LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

Approved by AICTE | Recognized by Government of Telangana | Affiliated to Osmania University

Accredited by NBA | Accredited with 'A' grade by NAAC | Accredited by NABL

Four Year Course Structure and First Year Syllabus

Department of Electronics and Communication Engineering

(With effect from the Academic Year 2023-24)

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LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
(UGC Autonomous Institution)
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTION & EXAMINATIONS [LR-23]
AICTE Model Curriculum (Tentative)
B.E. V-Semester (2025-2026)

S.No.	Course Code	Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Week	Maximum Marks CIE	Maximum Marks SEE	Duration in Hours	
Theory Course											
1	U23EC501	PCC	Electromagnetic Theory and Transmission Lines	3	0	0	3	40	60	3	3
2	U23EC502	PCC	Pulse and Linear Integrated Circuits	3	0	0	3	40	60	3	3
3	U23EC503	PCC	Control Systems	3	0	0	3	40	60	3	3
4	U23EC504	PCC	Digital Signal Processing	3	0	0	3	40	60	3	3
5	--	PEC	Professional Elective – I	3	0	0	3	40	60	3	3
6	--	OEC	Open Elective – I	3	0	0	3	40	60	3	3
Practical/ Laboratory Course											
7	U23EC5L1	PCC	Pulse and Linear Integrated Circuits Lab	0	0	2	2	25	50	3	1
8	U23EC5L2	PCC	Digital Signal Processing Lab	0	0	2	2	25	50	3	1
Skill Development Course											
9	U23MA5L1	BSC	Aptitude and Reasoning	-	-	4	-	50	50	3	2
Total				18	0	8	22	340	510	27	22

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

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

PCC: Program Core Course **PEC**: Professional Electives

OEC: Open Electives Course **BSC:** Basic Science Course

Note:

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

Course Code	Course Title						Core/Elective
U23EC501	**Electromagnetic Theory and Transmission Lines**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering Physics	**3**	**0**	**0**	**0**	**40**	**60**	**3**

Course Objectives:

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

1. Analyze fundamental concepts of vector analysis, electrostatics and magneto statics law and their applications to describe the relationship between Electromagnetic Theory and the Maxwell's equations in differential and integral form.
2. Understand the wave equations for conducting and Di-electric mediums to analyze the wave propagation characteristics of Uniform Plane Waves (UPW) in normal and oblique incidences.
3. To understand the concepts of RF Lines and their characteristics, Transmission lines and Smith Chart and its applications, acquire knowledge to configure circuit elements, QWTs and HWTs and to apply the same for practical problems

Course Outcomes:

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

1. Differentiate the different coordinate systems, vector calculus, coulombs law and gauss law for finding electric fields due to different charges and to formulate the capacitance for different capacitors.
2. Apply basic magneto-statics concepts and laws such as Biot-Savarts law and Amperes law, their application in finding magnetic field intensity, inductance and magnetic boundary conditions.
3. Distinguish between the static and time-varying fields, establish the corresponding sets of Maxwell's Equations and Boundary Conditions, and use them for solving engineering problems.
4. Determine the Transmission Line parameters to characterize the distortions and estimate the characteristics for different lines.
5. Apply the Smith Chart and stub matching features, and gain ability to match the transmission lines.

UNIT I

Electrostatics: Review of Coordinate Systems, Vector Calculus, Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Poisson's and Laplace's Equations, Illustrative Problems.

UNIT II

Magneto statics: Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Equations for Magneto static Fields, Modified Ampere's Law, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Faraday's Law, Maxwell's Equations in differential and integral form.

UNIT III

Electromagnetic Waves: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves Equation, Wave Propagation in Lossless and Conducting Media. Conductors & Dielectrics Characterization, Wave Propagation in Good Conductors and Good Dielectrics. Polarization. Reflection and Refraction of Plane Waves Normal and Oblique Incidences, Poynting Vector and Poynting Theorem.

UNIT IV

Transmission Lines - I: Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation, Attenuation and Phase Constant, Infinite Line Concepts, Lossless and Distortionless transmission line.

