211	PE	3	--	--	3	30	70	3 Hrs.

DIGITAL VLSI LAYOUT DESIGN

(For ECE)

Course Objectives: Students are expected to

1.	To equip students with the practical skills necessary to design, implement, and verify integrated circuit layouts, encompassing the entire workflow from schematic interpretation to the final physical verification checks.
2.	To enable students to proficiently create CAD layouts for fundamental digital circuits and standard cells, adhering to industry-standard design rules, mask specifications, and efficient routing techniques.

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

S.No	Outcome	Knowledge Level
1.	**Execute** the VLSI Layout Workflow	K3
2.	**Implement** Efficient IC Layouts	K4
3.	**Perform** Comprehensive Physical Verification	K3
4.	**Design** and Route Digital Standard Cells	K4
5.	**Create** CAD Layouts for Fundamental Digital Circuits	K3

SYLLABUS

UNIT-I (10Hrs)	**Layout workflow:** Schematic - Schematic capturing, Reading the Schematic Components, Layout flow, Understanding masks and associated rules, Cross Section with Drawn Layers.
UNIT-II (10 Hrs)	**Layout -** Floor-planning, Series and Parallel devices (Mos, Res and Cap), Placement, Routing.
UNIT-III (10 Hrs)	**Physical Verification** - Design Rule Check, Layout vs Schematic, Process Design Kit - Process Document, Rule file for all verification, Model libraries, ERC, Antenna Checks.
UNIT-IV (10 Hrs)	**Digital Cells Layout:** Digital cell library, Digital Cells Examples, Stick diagram, Euler path, Digital Cell Design and Routing, Routing, Digital Cell P&R Particulars, Metal Spacing Grids, Digital Cell Template, Guidelines to Std cell Layout.
UNIT-V (10 Hrs)	CAD Drawing for the following with Masks and rules (please give them a list of rules for the technology associated). Inverter, Buffer, NAND, NOR, XOR ,D flip flop, And / OR, Half adder and Full adder.

Textbooks:	
1.	“Digital Integrated Circuits: A Design Perspective" by Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic
2.	"Electronic Design Automation for IC System Design, Verification, and Testing" by Luciano Lavagno, Grant Martin, and Louis Scheffer, second edition
Reference Books:	
1.	"Application-Specific Integrated Circuits" by Michael John Sebastian Smith,first edition,Addison-Wesley
2.	"VLSI Physical Design: From Graph Partitioning to Timing Closure" by Major, H. Sarrafzadeh, and C. K. Wong
3.	"Microchip Fabrication: A Practical Guide to Semiconductor Processing" by Peter Van Zant, sixth Edition
e-Resources	
1.	https://www.edaplayground.com/

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3212	PE	3	--	--	3	30	70	3 Hrs.

REAL-TIME OPERATING SYSTEM

(For ECE)

Course Objectives: Students are expected to

1.	Understand the fundamentals of real-time systems and RTOS architecture, including scheduling mechanisms and multitasking concepts.
2.	Demonstrate the use of tasks, semaphores, and message queues to manage synchronization, communication, and concurrency in RTOS environments.
3.	Explain the role of kernel objects such as pipes, event registers, and signals for effective inter-process communication.
4.	Analyze exception-handling mechanisms, interrupts, and timer services to manage time- critical operations in real-time systems.
5.	Analyze exception-handling mechanisms, interrupts, and timer services to manage time- critical operations in real-time systems.

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

S.No	Outcome	Knowledge Level
1.	**Explain** real-time system characteristics and scheduling algorithms related to RTOS behavior.	K2
2.	**Describe** tasks, semaphores, and message queues in RTOS including their operations.	K2
3.	**Explain** the use of kernel objects like pipes, event registers, and signals for communication.	K2
4.	**Describe** exception handling mechanisms and timer services for managing time-critical operations in RTOS.	K2
5.	**Explain** I/O management techniques, memory handling methods, and synchronization mechanisms in embedded systems.	K2

SYLLABUS

UNIT-I (10Hrs)	**Introduction to real-time systems and real-time operating systems:** Defining the Embedded System, Applications, Real-Time Embedded Systems: Real-Time Systems, Characteristics of Real-Time Systems, Hard and Soft Real-Time Systems, Introduction to RTOS: Defining an RTOS, The scheduler- Schedulable Entities, Multitasking, The Context Switch, The Dispatcher, Scheduling Algorithms (preemptive priority-based scheduling, and round-robin scheduling); Objects, Services, Key Characteristics of an RTOS.

