Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination(Modified)
Semester III (w.e.f. session 2019-2020)

Sr. No.	Course No.	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	BS-201A	Optics & Waves	3:0:0	3	3	75	25	0	100	3
2	EC-201A	Electronic Devices	3:0:0	3	3	75	25	0	100	3
3	EC-203LA	Electronic Devices Lab	0:0:2	2	1	-	40	60	100	3
4	EC-205A	Digital Electronics	3:0:0	3	3	75	25	0	100	3
5	EC-207LA	Digital Electronics Lab	0:0:2	2	1	-	40	60	100	3
6	EC-209A	Signals & Systems	3:0:0	3	3	75	25	0	100	3
7	EC-211LA	Signals & Systems Lab	0:0:2	2	1	-	40	60	100	3
8	EC-213A	Network Theory	3:0:0	3	3	75	25	0	100	3
9	ES-219A	Essentials of Information Technology	3:0:0	3	3	75	25	0	100	3
10	*EC-215A	Industrial Training-I	2:0:0	2	-	-	100	-	100	3
11	**MC-901A	Environmental Sciences	3:0:0	3	-	75	25	0	100	3
		Total		**26**	**21**	**450**	**270**	**180**	**900**	

*EC-215A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.
**MC-901A is a mandatory credit-less course in which the students will be required to get passing grade.

3rd Sem

BS – 201A	Optics and Waves						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h

Unit - I

Waves: Travelling waves, Characteristics of waves, Mathematical representation of travelling waves, General wave equation, Phase velocity, Light source emit wave packets, Wave packet and Bandwidth, Group velocity and real light waves.

Propagation of light waves: Maxwell's equations, Electromagnetic waves and constitutive relations, Wave equation for free-space, Uniform plane waves, Wave polarization, Energy density, the pointing vector and intensity, Radiation pressure and momentum, Light waves at boundaries, Wave incident normally on boundary, Wave incident obliquely on boundary: law of reflection, Snell's law and reflection coefficients.

Unit - II

Interference: Principle of Superposition, Conditions for Sustained interference, Young's double slit experiment, Division of wave-front: Fresnel's Biprism and its applications, Division of amplitude: Interference due to reflected and transmitted light, Wedge-shaped thin film, Newton's rings and its applications, Michelson Interferometer and its applications.

Unit – III

Diffraction: Types of diffraction, Fraunhofer diffraction at a single slit, Plane transmission diffraction grating: theory, secondary maxima and secondary minima, width of principal maxima, absent spectra, overlapping of spectral lines, determination of wavelength; Dispersive power and resolving power of diffraction grating.

Polarization: Polarization of transverse waves, Plane of polarization, Polarization by reflection, Double refraction, Nicol Prism, Quarter and half wave plate, Specific Rotation, Laurent 's half shade polarimeter, Biquartz polarimeter.

Unit – IV

Laser: Stimulated Absorption, Spontaneous and Stimulated Emission; Einstein's Coefficients and its derivation, Population Inversion, Direct and Indirect pumping, Pumping schemes, Main components of Laser, Gas lasers (He-Ne, CO_2), Solid state lasers (Ruby, Neodymium, semiconductor), Dye laser, Characteristics of Laser, Applications of Laser.

Text/Reference Books:

1. P.K. Diwan, Applied Physics for Engineers, *Wiley India Pvt. Ltd., India*
2. N. Subrahmanyam, B. Lal, M.N. Avadhanulu, A Textbook of Optics, *S. Chand & Company Ltd., India.*
3. A. Ghatak, Optics, *McGraw Hill Education (India) Pvt. Ltd., India.*
4. E. Hecht, A.R. Ganesan, Optics, *Pearson India Education Services Pvt. Lt., India.*

Optics and Waves (BS-201A)

COs

BS – 201A.1	Understand the basic phenomenon for propagation of waves.
BS – 201A.2	Illustrate the fundamentals of Interference and their applications.
BS – 201A.3	Explain the fundamentals of Diffraction, Polarization and their applications.
BS – 201A.4	Summarize the basics of Laser technology and classify their different types.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
BS – 201A.1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
BS – 201A.2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
BS – 201A.3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
BS – 201A.4	2	-	-	-	-	-	-	-	-	-	-	-	2	-
AVG	2	2	-	-	-	-	-	-	-	-	-	-	2	-

EC-201A	Electronic Devices						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

UNIT-I

Charge Carriers Transport : Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Continuity equation, PN Junction: Basic Structure, small signal equivalent circuit of p-n diode, derivation of barrier potential and diode current equation, Simple diode circuits: clipping, clamping and rectifiers, Zener diode and its application as voltage regulator.