UNIT V

Transmission Lines-II: Input Impedance of loss less transmission line, SC and OC Lines, Reflection Coefficient, VSWR. Lines of Different length $\lambda/8$, $\lambda/4$, $\lambda/2$, Lines – Impedance matching devices. Significance of Z min and Z max, Smith Chart Configuration and Applications, Single and Double Stub Matching.

Suggested Readings:

1. Matthew N.O. Sadiku *Elements of Electromagnetics*, Oxford Univ. Press, 4th ed., 2008.
2. William H. Hayt Jr. and John A. Buck *Engineering Electromagnetics*, TMH, 7th ed., 2006.
3. Nathan Ida *Engineering Electromagnetics*, Springer (India) Pvt. Ltd., New Delhi, 2nd ed. 2005.
4. Umesh Sinha *Transmission Lines and Networks*, Stya Prakashan,2001(Tech India publications),New Delhi.
5. E.C. Jordan and K.G. Balmain *,Electromagnetic Waves and Radiating Systems*, PHI, 2nd Edition,2000.

Course Code	Course Title						Core/Elective
U23EC502	**Pulse and Linear Integrated Circuits**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Electronics Devices	**3**	**0**	**0**	**0**	**40**	**60**	**3**

Course Objectives

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

1. Analyze, design and implement the shape of electrical waveforms.
2. Understand the operation of Multivibrators.
3. Illustrate designing of op-amp for specific application.

Course Outcomes

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

1. Construct different linear networks and analyse their response to different input signals
2. Analyse and Design Multivibrators and Sweep Circuits using Transistors.
3. To understand the basic concepts of Operational Amplifier and Differential Amplifier.
4. Develop skills to design simple circuits using OP-AMP and simple filter circuits.
5. Learn about various techniques to develop A/D and D/A converters.

UNIT-I

Wave Shaping Circuits: High pass, low pass RC circuits, their responses for sinusoidal, step, pulse, square and ramp inputs. RC network as Differentiator and Integrator.

Diode clippers, Transistor clippers, Clipping at two independent levels, Clamping operation, Clamping circuit theorem.

UNIT-II

Multivibrators & Time Base Generators: Analysis and Design of Bi-stable, Monostable, Astable Multivibrators and Schmitt trigger using transistors. General features of a time base signal, methods of generating voltage time base waveform.

UNIT-III

Operational Amplifiers: Differential Amplifier-Configurations and Modes of Operations Constant Current Bias, Current Mirror. OP-AMP Block diagram, Ideal OP-AMP characteristics, OP-AMP and its features, OP-AMP Parameters, Input and Output Offset voltages and currents, Slew rate, CMRR, PSRR.

UNIT-IV

OPAMP Applications: Inverting and Non-Inverting Amplifiers, Integrator and Differentiator, Summing Amplifier, Precision Rectifier, Voltage to Current Converter and Current to Voltage Converter, Logarithmic amplifier, Antilogarithmic amplifier.

Active filters: Low pass, High pass, Band pass and Band stop.

UNIT-V:

Data Converters: Digital-to-Analog Converters (DAC): Weighted Resistor, R-2R ladder and Inverted R-2R ladder. Analog-to-Digital Converters (ADC): Flash, Dual Slope, Successive Approximation, DAC/ADC Specifications.

Suggested Readings:

1. J. Millman and H. Taub. *"Pulse, Digital and Switching Waveforms"* McGraw-Hill 1991
2. D. RoyChoudhry, Shail Jain, *"Linear Integrated Circuits"*, New Age International Pvt. Ltd., 2000
3. Ramakant A. Gayakwad ,*Op-Amps and Linear Integrated Circuits* , 3rd Edition.
4. A. Anand Kumar, " *Pulse And Digital Circuits*" Second Edition, PHI Learning Pvt. Ltd., 12-Feb-2008
5. Mothiki S. Prakash Rao, *Pulse and Digital Circuits*, Tata McGraw Hill, India,(2006)

Course code	Course title						Core/Elective
U23EC503	**Control Systems**						**Core**
Pre-requisites	Contact Hpurs Per Week				CIE	SEE	Credits
	L	T	D	P			
Linear Algebra, Laplace Transforms	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

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

1. To develop basic skills of utilizing mathematical tools needed to analyze and designclassical linear control systems.
2. To access the system performance using time domain analysis and methods for improving it.
3. Acquire the knowledge of stability analysis techniques and develop the state space representation of control systems.