UNIT-II (10 Hrs)	**Tasks, Semaphores, Message Queues:** Introduction, defining a Task, Task States and Scheduling, Typical Task Operations, Define Synchronization, Communication, and Concurrency; Defining Semaphores- Binary Semaphores, Counting Semaphores, Mutual Exclusion (Mutex) Semaphores, Typical Semaphores operations; Defining Message Queue States, Message Queue Content, Message Queue Storage, Typical Message Queue Operations.
UNIT-III (10 Hrs)	**Other Kernel Objects:** Pipes, Pipe Control Blocks- Pipe States, Named and Unnamed Pipes, Typical Pipe Operations, Typical Uses of Pipes; Event Registers- Event Register Control Block, operations, Typical Uses of Event Registers; Signals- Signal Control Blocks, Typical Signal Operations, Typical Uses of Signals.
UNIT-IV (10 Hrs)	**Other RTOS Services:** Exceptions and Interrupts: What are Exceptions and Interrupts, Applications of Exceptions and Interrupts, A Closer Look at Exceptions and Interrupts, Processing General Exceptions, (Processing General Exceptions), The Nature of Spurious Interrupts; Timer and Timer Services: Real-Time Clocks and System Clocks, Programmable Interval Timers, Timer Interrupt Service Routines.
UNIT-V (10 Hrs)	**I/O Subsystem, Memory Management Synchronization and Communication:** Basic I/O Concepts, The I/O Subsystem- Standard I/O Functions; Memory Management: Dynamic Memory Allocation in Embedded Systems, Fixed-Size Memory Management in Embedded Systems, Hardware Memory Management Units, Synchronization- Resource Synchronization, Introduction to barrier synchronization, communication.
Textbooks:	
1.	Real-Time Concepts for Embedded Systems by Qing Li and Caroline Yao" Published byCMP Books
2.	Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.
Reference Books:	
1.	Free RTOS Documentation and User Guide by Richard Barry
2.	Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C byYifeng Zhu
e-Resources	
1.	https://onlinecourses.nptel.ac.in/noc25_cs78/preview
2.	https://archive.nptel.ac.in/courses/106/105/106105229/

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3213	PE	3	--	--	3	30	70	3 Hrs.

CRYPTOGRAPHY AND NETWORK SECURITY

(For ECE)

Course Objectives: Students are expected to

1.	To provide an overview of the computer security and classical encryption techniques.
2.	To introduce working principles and utilities of various cryptographic algorithms including symmetric key cryptography and public key cryptography algorithms.
3.	To explain design issues and working principles of hashing, message digest algorithms and various authentication protocols.
4.	To illustrate various secure communication protocols standards.
5.	To introduce concepts of firewalls and block chain technology.

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

S.No	Outcome	Knowledge Level
1.	**Illustrate** information Security goals, classical encryption techniques related to cryptography.	K2
2.	**Apply** symmetric and public key cryptographic algorithms for secure data communication.	K3
3.	**Implement** cryptographic hash functions, message authentication techniques, digital signatures, and remote user authentication protocols.	K3
4.	**Evaluate** and implement electronic mail security, IP security protocols, and transport layer security mechanisms to ensure secure communication.	K3
5.	**Analyze** firewall technologies and blockchain fundamentals to enhance network security and trust.	K3

SYLLABUS

UNIT-I (8 Hrs)	**Introduction to Cryptography:** Security Attacks, Services & Mechanisms, Symmetric Cipher Model, Substitution and Transposition Techniques. **Block Ciphers:** Traditional Block Cipher Structure, Block Cipher Design Principles.
UNIT-II (12 Hrs)	**Symmetric Key Cryptography:** Data Encryption Standard (DES), Advanced Encryption Standard (AES), IDEA, Block Cipher Modes of Operations. **Public Key Cryptography:** Principles, Public Key Cryptography Algorithms, Euler's Theorem, RSA Algorithm, Diffie-Hellman Key Exchange.
UNIT-III (12 Hrs)	**Cryptographic Hash Functions:** Application of Cryptographic Hash Functions, SHA and MD5 Algorithms, Message Authentication Functions, HMAC & CMAC. **Digital Signatures:** DSS, DSS with RSA **User Authentication:** Remote User Authentication Principles, Kerberos.
UNIT-IV (10 Hrs)	**Electronic Mail Security:** Pretty Good Privacy (PGP) And S/MIME. **IP Security:** IP Security Overview, IP Security Architecture, Authentication Header,