UNIT-II

Bipolar Junction Transistor: Basic principle of operation, Current gains : derivation of α,β,Υ and their relationship. Various modes of operation of BJT, Base Width Modulation, Transistor hybrid model, h-parameter equivalent circuit of transistor, Analysis of transistor amplifier using h-parameters, calculation of input impedance, output impedance and voltage gain.

UNIT-III

Field Effect Devices: JFET : basic Operation and characteristics, drain and transfer characteristics, pinch off voltage, parameters of JFET: Transconductance (g_m), ac drain resistance (r_d), amplification factor(μ) ,Small Signal Model & Frequency Limitations. MOSFET: basic operation, depletion and enhancement type, pinch-off voltage, Shockley equation and Small Signal Model of MOSFET, MOS capacitor.

UNIT-IV

Regulated Power Supplies: Voltage Regulation, block diagram of DC regulated power supply, Zener diode voltage regulators: transistor series voltage regulator, Transistor shunt voltage regulator, Controlled Transistor Voltage Regulator, Op-Amp Series and shunt voltage regulator.

Text Books:

1. Millman & Halkias: Integrated Electronics, TMH.
2. Boylestad & Nashelsky: Electronic Devices & Circuit Theory, PHI.

Reference Books:

1. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995.
2. E S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
3. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
4. S Salivahanan and N Naresh Kumar, Electronics devices and circuits, McGraw Hill,1998.

Electronic Devices (EC-201A)

COs

EC-201A.1	Understand the concept of carrier transport phenomena, Fermi Energy in semiconductors devices and infer the working operation of different diodes with V-I characteristics
EC-201A.2	Explain the working mechanism of Bipolar Junction Transistor in various configurations with characteristics and analysis of transistor amplifier in hybrid model for various parameters
EC-201A.3	Analyze the non-ideal behavior of FET devices regarding their construction, operation, voltage current characteristics using N channel and P channel.
EC-201A.4	Design different configurations of regulated power supplies using Zener diodes and Op-Amp

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-201A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
EC-201A.2	3	2	-	1	-	-	-	-	-	-	-	-	3	1
EC-201A.3	3	2	-	1	-	-	-	-	-	-	-	-	3	1
EC-201A.4	3	-	1	-	-	-	-	-	-	-	-	-	3	1
AVG	3	2	1	1	-	-	-	-	-	-	-	-	3	1

EC-203LA	Electronic Devices Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

List of experiments:

1. To study the VI characteristics of p-n diode in forward and reverse bias and find the threshold voltage from the VI curve.

2. To study the operation of Zener diode as a voltage regulator.

3. To study the operation of half-wave and full wave rectifiers and calculate their ripple factor values.

4. To study the operation of series and parallel Clippers using P-N junction diodes.

5. To study the operation of clampers using P-N junction diodes.

6. To experimentally plot the input and output characteristics of a given BJT transistor in CE configuration and calculate its various parameters.

7. To experimentally plot the input and output characteristics of a given BJT transistor in CB configuration and calculate its various parameters.

8. To study the transfer and drain characteristics of JFET and calculate its various parameters.

9. To study the transfer and drain characteristics of MOSFET and calculate its various parameters.

10. To study the different types of negative feedback in two stage amplifier and to observe its effects upon the amplifier parameters.