Course Outcomes:

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

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

UNIT-IV

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

UNIT-V

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

Suggested Readings:

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

Course Code	Course Title						Core/Elective
U23EC504	**Digital Signal Processing**						**Core**
	Contact Hours per Week						
Prerequisite	L	T	D	P	CIE	SEE	Credits
Signals & Systems	**3**	**-**	**-**	**0**	**40**	**60**	**3**

Course Objectives:

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

1. To understand the fast computation of DFT and FFT processing.
2. To study the designs and structures of digital (IIR and FIR) filters and analyze for a given specifications.
3. Describe the DSP processor architecture for the efficient implementation of digital filters.

Course Outcomes:

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

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

UNIT– I

Introduction to DFT & FFT: Discrete Fourier transform (DFT) definition, Properties of DFT, Linear and circular convolution using DFT.

Fast-Fourier-transform (FFT): Direct computation of DFT, Need for efficient computation of the DFT (FFT algorithms), Radix-2 FFT algorithm for the computation of DFT and IDFT using decimation-in-time and decimation-in-frequency algorithms.

UNIT-II

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

UNIT-III

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

UNIT–IV

Realization of Filters: Realization IIR and FIR filters using direct form-I and direct form-II, cascade, lattice, and parallel form.

Finite Word Length Effects: Limit cycles, Overflow Oscillations, Round-off Noise in IIR Digital Filters.

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

UNIT-V

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

Suggested Readings:

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

Course Code	Course Title						Core/Elective
U23EC5L1	**Pulse and Linear Integrated Circuits Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Electronic Devices Lab	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

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

1. Implementing high pass and low pass circuit, clipping and clamping circuits and study it's performance.
2. Bi-stable, Monostable and Astable Multivibrators.
3. Applications of Op-Amps and build circuits using Op-Amp and study it's performance.

Course Outcomes

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

1. Analyze the behavior of RC low-pass and high-pass circuits for various time constants and determine parameters like rise time.
2. Evaluate clipping and clamping circuits for waveform shaping applications.
3. Analyze multivibrator circuits (bistable, monostable, astable) and observe their switching behavior.
4. Demonstrate the operation and applications of special waveform generation circuits like Schmitt Triggers and OPAMP-based integrators/differentiators.
5. Measure key parameters of OPAMPs and design basic analog circuits like voltage followers, inverting and non-inverting amplifiers.

List of Experiments:

1. To study the Low Pass and High Pass RC Circuits at different RC time constant and find the rise time.
2. To design clipper circuit and understand the Clipping Circuit.
3. To design clamper circuit and understand the Clamping Circuit.
4. To design a Collector Coupled Bistable Multivibrators and its output waveform.
5. To design a Collector Coupled Monstable Multivibrators and its output waveform.
6. To design a Collector Coupled Astable Multivibrators and its output waveform.
7. To study the operation and output characteristics of the Schmitt Trigger Circuit.
8. To measure the OP-AMP Parameters
9. To design Inverting and Non-inverting OP-AMP Voltage follower.
10. To design and verify the function of Integrator and Differentiator using OPAMP.

Suggested Readings:

1. Robert Boylestad and Louis Nashelsky. *Electronic Devices and Cirenit Theon*: 5 Edition Prentice-Hall of India Private Limited. New Delhi. 1995.
2. David A. Bell. *Laboratory Manual for Electronte Devices and Circuits* 4 Edition. Prentice-Hall of India Private Limited. New Delhi. 2004.

Course Code	Course Title						Core/Elective
U23EC5L2	**Digital Signal Processing Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
Basic Simulation Lab	L	T	D	P			
	-	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives:

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

1. Implement the basic algorithms of DFT, IDFT FFT and IFFT.
2. Design FIR Filter with specific magnitude and phase requirements.
3. Design IIR Filter with specific magnitude and phase requirements.