	Encapsulating Security Payload. **Transport Level Security:** Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS).
UNIT-V (10 Hrs)	**Firewalls:** Characteristics, Types of Firewalls, Placement of Firewalls, Firewall Configuration, Trusted Systems. **Blockchain Technology:** Introduction to Blockchain Technology Fundamentals, how blockchain works-Shared Ledger, Permissions, Concensus, Smart contracts.
Textbooks:	
1.	Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition.
2.	Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition.
Reference Books:	
1.	Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyaya, McGrawHill, 3rd Edition, 2015.
2.	Network Security Illustrated, Jason Albanese and Wes Sonnenreich, MGH Publishers, 2003.
3.	BlockchainFundamentals- Ravindhar vadapalli, https://www.researchgate.net/publication/345045424_
e-Resources	
1.	https://nptel.ac.in/courses/106/105/106105162/

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3214	PE	3	--	--	3	30	70	3 Hrs.

MICROWAVE ENGINEERING

(For ECE)

Course Objectives:

1.	The purpose of this course is to provide operational characteristics and conceptual understanding of active and passive components at microwave frequencies.
2.	This course also emphasizes formulation and application of scattering matrix for the analysis of different microwave passive components.
3.	Further, this course also provides an understanding of measurement techniques of different parameters.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	**Describe** and Explain the working principle of different passive waveguide components used at microwave frequencies.	**K3**
2.	**Apply** the properties of scattering matrix for solving the scattering matrix of different passive microwave components for both ideal and practical considerations and analyse their operation	**K4**
3.	**Aware** of conceptual and operational characteristics of different microwave Tube circuits(generators).	**K3**
4.	**Describe** and Explain the operational characteristics of different microwave solid state devices.	**K3**
5.	**Demonstrate** and implement different experimental procedures involving measurement of microwave parameters	**K4**

SYLLABUS

UNIT-I (12 Hrs)	**Microwave Components and its applications:** Introduction, Microwave Spectrum and Bands, Applications of Microwaves, Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide irises, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Resistive Card, Rotary Vane types; Waveguide Phase Shifters – Dielectric, Rotary Vane types, E-plane and H-plane Tees, Magic Tee, Hybrid Ring; Directional Couplers – 2Hole, Bethe Hole types, Ferrite Components– Faraday Rotation, Gyrator, Isolator, Circulator, Related Problems.
UNIT-II (08 Hrs)	**Scattering Matrix: Scattering Matrix** – Significance, Formulation and Properties, Scattering Matrix of Isolator, circulator, directional coupler, E Plane Tee, H plane Tee and Magic Tee.
UNIT-III	**Qualitative treatment on Microwave Tubes:** Limitations and Losses of conventional

(12 Hrs)	tubes at microwave frequencies-entrant Cavities,Microwave tubes – O type and M type classifications. O-type tubes :2 Cavity Klystrons – Structure, Velocity Modulation Process and Applegate Diagram, Bunching Process and Applications, Reflex Klystrons – Structure, Applegate Diagram and Principle of working, Applications. HELIX TWTS: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT (Qualitative treatment). M-type Tubes Introduction, Cross-field effects, Magnetrons –8-Cavity Cylindrical Travelling Wave Magnetron
UNIT-IV (08 Hrs)	**Microwave Solid state Devices:** Negative resistance phenomenon, Gunn Diode, domain formation, Tunnel Diode- principle of operation, IMPATT- principle of operation, TRAPATT, PIN Diodes and its applications (Qualitative analysis only). Detector diode or point contact diode and its characteristics.
UNIT-V (08 Hrs)	**Microwave Measurements:** Microwave Test bench, Measurement of Power, VSWR, Frequency, Guide Wavelength, Unknown load impedance.
Textbooks:	
1.	Microwave and Radar Engineering-M.Kulkarni, Umesh Publications, 3rd Edition.
2.	Microwave Devices and Circuits, Third Edition, Samuel Y. Liao, Pearson Education.
Reference Books:	
1.	Microwave Engineering, Annapurna Das, Sisir K. Das, Tata McGraw-Hill Education
2.	Microwave Engineering, 4th Edition, David M. Pozar, November 2011.
3.	Microwave and Radar Engineering, GottapuSasibhushanaRao, Pearson Education, New Delhi, 2014.
4.	Foundation for Microwave Engineering, R.R.Collin, McGraw Hill.
e-Resources	
1.	https://nptel.ac.in/courses/108/103/108103141/(IIT Guwahati)