11. To study the Zener diode as a transistor series voltage regulator.

12. To study the Zener diode as a transistor shunt voltage regulator.

Reference Books:

1. Millman & Halkias: Integrated Electronics, TMH.
2. Boylestad & Nashelsky: Electronic Devices & Circuit Theory, PHI.

Electronic Devices Lab (EC-203LA)

COs

EC-203LA.1	Examine the VI characteristics of various diodes such as p-n diode, zener diode etc. find the threshold voltage and zener breakdown voltage from the VI curve.
EC-203LA.2	Construct various configuration of transistor experimentally and examine various parameters of Transistor such as voltage gain, current gain etc.
EC-203LA.3	Analyze the non ideal behavior of FET devices regarding their construction, operation, VI characteristics using N channel and P channel.
EC-203LA.4	Design different configurations of regulated power supplies using Zener diodes and Op-Amp.ent kind of regulated power supplies.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-203LA.1	2	-	-	-	-	-	-	1	2	1	-	-	3	-
EC-203LA.2	2	-	-	1	-	-	-	1	2	1	-	1	3	1
EC-203LA.3	2	2	-	1	-	-	-	1	2	1	-	1	3	1
EC-203LA.4	2	-	1	-	-	-	-	1	2	1	-	-	3	1
AVG	2	2	1	1	-	-	-	1	2	1	-	1	3	1

EC-205A	Digital Electronics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

UNIT-I

Fundamentals of Digital Systems and Techniques: Digital signals, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, number systems: binary, signed binary, octal, hexadecimal number, binary arithmetic,one's and two's complements arithmetic, Codes:BCD codes, Excess-3, Gray codes, Error detecting and correcting codes: parity check codes and Hamming code

Minimization Techniques: Basic postulates and fundamental theorems of Boolean algebra: Standard representation of logic functions: SOP and POS forms, Simplification of switching functions using K-map and Quine-McCluskey tabular methods,Don't care conditions, Digital logic families: TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

UNIT-II

Combinational DigitalCircuits:Design procedure: Half adder, Full Adder, Half subtractor, Full subtractor , Parallel binary adder, parallel binary Subtractor, Carry Look Ahead adder, Serial Adder/Subtractor, BCD adder, Binary Multiplier, Binary Divider, Multiplexer/ De-multiplexer, decoder, encoder, parity checker, parity generators, code converters, Magnitude Comparator.

UNIT-III

Sequential circuits: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K, T and D types flip flops, applications of flip flops: shift registers, serial to parallel converter, parallel to serial converter, Synchronous and Asynchronous mod counter,FSM, sequence generator and detector.

UNIT-IV

A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/Aconverter, specifications for D/A converters, analog to digital converters: quantization and encoding, parallel comparator A/Dconverter, successive approximation A/D converter, specifications for A/D converters

Semiconductor Memories and Programmable Logic Devices: Characteristics of memories, read only memory (ROM), read and write memory (RAM), Programmable logic array, Programmable array logic, Introduction to Field Programmable Gate Array (FPGA)

Text Books:

1. M. M. Mano, "Digital design", Pearson Education India, 2016.
2. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 8th Edition, TMH, 2003.
3. Taub Schilling, Digital Integrated Electronics, TMH

Reference Books:

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. A.K. Maini, Digital Electronics, Wiley India
3. R P Jain, Modern digital electronics, TMH

Digital Electronics (EC-205A)

COs

EC-205A.1	Summarize the number systems and to learn minimization of functions using Boolean algebra, Karnaugh maps and Quine-McClusky method.
EC-205A.2	Understand the operational and electrical characteristics of logic families.
EC-205A.3	Construct different type of combinational circuits.
EC-205A.4	Design and analysis of synchronous and asynchronous sequential circuits using flip flops.
EC-205A.5	Illustrate the working of different A/D and D/A converters
EC-205A.6	Implement combinational logic circuits using various programmable logic devices

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-205A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
EC-205A.2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
EC-205A.3	3	-	3	-	-	-	-	-	-	-	-	-	3	2
EC-205A.4	3	3	3	2	-	-	-	-	-	-	-	-	3	2
EC-205A.5	3	-	-	-	-	-	-	--	-	-	-	-	3	-
EC-205A.6	3	-	3	2	-	-	-	-	-	-	-	-	3	2
AVG	3	3	3	2	-	-	-	-	-	-	-	-	3	2

EC-207LA	Digital Electronics Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

List of experiments:

1. Familiarization with Digital Trainer Kit and associated equipment.

2. Study of TTL gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.

3. Design and realize a given function using K-Maps and verify its performance.

4. To verify the operation of Multiplexer and De-multiplexer.

5. To verify the operation of Comparator.

6. To verify the truth table of S-R, J-K, T, D Flip-flops.

7. To verify the operation of Bi-directional shift register.

8. To design and verify the operation of 3-bit asynchronous counter.

9. To design and verify the operation of asynchronous Up/down counter.

10. To design and verify the operation of asynchronous Decade counter.

11. Study of Encoder and Decoder.

12. Study of BCD to 7 segment Decoder

Text Books:

1. M. M. Mano, "Digital design", Pearson Education India, 2016.
2. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 8th Edition, TMH, 2003.