Course Outcomes:

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

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

List of Experiments:

Perform the following programs using SCILAB Simulator/Equivalent Software

1. To Perform DFT and FFT algorithm.
2. To Perform Linear convolution.
3. To Perform Circular Convolutions.
4. To Perform FIR filters design using different window functions.
5. To Perform IIR filters design using Butterworth
6. To Perform IIR filters design using Chebyshev
7. To Perform Decimation process.
8. To Perform Interpolation process.
9. To implement Sampling rate conversion.
10. To determine Power Spectrum of a given signal.

Suggested Readings:

1. Jaydeep Chakravorthy, *Introduction to MATLAB Programming: Toolbox andSimulink*,1/e, University Press,2014.

2.. Proakis, John G. and Manolakis, Dimitris G. *Digital Signal Processing: Principles, Algorithms, and Applications* Edition: 4th Edition Publisher: Pearson Education ISBN: 978-0131873742.

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SCHEME OF INSTRUCTION & EXAMINATIONS [LR-23]
AICTE Model Curriculum (Tentative)
B.E. VI-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Week	Maximum Marks CIE	Maximum Marks SEE	Duration in Hours	
Theory Course											
1	U23EC601	PCC	Antennas and Wave Propagation	3	0	0	3	40	60	3	3
2	U23EC602	PCC	VLSI Design	3	0	0	3	40	60	3	3
3	U23EC603	PCC	Embedded Systems	3	0	0	3	40	60	3	3
4	U23EC 604	PCC	Electronics Measurement & Instrumentation	3	0	0	3	40	60	3	3
5	--	PEC	Professional Elective – II	3	0	0	3	40	60	3	3
6	--	OEC	Open Elective – II	3	0	0	3	40	60	3	3
Practical/ Laboratory Course											
7	U23EC6L1	PCC	Embedded System and IOT lab	0	0	2	2	25	50	3	1
8	U23EC6L2	PCC	ECAD Lab	0	0	2	2	25	50	3	1
9	U23EC6P1	PROJ	Mini Project	0	0	6	6	50	50	3	3
Total				18	0	10	28	340	510	27	23

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

CIE: Continuous Internal Evaluation **SEE:** Semester End Examination

PCC: Program Core Course **PEC**: Professional Electives

PROJ: Project Work **OEC:** Open Elective Course

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

Course Code	Course Title						Core/Elective
U23EC601	**Antennas and Wave Propagation**						**Core**
	Contact Hours per Week						
Prerequisite	L	T	D	P	CIE	SEE	Credits
Electromagnetic Waves &Transmission Lines	**3**	**-**	**-**	**0**	**40**	**60**	**3**

Course Objectives:

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

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

Course Outcomes:

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

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

UNIT–I

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

UNIT– II

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

UNIT-III

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

UNIT-IV

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

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

UNIT-V

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

Suggested Readings:

1. J. D. Kraus, R. J. Marhefka, and Ahmad S. Khan, *Antennas and Wave Propagation* , McGraw-Hill, 4th Edition, 2010.
2. Constantine A. Balanis,*Antenna Theory: Analysis and Design*, 3rd Edition, John Wiley, 2005.
3. Robert E. Collin,*Antennas and Radiowave Propagation*, McGraw-Hill, 1985.
4. A.R.Harish and M. Sachidananda *Antennas and Wave Propagation,* Oxford University Press, 2007..
5. K D Prasad *,Antenna and Wave propagation* , 2nd edition, Satya Prakashan, 2007.

Course Code	Course Title						Core/Elective
U23EC602	**VLSI Design**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Digital Electronics & Pulse and Linear ICs	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objective:

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

1. Give exposure to different steps involved in the fabrication of ICs.
2. Give exposure to the design rules to be followed to draw the layout of any logic circuit.
3. Provide design concepts to design building blocks of data path of any system using gates, and to understand basic programmable logic devices and testing of CMOS circuits.