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3215	PE	3	--	--	3	30	70	3 Hrs.

ANALOG IC DESIGN

(For ECE)

Course Objectives: Students are expected to

1.	To understand the fundamental behavior and modeling of MOS devices and their impact on analog design.
2.	To analyze and design analog CMOS sub-circuits such as current mirrors, voltage/current references, and amplifiers.
3.	To explore advanced analog building blocks including comparators, oscillators, and phase-locked loops for real-time applications.

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

S.No	Outcome	Knowledge Level
1.	**Understand** the concepts of MOS Devices and Modeling.	K2
2.	**Describe** the working principles of CMOS sub-circuits such as current mirrors and references.	K2
3.	**Analyze** CMOS amplifier architectures and their functional characteristics.	K3
4.	**Demonstrate** understanding of open-loop comparators and their performance parameters.	K3
5.	**Design** simple analog CMOS circuits for real-time applications	K4

SYLLABUS

UNIT-I (12 Hrs)	**MOS Devices and Modelling**: The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modelling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.
UNIT-II (12 Hrs)	**Analog CMOS Sub-Circuits:** MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference**.**
UNIT-III (10 Hrs)	**CMOS Amplifiers:** Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures. CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power-Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

UNIT-IV (8 Hrs)	**Comparators:** Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete- Time Comparators.
UNIT-V (12 Hrs)	**Oscillators & Phase-Locked Loops:** General Considerations, Ring Oscillators, LC Oscillators, Voltage Controlled Oscillators. Simple PLL, Charge Pump PLLs, Non-Ideal Effects in PLLs, Delay Locked Loops, Applications.

Textbooks:	
1.	Design of Analog CMOS Integrated Circuits- BehzadRazavi, TMH Edition,SecondEdition.
2.	CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition,2010.
Reference Books:	
1.	Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition,2010.
2.	Analog Integrated Circuit Design- David A.Johns, Ken Martin, Wiley Student Edn,2013.
e-Resources	
1.	https://nptel.ac.in/courses/117106086

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3216	PE	3	--	--	3	30	70	3 Hrs.

SOFT COMPUTING TECHNIQUES

(For ECE)

Course Objectives: Students are expected to

1.	To introduce the fundamental principles of intelligent control, including symbolic reasoning, expert systems, and AI-based approaches.
2.	To develop an understanding of Artificial Neural Networks (ANNs), their architectures, learning methods, and applications in control systems.
3.	To familiarize students with fuzzy logic systems, including fuzzification, inferencing, defuzzification, and their applications in nonlinear control.
4.	To explore optimization techniques and application of MATLAB toolboxes for solving optimization problems.

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

S.No	Outcome	Knowledge Level
1.	**Explain** intelligent control paradigms, including symbolic reasoning, rule-based systems, and expert systems.	K2
2.	**Apply** Artificial Neural Networks (ANNs) for control applications, covering perceptrons, multilayer networks, and self-organizing maps.	K3
3.	**Design** fuzzy logic controllers using fuzzification, inferencing, and defuzzification for nonlinear systems.	K3
4.	**Implement** Genetic Algorithms (GAs) and other optimization techniques for intelligent control system tuning.	K3
5.	**Apply** MATLAB toolboxes for ANN, fuzzy logic, and GA-based control system modeling and optimization.	K3

SYLLABUS

UNIT-I (10Hrs)	Introduction: Approaches to intelligent control, Architecture for intelligent control, Symbolic reasoning system, Rule-based systems, the AI approach, Knowledge representation - Expert systems.
UNIT-II (10 Hrs)	Artificial Neural Networks: Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron, Learning and Training the neural network, Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations, Hopfield network, Self-organizing network and Recurrent network, Neural Network based controller.