DIGITAL ELECTRONICS LAB (EC-207LA)	
	COs
EC-207LA.1	Identify various digital ICs and understand their operation
EC-207LA.2	Design basic combinational Circuits and verify their functionalities
EC-207LA.3	Apply the design procedures to design basic sequential circuits using Flip-Flops
EC-207LA.4	Understand the concept of encoders and decoders and verify their operation

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-207LA.1	3	-	-	-	-	-	-	1	2	1	-	1	3	-
EC-207LA.2	3	-	3	1	-	-	-	1	2	1	-	1	3	2
EC-207LA.3	3	2	3	1	-	-	-	1	2	1	-	1	3	2
EC-207LA.4	3	-	3	1	-	-	-	1	2	1	-	1	3	2
AVG	3	2	3	1	-	-	-	1	2	1	-	1	3	2

EC-209A	Signals and Systems						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

UNIT-I

Introduction to Signals: Continuous and discrete time signals, deterministic and stochastic signals, periodic and a periodic signals, even and odd signals, energy and power signals, exponential and sinusoidal signals and singular functions. Signal representation in terms of singular functions, orthogonal functions and their use in signal representation

Introduction to Systems: Linear and non-linear systems, time invariant and time varying systems, lumped and distributed systems, deterministic and stochastic systems, casual and non-causal systems, analog and discrete/digital memory and memory less systems.

UNIT-II

Random Variables: Introduction to Random Variables, pdf, cdf, moments, distributions, correlation functions.

Linear Time Invariant Systems: Introduction to linear time invariant (LTI) systems, properties of LTI systems, convolution integral, convolution sum, causal LTI systems described by differential and difference equations, Concept of impulse response.

UNIT-III

Discretization of Analog Signals: Introduction to sampling, sampling theorem and its proof, effect of undersampling, reconstruction of a signal from sampled signal.

Fourier Series : Continuous time Fourier series (CTFS), Properties of CTFS, Convergence of Fourier series, Discrete time Fourier Series (DTFS), Properties of DTFS **,** Fourier series and LTI system, Filtering.

UNIT-IV

Fourier Transform: Continuous Time Fourier Transform (CTFT), Properties of CTFT, Systems characterized by linear constant- coefficient differential equations, Discrete time fourier transform (DTFT), Properties of DTFT, Duality, Systems characterized by Linear constant coefficient difference equations.

Laplace Transform: Introduction to Laplace transform, Region of convergence for laplace transform, Inverse laplace transform, Properties oflaplace transform, Analysis and characterization of LTI systems using laplace transform, System function algebra and block diagram representations,Unilateral laplace transform.

Text Books:

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, Signals and Systems, Prentice Hall India, 2nd Edition, 2009

Reference Books:

1. Simon Haykins – "Signal & Systems", Wiley Eastern
2. Tarun Kumar Rawat , Signals and Systems , Oxford University Press.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
5. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

SIGNAL & SYSTEM (EC-209A)

COs

EC-209A.1	Illustrate different types of signals and systems.
EC-209A.2	Understand the concept of Random Variable and analysis of systems using convolution technique.
EC-209A.3	Make use of sampling phenomenon to convert continuous time signal into discrete signal.
EC-209A.4	Solve Fourier Series technique to analyze spectrum of continuous and discrete time signals.
EC-209A.5	Apply different time to frequency domain transformation techniques to analyze different system

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-209A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
EC-209A.2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
EC-209A.3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
EC-209A.4	3	2	-	2	-	-	-	-	-	-	-	-	3	1
EC-209A.5	3	2	-	2	-	-	-	--	-	-	-	-	3	1
AVG	3	2	-	2	-	-	-	-	-	-	-	-	3	1

ECE-211LA	Signals & Systems Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

List of experiments:

1. Introduction of the MATLAB/SciLab/Octave software.
2. To demonstrate some simple signal.
3. To explore the effect of transformation of signal parameters (amplitude-scaling, time-scaling and time-shifting).
4. To visualize the complex exponential signal and real sinusoids.
5. To identify a given system as linear or non-linear.
6. To explore the time variance and time invariance property of a given system.
7. To explore causality and non-causality property of a system.
8. To determine Fourier transform of a signal.
9. To determine Laplace transform of a signal.
10. To demonstrate the time domain sampling of band limited signals (Nyquist theorem).
11. To demonstrate the sampling in frequency domain (Discrete Fourier Transform).
12. To demonstrate the convolution and correlation of two continuous-time signals.
13. To demonstrate the convolution and correlation of two discrete-time signals.

Reference Books:

1. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

2. Signals and Systems using Scilab, www.scilab.in.

3.Signals and Systems using Octave, www.octave.org

Signal & System Lab (EC-211LA)

COs

ECE-211LA.1	Understand the basic concepts of MATLAB
ECE-211LA.2	Illustrate various properties of signals and systems.
ECE-211LA.3	Demonstrate the relationship between time and frequency domain.
ECE-211LA.4	Determine the Convolution and Correlation of two signals.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECE-211LA.1	-	-	-	-	3	-	-	1	-	1	-	1	3	-
ECE-211LA.2	3	-	-	-	3	-	-	1	-	1	-	1	3	1
ECE-211LA.3	3	-	-	-	3	-	-	1	-	1	-	1	3	1
ECE-211LA.4	3	-	-	-	3	-	-	1	-	1	-	1	3	1
AVG	3	-	-	-	3	-	-	1	-	1	-	1	3	1

EC-213A	Network Theory						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

UNIT I

INTRODUCTION: - Principles of network topology, graph matrices, Network Analysis (Time-Domain): Singularity Functions, Source-Free RC, RL, Series RLC, Parallel RLC circuits, Initial & Final Conditions, Impulse & Step Response of RC, RL, Series RLC, Parallel RLC circuits.

UNIT 2

NETWORK ANALYSIS (using Laplace Transform): - Circuit Element Models, Transient Response of RC, RL, RLC Circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using Laplace transform.

NETWORK FUNCTIONS: - Terminal pairs or Ports, Network functions for one-port and two-port networks, poles and zeros of Network functions, Restrictions on pole and zero Locations for driving point functions and transfer functions.

UNIT 3

CHARACTERISTICS AND PARAMETERS OF TWO PORT NETWORKS: - Relationship of two-port variables, short-circuit admittance parameters, open circuit impedance parameters, transmission parameters, hybrid parameters, relationships between parameter sets, Inter-connection of two port networks.

UNIT 4

TYPES OF FILTERS AND THEIR CHARACTERISTICS: - Filter fundamentals, constant-k and m-derived low-pass and high-pass filters.

NETWORK SYNTHESIS: - Causality & Stability, Hurwitz Polynomials, Positive real functions, Synthesis of one port networks with two kind of elements.

TEXT BOOKS:

1. Fundamentals of Electric Circuits: Charles K. Alexander, Matthew N. O. Sadiku, McGraw Hill Education
2. Network Analysis: M.E. Van Valkenburg, PHI

REFERENCE BOOKS:

1. Network Analysis & Synthesis: F. F. Kuo, John Wiley.
2. Circuits & Networks: Sukhija & Nagsarkar, Oxford Higher Education.
3. Basic Circuit Theory: DasoerKuh, McGraw Hill Education.
4. Circuit Analysis: G.K. Mithal, Khanna Publication.