Course Outcomes:

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT –IV

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

UNIT – V

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

Suggested Readings:

1. Kamran Eshraghian, Eshraghian Dougles and A.Pucknell,,*Essentials of VLSI circuits and systems* PHI, New Edition.
2. Neil H. E Weste, David Harris,Ayan Banerjee,*CMOS VLSI Design – A Circuits and Systems Perspective*, 3rd Ed, Pearson, 2009.
3. Ming-BO Lin, *Introduction to VLSI Systems: A Logic, Circuit and System Perspective* CRCPress, 2011,
4. Wayne Wolf, *Modern VLSI Design* ,Pearson Education, 3rd Edition, 1997.
5. K. Lal Kishore, V. S. V. Prabhakar, *VLSI Design*,I.K International, 2009.

Course Code	Course Title						Core/Elective
U23EC603	**Embedded Systems**						**Core**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	0	p			
Microprocessors and Microcontrollers	**3**	**0**	**0**	**0**	**40**	**60**	**3**

Course Objectives:

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

1. To understand the architecture of 8051 microcontrollers.
2. To understand the various applications of Embedded Systems using the concepts of Interfacing.
3. To familiarize with the design principles of SOC.

Course Outcomes:

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

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

UNIT-I

Embedded Computing Introduction: General Computing system v/s Embedded Computing System, History of Embedded Systems Classification Of Embedded System, Characteristics of Embedded Systems, operational requirements of embedded systems and non-operational requirements of embedded system, Major applications areas of Embedded systems.

UNIT-II

Typical Embedded Systems: Core of the embedded systems, Microprocessors v/s Microcontrollers, memory concepts, Applications: Interfacing with Push buttons and switches, Interrupts controllers, Serial Data Communication, Bus protocols: I2Cbus and CAN bus. External communication Interface: Zigbee, GPRS, Bluetooth, RFID

UNIT-III

Embedded Firmware Design and Development: Embedded Firmware Design Approaches, OS based, super loop based, Assembly language based, High level language based approaches, IDE concepts, sample programs on Embedded C.

UNIT-IV

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

UNIT-V

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

Suggested Readings:

1. Shibu K V ,*Introduction to Embedded Systems* , 5th edition, Mc Graw Hill Education
2. C Muhammad Ali Mazidi Janice Gillespie Mazidi, Rolin D. McKinlay,*The 8051Microcontroller and Embedded Systems using Assembly*,Prentice Hall India,2nd Edition.
3. Raj Kamal *,Embedded Systems*, Second Edition, Mc Graw Hill Education
4. D. Patranabis, *Sensors and Transducers*, PHI Learning Private Limited.
5. David E. Simon *An Embedded Software Primer*", Pearson Education

Course Code	Course Title						Core / Elective
U23EC604	**Electronic Measurement and Instrumentation**						**Core**
Prerequisite	**Contact Hours Per Week**				**CIE**	**SEE**	**Credits**
Electronic Devices and Circuits	**L**	**T**	**D**	**P**			
	3	-	-	-	40	60	3

Course Objectives:

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

1. Understand the different standards of measurements.
2. Study different types of transducers, Sensors and their measuring techniques
3. Learn about various types of biomedical instrumentation equipment.

Course Outcomes:

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

1. Describe characteristic of an instrument and state different Standards of measurements
2. Identify and explain different types of Transducers
3. Draw and Interpret types of transducers.
4. Design and analyse the digital voltmeters and prioritize the instruments.
5. Identify and classify types of Biomedical instruments.

UNIT-I

Electronic Measurement fundamentals: Accuracy, Precision, Resolution and Sensitivity. Errors and their types. Standards of measurement, classification of standards, IEEE standards.

UNIT-II

Transducers: Classification, factors for selection of a transducer, transducers for measurement of velocity, acceleration. Passive electrical transducers- Strain gauges and strain measurement, LVDT and displacement measurement, capacitive transducer and thickness measurement. Active electrical transducers: Piezo electric, photo conductive, photo voltaic and photo emissive transducers

UNIT-III

Electronic Sensors: Characteristics of sound, pressure, power and loudness measurement. Microphones and their types. Temperature measurement, resistance wire thermometers, semiconductor thermometers and thermo couples..