UNIT-III (10 Hrs)	Fuzzy Logic System: Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning, Introduction to fuzzy logic modeling and control, Fuzzification, inferencing and defuzzification, Fuzzy knowledge and rule bases, Fuzzy modeling and control schemes for nonlinear systems, Self-organizing fuzzy logic control, Fuzzy logic control for nonlinear time delay system.
UNIT-IV (10 Hrs)	Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, Adjustment of free parameters, Concept on some other search techniques like Tabu search and ant D-colony search techniques for solving optimization problems.
UNIT-V (10 Hrs)	Applications: GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using MATLAB-Neural Network toolbox, Stability analysis of Neural Network interconnection systems, Implementation of fuzzy logic controller using MATLAB fuzzy-logic toolbox.

Textbooks:	
1.	Introduction to Artificial Neural Systems - Jacek.M.Zurada, Jaico Publishing House, 1999.
2.	Neural Networks and Fuzzy Systems - Kosko, B., Prentice-Hall of India Pvt. Ltd., 1994.
Reference Books:	
1.	Fuzzy Sets, Uncertainty and Information - Klir G.J. &Folger T.A., Prentice-Hall of India Pvt. Ltd., 1993.
2.	Fuzzy Set Theory and Its Applications - Zimmerman H.J. Kluwer Academic Publishers, 1994. Introduction to Fuzzy Control - Driankov, Hellendroon, Narosa Publishers.
e-Resources	
1.	https://www.mathworks.com/help/deeplearning/

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3218	PC	--	--	3	1.5	30	70	3 Hrs.

VLSI LAB

(For ECE)

Course Objectives:

1	To learn Verilog /VHDL Source coding, perform simulation and analyze the results using necessary Synthesizer.
2	To provide knowledge in designing the schematic diagrams and layouts of various combinational and sequential circuits using CMOS 180nm/90nm/45nm Technology with necessary EDA tools (Cadence/Synopsis/Ansys/Keysight EDA Tools).

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

S.No	Outcome	Knowledge Level
1	**Analyze** and program synthesizable codes in Verilog/VHDL/System Verilog.	K4
2	**Design** schematics and layouts using CMOS logic and verify their functionality including parasitics using Cadence/Synopsis/Ansys /Keysight EDA tools.	K4

LIST OF EXPERIMENTS

PART-A (Any Three Experiments)

Note: Develop Verilog/VHDL Source code, perform simulation using relevant simulator and analyze the obtained simulation results using necessary Synthesizer.

1	4-Bit Ripple carry adder
2	Carry look ahead adder using behavioural, dataflow and structural modeling
3	4-Bit Binary to Gray Converter
4	Finite State Machine (FSM) that detects a random sequence for input sequence of bits.

PART-B (Any Seven Experiments)

Back-end Level Design and Implementation using EDA tools

1	Universal gates
2	An Inverter
3	Half Adder
4	Full Adder
5	Full Subtractor
6	D-Latch
7	2x4 Decoder
8	Multiplexer
9	Comparator
10	Shift Register

Reference Books:

1	EDA Tool that supports FPGA programming including Xilinx Vivado.
2	Cadence/Synopsis/Ansys /Keysight EDA Equivalent Industry Standard Tools.
3	Desktop computer with appropriate Operating System that supports the EDA tools.
e-Resources:	
1.	https://courses.engr.illinois.edu/ece110/sp2021/content/courseNotes/files/?logicAndCMOS

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3219	PC	--	--	3	1.5	30	70	3 Hrs.

MICROPROCESSORS AND MICROCONTROLLERS LAB

(For ECE)

Course Objectives:

1	To Introduce ALP concepts, features and Coding.
2	Get familiarized with 8086 and 8051 instructions.
3	Developing Assembly Language Programs using the instruction sets of microprocessor(8086) and 8051 microcontroller.
4	The accompanying lab is designed to provide practical hands-on experience with Microprocessor hardware kits and software applications.