Network Theory (EC-213A)

COs

EC-213A.1	Apply the concept of graph theory on network topologies.
EC-213A.2	Analyze the network in the time domain and frequency domain for different singular functions.
EC-213A.3	Evaluate the time domain behavior from the pole-zero plots.
EC-213A.4	Examine the characteristics & parameters of two port networks.
EC-213A.5	Understand the concept & design of passive filters and one port networks.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-213A.1	3	3	-	3	-	-	-	-	-	-	-	-	3	2
EC-213A.2	3	3	-	3	-	-	-	-	-	-	-	-	3	2
EC-213A.3	3	3	-	3	-	-	-	-	-	-	-	-	3	2
EC-213A.4	3	-	-	-	-	-	-	-	-	-	-	-	3	-
EC-213A.5	3	-	3	-	-	-	-	--	-	-	-	-	3	2
AVG	3	3	3	3	-	-	-	-	-	-	-	-	3	2

ES-219A	Essentials of Information Technology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

UNIT-I

Python Programming: Familiarization with the basics of Python programming, process of writing a program, running it, and print statements; simple data-types: integer, float, string. The notion of a variable, and methods to manipulate it, Knowledge of data types and operators: accepting input from the console, assignment statement, expressions, operators and their precedence. Conditional statements: if, if-else, if-elsif-else; Notion of iterative computation and control flow: for, while, flowcharts, decision trees and pseudo code

UNIT-II

Idea of debugging: errors and exceptions; debugging: pdb, break points. Sequence datatype: Lists, tuples and dictionary, Introduce the notion of accessing elements in a collection using numbers and names. Sorting algorithm: bubble and insertion sort; count the number of operations while sorting. Strings: Strings in Python : compare, concat, substring. **Data visualization using Pyplot:** line chart, pie chart, and bar chart.

UNIT-III

Computer Systems and Organization: description of a computer system and mobile system, CPU, memory, hard disk, I/O, battery, power. Types of software:Types of Software – System Software, Utility Software and Application Software, how an operating system runs a program, operating system as a resource manager. **Cloud Computing**: Concept of cloud computers, cloud storage (public/private),and brief introduction to parallel computing.

UNIT-IV

Relational databases: idea of a database and the need for it, relations, keys, primary key, foreign key; use SQL commands to create a table, foreign keys; insert/delete an entry, delete a table. SQL commands: select, project, and join; indexes. Basics of NoSQL databases: Mongo DB

Text Books:

1. Python Programming: A modular approach by Sheetal Taneja and Naveen Kumar Pearson

Reference Books:

1. Python Programming - Using Problem Solving Approach by Reema Thareja Oxford Publication.
2. Database Management System a Practical Approach by Rajiv Chopra by S. Chand

Note: Separate paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

Essentials of Information Technology (ES-219A)

COs

ES-219A.1	Familiarization with the fundamental concepts of python language.
ES-219A.2	Develop a basic understanding of errors and exceptions and to apply data visualization functions using pyplot.
ES-219A.3	Understand the concepts of computer system architecture and cloud computing.
ES-219A.4	Learn theoretical and practical aspects of SQL programming.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ES-219A.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
ES-219A.2	3	2	-	2	-	-	-	-	-	-	-	-	-	-
ES-219A.3	3	2	2	2	-	-	-	-	-	-	-	-	-	-
ES-219A.4	3	2	2	2	-	-	-	-	-	-	-	-	-	-
AVG	3	2	2	2	-	-	-	-	-	-	-	-	-	-

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination(Modified)
Semester IV (w.e.f. session 2019-2020)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	BS-207A	Applied and Computational Mathematics	3:0:0	3	3	75	25	0	100	3
2	EC-202A	Digital Communication	3:0:0	3	3	75	25	0	100	3
3	EC-204LA	Communication Lab	0:0:2	2	1	-	40	60	100	3
4	EC-206A	Analog Circuits	3:0:0	3	3	75	25	0	100	3
5	EC-208LA	Analog Circuits Lab	0:0:2	2	1	-	40	60	100	3
6	EC-210A	Microprocessors & Microcontrollers	3:0:0	3	3	75	25	0	100	3
7	EC-212LA	Microprocessors & Microcontrollers Lab	0:0:2	2	1	0	40	60	100	3
8	EC-214A	Electromagnetic Field Theory	3:0:0	3	3	75	25	0	100	3
9	ES-208A	Basics of Analog Communication	3:0:0	3	3	75	25	0	100	3
10	*MC-902A	Constitution of India	3:0:0	3	-	75	25	0	100	3
		Total		**27**	**21**	**450**	**270**	**180**	**900**	

*MC-902A is a mandatory credit-less course in which the students will be required to get passing grade.