UNIT-IV

Measuring instruments: Block diagram, specification and design considerations of different types of DVMs. Spectrum analysers. The IEEE488 or GPIB Interface and protocol. Delayed time base oscilloscope and Digital storage oscilloscope. Introduction to virtual instrumentation, SCADA. Data acquisition system block diagram.

UNIT-V

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

Suggested Readings:

1. A.K. Shawney, Dhanpat Rai & Co. Jan, 2021.
2. A.D. Helbincs, W. D.Cooper ,*Modern Electronic Instrumentation and Measurement Techniques*, PHI 5th Edition 2003.
3. H. S. Kalsi ,*Electronic Instrumentation*:– TMH, 2nd Edition 2004.
4. David A. Bell ,*Electronic Instrumentation and Measurements* , Oxford Univ. Press, 1997.
5. Khandpur. R.S., "*Handbook of Bio- Medical Instrumentation*", TMH, 2003.

Course Code	Course Title						Core/Elective
U23EC6L1	**Embedded Systems and IoT lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Microcontrollers	**-**	**-**	**2**	**2**	**25**	**50**	**1**

Course Objectives:

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

1. To program Arduino to control lights, motors, and other devices.
2. To learn Arduino's architecture, including inputs and connectors for add-on devices.
3. To add third-party components such as Sensors, LEDs Switches, LCDs, Buzzers, to extend Arduino's functionality.

Course Outcomes:

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

1. Execute basic and advanced Embedded C language programs.
2. Learn the ways to interface I/O devices with processor for task sharing.
3. Recall the basics of co-processor and its ways to handle Multiple Interfacings.
4. Recognize the functionality of micro controller, latest version processors and its applications.
5. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyse the results

List of Experiments:

1. Switch/Pushbutton and LED Interfacing with Arduino to perform GPIO Operation.
2. LCD Interfacing with Arduino to print a character/string.
3. DC-Motor Interfacing with Arduino.
4. LDR Interfacing with Arduino.
5. Humidity Sensor Interfacing with Arduino.
6. Ultrasonic Sensor Interfacing with Arduino.
7. MQ2 Interfacing with Arduino.
8. Relay & Buzzer Interfacing with Arduino.
9. Bluetooth Interfacing with Arduino for Serial Communication.
10. IOT Module ESP8266 Interfacing with Arduino for IOT Communication.

Suggested Readings:

1. Arduino Projects for Engineers: *A Multipurpose Book for all Engineering Branches* (English Edition) 1st Edition, Kindle Edition by Neerparaj Rai.
2. *Microcontroller Programming with Arduino and Python Paperback* – 23 February 2024 by FOSSEE team at IIT Bombay.

Course Code	Course Title						Core/Elective
U23EC6L2	**ECAD Lab**						**Core**
	Contact Hours per Week				CIE	SEE	Credits
Prerequisite	L	T	D	P			
VLSI design	**-**	**-**	**2**	**2**	**25**	**50**	**1**

Course Objectives:

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

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

Course Outcomes:

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

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

List of Experiments:

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

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

Suggested Readings:

1. M. Morris Mano,Michael D.Ciltti ,*Digital Design*, 6th Edition 2018.
2. Samir Palnitkar ,*Verilog* HDL, *Foreword* by Prabhu Goel, 2 Edition 2003.

Course Code	Course Title					Core / Elective
U23EC6P1	**Mini Project**					**PROJ**
Prerequisite	Contact Hours Per Week			CIE	SEE	Credits
	L	T	P			
-	**-**	**-**	**6**	**50**	**50**	**3**

Course Objectives:

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

1. Familiarize tools and techniques of systematic literature survey and documentation.
2. Expose the students to industry practices and team work.
3. Encourage students to work with innovative and entrepreneurial ideas.