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

S.No	Outcome	Knowledge Level
1	**Develop** 8086 assembly language programs using data transfer, arithmetic and logical instructions	K3
2	**Develop** 8051 assembly language programs on data transfer, arithmetic and logical operations	K3
3	**Develop** 8051 assembly language programs to interface peripherals	K3

LIST OF PROGRAMS

Experiments Based On 8086:	
1	Write an 8086 µP ALP to perform Addition/Subtraction operation of two-16 and 32-bit numbers (using Various Addressing Modes).
2	Write an 8086 µP ALP to perform Multiplication/Division of two 16-bit unsigned numbers
3	Write an 8086 µP ALP to find the factorial of a given byte (less than 9).
4	Write an 8086 µP ALP to find average of N 8-bit numbers
5	Write an 8086 µP ALP to additionof two 4-digit BCD numbers
6	Write an 8086 µP Assembly Program to find the largest/smallest element in given array
7	Write an 8086 µP Assembly Program using string manipulation instruction
8	Write an 8086 µP Assembly Program to sort the block of data in ascending order by using bubble sorting technique. Assume the number of bytes of a block of data is at location 'X' and data starts from location 'X+1'onwards
Experiments Based On 8051:	
9	Write an 8051 µC ALPs on basic Data transfer instructions
10	Write an 8051 µC ALPs on basic Arithmetic instructions
11	Write an 8051 µC ALP to compute the number of logic 1's and 0's in a given byte
12	Write an 8051 µC Assembly Program to find the largest element in given array
13	Write an 8051 µC Assembly Program to find Average of N-bytes
14	Write an 8051 µC Assembly Program to find the sum of first 10 natural numbers

15	Write an 8051 µC Assembly Program to interface stepper motor
16	Write an 8051 µC Assembly Program to interface ADC
17	Write an 8051 µC Assembly Program to interface DAC
Reference Books:	
1	Lab Manual
e-Resources:	
1.	https://www.cs.virginia.edu/~evans/cs216/guides/x86.html

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EC3220	SEC	--	--	3	2	30	70	3 Hrs.

MACHINE LEARNING LAB

(For ECE)

Course Objectives:

1	To impart foundational knowledge of key machine learning algorithms such as regression, classification, clustering, and neural networks through hands-on experiments.
2	To enable students to implement and validate machine learning techniques on real-world datasets using Python or Scilab.
3	To encourage critical thinking and problem-solving skills by analyzing the performance of various ML models using appropriate metrics.

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

S.No	Outcome	Knowledge Level
1	**Apply** basic machine learning algorithms such as linear regression, logistic regression, and k-nearest neighbors to solve real-world problems.	K3
2	**Develop** and implement classification models using decision trees, SVM, and Naïve Bayes, and evaluate their performance using precision, recall, and F1-score.	K3
3	**Analyze** and visualize the performance of ML models using tools like SCILAB, matplotlib, and confusion matrices.	K4
4	**Apply** dimensionality reduction techniques such as PCA and neural network architectures to optimize and model datasets effectively.	K4

LIST OF EXPERIMENTS

1	Data pre-processing: Handling missing values, handling categorical data, bringing features to same scale, selecting meaningful features.
2	Model Evaluation and optimization: K-fold cross validation, learning and validation curves, grid search.
3	Linear Regression using Least Squares Method ○ Implement simple linear regression on a given data set. ○ Plot regression line and data points.
4	Logistic Regression for Binary Classification ○ Simple classification problem using a given data set. ○ Simulate classification output (e.g., actual Vs Predicted) and compute metrics including Accuray, Precision, Recall, F1-score, ROC. ○ Visualize confusion matrix using SCILAB.
5	Implementation of k-Nearest Neighbor algorithm to classify a given data set.
6	Application of Decision Tree Algorithm to classify a given data set.
7	Implementation of K-Means clustering.

8	Dimensionality reduction using Principal Component Analysis.
9	Implementation of Support vector Machines.
10	Implement Naïve Bayes theorem to classify the given data set.
11	Activate function Plots Plot Sigmoid, tanh, ReLU functions and analyse their behaviours.
12	Recognition of characters in a image using basic neural network.
Reference Books:	
1	Chris Albon, "Machine Learning with Python Cookbook-practical solutions from preprocessing to Deep learning", O'REILLY Publisher,2018
2	Sebastian Raschka & Vahid Mirjalili, "Python Machine Learning", Packt Publisher, 2017
3	Ian Good Fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
4	Francois Chollet, "Deep Learning with Python", Manning Publications, 2018.
e-Resources:	
1.	https://scikit-learn.org/stable/modules/generated/sklearn.linear_model.Perceptron.html
2.	https://machinelearningmastery.com