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 4th semester which will be evaluated in 5th semester

4th Sem

BS-207A	APPLIED AND COMPUTATIONAL MATHEMATICS						
LECTURE	TUTORIAL	PRACTICAL	CREDIT	MAJOR TEST	MINOR TEST	TOTAL	TIME
3	-	-	3	75	25	100	3 H

UNIT-1

ORDINARY & PARTIAL DIFFERENTIAL EQUATIONS

ODE: First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Second order linear differential equations with constant coefficients.

PDE: Formation of Partial Differential Equations, Solutions of first order linear and non-linear PDEs, Charpit's method, Solution to homogenous linear partial differential equations (with constant coefficients) by complimentary function and particular integral method.

UNIT-2

ADVANCE CALCULUS

Multivariable Calculus: Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar and) Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere .

Vector Calculus: Gradient, divergence and Curl and their properties, Directional derivative. Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

UNIT-3

LAPLACE TRANSFORM

Laplace Transform, Laplace Transform of Elementary Functions, Basic properties of Laplace Transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, solving ODEs by Laplace Transform method.

UNIT-4

NUMERICAL TECHNIQUES

Solution of polynomial and transcendental equations: Bisection method, Newton-Raphson method and Regula-Falsi method, Lagrange's formulae.

Numerical Differentiation using Newton's forward and backward difference formulae, Numerical integration: Trapezoidal rule and Simpson's $1/3^{rd}$ rule, Taylor's series, Runge-Kutta method for solving first and second order equations.

Textbooks/References:

1. Erwin Kreyszig and Sanjeev Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint, 2015.
2. W. E. Boyce and R. C. Di Prima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India,
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. G.F. Simmons and S.G. Krantz, Differential Equations, Tata McGraw Hill, 2007.
6. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall.
7. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
8. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
11. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.

12. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
13. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
14. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Applied and Computational Mathematics (BS-207A)	
	COs
BS-207A.1	Identify the ordinary and partial differential equations, its formation and solutions for multivariable differential equations originated from real world problems.
BS-207A.2	Extend the topic in calculus essential for computation w.r.t parameter variations, vectors and field theory.
BS-207A.3	Apply the concept of Laplace transform and how it is useful in solving the definite integrals and intial value problems.
BS-207A.4	Analyze the tools of numerical methods in a comprehensive manner those are used in approximating the solutions of various engineering problems.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
BS-207A.1	3	2	-	2	-	-	-	-	-	-	-	-	3	-
BS-207A.2	3	2	2	1	-	-	-	-	-	-	-	-	2	1
BS-207A.3	3	2	2	1	-	-	-	-	-	-	-	-	3	1
BS-207A.4	3	3	2	1	-	-	-	-	-	-	-	-	3	-
AVG	**3**	**2.25**	**1.5**	**1.25**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.75**	**0.5**

EC-202A	Digital Communication						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

UNIT-I

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing. Quantization noise in delta modulation, The O/P signal to quantization noise ratio in delta modulation, O/P signal to noise ratio in delta modulation, varients of DM.

UNIT-II

Base Band Pulse Transmission: Matched filter and its properties, average probability of symbol error in binary enclosed PCM receiver, Intersymbol interference, Nyquist criterion for distortionless base band binary transmission, ideal Nyquist channel raised cosine spectrum, correlative level coding Duo binary signalling, tapped delay line equalization, adaptive equalization, LMS algorithm, Eye pattern.

UNIT-III

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms-Probability of Error evaluations.

Pass band Digital Modulation schemes- ASK, Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. Signal space diagram and spectra of the above systems, effect of intersymbol interference, bit symbol error probabilities, synchronization.

UNIT-IV

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver).Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Text Books:

1.Haykin S., "Communications Systems", John Wiley and Sons, 2001.

2.Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.

3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.