Course Outcomes:

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

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

Guidelines:

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

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(W. e. f Academic Year 2023-24)
PROFESSIONAL ELECTIVE COURSES

S. No.	Course Code	Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Week	Maximum Marks		Duration in Hours	
								CIE	SEE		
Theory Course											
1	U23EC505	PEC 1	Global System for Mobile Communications	3	0	0	3	40	60	3	3
	U23EC506		Digital Image Processing	3	0	0	3	40	60	3	3
	U23EC507		Advanced Micro Controllers	3	0	0	3	40	60	3	3
	U23EC508		Digital IC Design	3	0	0	3	40	60	3	3
2	U23EC605	PEC 2	Wireless Communication	3	0	0	3	40	60	3	3
	U23EC606		Digital Signal Processor Architectures	3	0	0	3	40	60	3	3
	U23EC607		Introduction to IOT	3	0	0	3	40	60	3	3
	U23EC608		Digital System Design through Verilog	3	0	0	3	40	60	3	3
3	U23EC704	PEC 3	Satellite Communication	3	0	0	3	40	60	3	3
	U23EC705		Multirate Signal Processing	3	0	0	3	40	60	3	3
	U23EC706		IOT Protocols and its Applications	3	0	0	3	40	60	3	3
	U23EC707		Low power VLSI Design	3	0	0	3	40	60	3	3
4	U23EC802	PEC 4	Radar Systems	3	0	0	3	40	60	3	3
	U23EC803		Mixed signal Design	3	0	0	3	40	60	3	3
	U23EC804		Artificial Intelligence & Machine Learning	3	0	0	3	40	60	3	3
	U23EC805		System on Chip Design	3	0	0	3	40	60	3	3

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OPEN ELECTIVE COURSES

S. No.	Course Code	Category	Course Title
01	U23EE508	OEC 1	Non Conventional Energy Systems
	U23EE509		Energy Conservation and Management
	U23CS508		Fundamentals Of Database Management System
	U23IT506		Data Structures
	U23ME509		Basics of Mechanical Engineering
	U23ME510		Modern Manufacturing Processes
	U23CE510		Disaster Preparedness and Management
	U23CE511		Civil Engineering Principles and Practices
	U23EC509		Principles of Electronics Communication
	U23EC510		Introduction to Internet of Things
	U23MB501		Business Communication
	U23MB502		Managerial Science and Theory
	U23SH501		History of Science & Technology
	U23SH502		Economic Policies in India

S. No.	Course Code	Category	Course Title
01	U23EE608	OEC 2	Fundamental of Power Electronics
	U23EE609		Electrical Installation and Safety
	U23CS607		Introduction To Programming In Java
	U23IT606		Operating Systems
	U23ME608		Basics Of 3-D Printing
	U23ME609		Optimization Methods for Engineers
	U23CE609		Construction Materials
	U23CE610		Engineering Geology
	U23EC609		Principles of Data Communication and Computer Network
	U23EC610		Introduction to Micro Processor & Micro Controller
	U23MB602		Total Quality Management
	U23MB603		Innovation Management
	U23SH601		Indian Music System
	U23SH602		Introduction to Art and Aesthetics

S. No.	Course Code	Category	Course Title
01	U23EE711	OEC 3	Introduction to Electrical Vehicles
	U23EE712		Design estimation and Costing of Electrical Systems
	U23CS711		Data Sciences
	U23IT705		Basics of Artificial Intelligence
	U23ME711		Renewable Energy Resources
	U23ME712		Cooling of Electronic Components
	U23CE711		Environmental Systems
	U23CE712		Urban Transportation System
	U23EC708		IOT and its applications
	U23EC709		Fundamental of Wireless Communication
	U23MB702		Supply Chain Management
	U23MB703		Start Up Management
	U23SH701		Display Devices
	U23SH702		Comparative Study of Literature

S. No.	Course Code	Category	Course Title
01	U23EE804	OEC 4	Smart Building Systems
	U23EE805		Industrial Automation
	U23CS806		Basics of Machine Learning
	U23IT802		Cloud computing
	U23ME806		Automobile Engineering
	U23ME807		Power Plant Engineering
	U23CE806		Green Building Technology
	U23CE807		Environmental Impact Assessment
	U23EC806		Embedded Systems
	U23EC807		5G Communication
	U23MB802		Entrepreneurship
	U23MB803		Digital Marketing
	U23SH801		Corrosion Science and Technology
	U23SH802		Introduction To Philosophical Thoughts