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23AC3202	AC	2	--	--	--	30	--	--

RESEARCH METHODOLOGY AND IPR

(For ECE)

Course Objectives:

1.	To impart knowledge on the formulation of research problems and methodology, including literature review, data analysis, and report writing techniques.
2.	To instill awareness of research ethics and plagiarism while developing the ability to prepare and present technical research proposals.
3.	To introduce the fundamental concepts of Intellectual Property Rights (IPR), their role in research and development, and their impact on individual and national growth.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Understand the formulation of a research problem and identify its characteristics and scope.	K2
2.	Analyze literature, avoid plagiarism, and follow ethical practices in research.	K4
3.	Develop and present a research proposal effectively.	K3
4.	Understand the basics of IPR and apply for patents and copyrights.	K2
5.	Evaluate the importance of IPR in modern technological and socio-economic development.	K5

SYLLABUS

UNIT-I	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations
UNIT-II	Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee
UNIT-III	Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT
UNIT-IV	Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.

UNIT-V	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc, Traditional knowledge Case Studies, IPR and IITs
Textbooks:	
1.	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'".
2.	Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
Reference Books:	
1.	Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
2.	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
3.	Mayall , "Industrial Design", McGraw Hill,1992
e-Resources	
1.	https://epgp.inflibnet.ac.in

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23MC3201	MC	2	--	--		30	--	

EMPLOYABILITY SKILLS

(For AIDS, CIC, CSIT, CSD, ECE and EEE)

Course Objectives:

1.	To introduce concepts required in framing grammatically correct sentences and identifying errors while using standard English.
2.	To acquaint the learner of making a coherent and cohesive sentences and paragraphs for composing a written discourse.
3.	To inculcate logical thinking in order to frame and use data as per the requirement.

Course Outcomes

S.No	Outcome	Knowledge Level
1	Match various vocabulary items that appear in competitive examinations with their contextual meanings accurately.	K1
2.	Identify grammatical and ungrammatical usage of English language in all the grammar related questions asked in various competitive examinations like CAT, GRE, IBPS.	K3
3.	Infer meaning from complex texts that are set as questions in different competitive examinations held for higher education or employment	K2
4.	Find solutions to complex arithmetic problems set as questions in the competitive examinations held for employment or higher education	K1
5.	Apply logical thinking abilities in solving the problems of reasoning that appear in the examinations like CAT, GRE, GATE, IBPS.	K3

SYLLABUS

UNIT-I (10Hrs)	Synonyms, Antonyms, Frequently Confused Words, Foreign Phrases, Idioms and Phrasal Verbs, Collocations. Spotting Errors, Sentence Improvement
UNIT-II (10 Hrs)	Time and work, Pipes and Cisterns. Time and Distance Problems, Problems on boats and streams. Percentages, Profit and loss, Simple interest and Compound interest. Discount Problems.
UNIT-III (10 Hrs)	Analogies, Odd One Out. (Verbal ability) Number Series, Letter Series, Analogy, Alpha Numeric Series, Order and Ranking, Directions, Data sufficiency, Syllogisms.
UNIT-IV (10 Hrs)	Sentence Completion, Sentence Equivalence, Close Test Reading Comprehension , Para Jumbles

UNIT-V (10 Hrs)	Number System: Divisibility tests, finding remainders in various cases, Problems related to numbers, Methods to find LCM, Methods to find HCF.
Textbooks:	
1.	*How to Prepare for Verbal Ability and Reading Comprehension for CAT* (10th edition) by Arun Sharma and Meenakshi Upadhyay, McGraw Hill Education, 2022.
2.	How to Prepare for Quantitative Aptitude for CAT (10th edition) by by Arun Sharma , McGraw Hill Education, 2022.
Reference Books:	
1.	*English Collocation in Use*- Intermediate (2nd edition) by Michael McCarthy& Felicity O'Dell, CUP, 2017.
2.	*Magical Book On Quicker Maths* (5th Edition) By M.Tyra, BSC Publishing Co Pvt. Ltd, 2018.
e-Resources	
1.	www.Indiabix.com
2.	www.800score.com