Reference Books:

1.Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

2.Lathi B.P., " Modern Digital and Analog Communication", 4th edition, Oxford university Press, 2010

Digital Communication (EC-202A)

COs

EC-202A.1	Summarize digitization process of analog signal and analyze different baseband transmission schemes and their performance
EC-202A.2	Understand the concept of transmitting digital data over base band channel to examine various parameters
EC-202A.3	Compare different digital modulation scheme wrt various parameters like Spectra, BER etc
EC-202A.4	Analyze different modulation trade-offs and different equalization techniques

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-202A.1	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	3	**-**
EC-202A.2	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	3	**-**
EC-202A.3	3	2	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	1	3	**-**
EC-202A.4	3	2	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	1	3	**-**
AVG	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**

EC-204LA	COMMUNICATION LAB						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

List of experiments:

1: To study and Perform Amplitude Modulation & Demodulation.
2: To study and Perform Frequency Modulation and Demodulation.
3: To study and Perform Pulse Amplitude Modulation and Demodulation.
4: To study and Perform Pulse Width Modulation and Demodulation.
5: To study and Perform Pulse Position Modulation and Demodulation.
6: To study and Perform Pulse Code Modulation and Demodulation.
7: To study and Perform Time Division Multiplexing (TDM) system.
8: To study and Perform Amplitude Shift Keying (ASK) Modulation and De- Modulation.
9: To study and Perform Frequency Shift Keying (FSK) Modulation and De-Modulation.
10: To study and Perform Phase Shift Keying (PSK) Modulation and De-Modulation.
11: To study and Perform Quadrature Phase Shift Keying (QPSK) Modulation and De-Modulation.
12: To study and perform Adaptive Delta Modulation and demodulation.
13. To study Base Band Transmission and calculate bit error rate.

Reference Books:

1. Taub & Schilling, Principles of Communication Systems, McGraw Hill Publications, (1998) 2nd ed.
2. Simon Haykin, Communication Systems, John Wiley Publication, 3rd ed.
3. Sklar, Digital Communications, Prentice Hall-PTR, (2001) 2nd ed.
4. Lathi B. P., Modern Analog and Digital Communication, , Oxford University Press, (1998) 3rd

Communication Lab (EC-204LA)

COs

EC-204LA.1	Analyze analog modulated and demodulated Signals.
EC-204LA.2	Illustrate the outputs of different types of analog detectors.
EC-204LA.3	Examine digital Modulated and demodulated Signals.
EC-204LA.4	Interpret the outputs of different types of digital detectors.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-204LA.1	3	2	2	-	**-**	**-**	**-**	1	2	1	**-**	1	3	1
EC-204LA.2	3	-	-	-	**-**	**-**	**-**	1	2	1	**-**	-	3	-
EC-204LA.3	3	2	2	1	**-**	**-**	**-**	1	2	1	**-**	1	3	1
EC-204LA.4	3	-	-	-	**-**	**-**	**-**	1	2	1	**-**	-	3	-
AVG	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**-**	**1**	**3**	**1**

EC-206A	Analog Circuits						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

UNIT-I

Amplifier Models: Amplifier types: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier, comparison based on input impedance and output impedance. Small signal analysis of BJT amplifiers: CE, CB and CC amplifiers using r_e model, small signal analysis of the CS JFET amplifiers, estimation of voltage gain, input resistance, output resistance etc, design procedure for particular specifications of amplifiers.

UNIT-II

Transistor Frequency Response: Class A, class B, class C amplifiers: calculation of maximum efficiency. Frequency response of the amplifiers: low frequency, mid-frequency and high frequency region. Effect of cascading of amplifiers on the frequency response, cut-off frequencies, Bandwidth and voltage gain. Miller effect, Feedback in amplifiers: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth, input impedance, output impedance.

UNIT-III

Oscillators: Barkhausen criterion for oscillators, types of Oscillators: RC phase shift oscillator, Wien bridge oscillator, LC oscillators : Hartley oscillator, Collpit oscillator, derivation of frequency of oscillation for BJT and Op-amp configurations, 555 timer: operation as astable and monostable multivibrator.

UNIT-IV

Op-Amp Applications: Simple op-amp circuits: adder, subtractor, Schmitt trigger, Differential amplifier: calculation of differential gain, common mode gain, CMRR, OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages.

Text Books:

1. Millman & Halkias: Integrated Electronics, TMH.
2. Boylestad & Nashelsky: Electronic Devices & Circuit Theory, PHI.

Reference Books:

1. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995.
2. E S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
3. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
4. S Salivahanan and N Naresh Kumar, Electronics devices and circuits, McGraw Hill,1998.

Analog Circuits (EC-206A)

COs

EC-206A.1	Illustrate the basics concept of amplifying devices like BJT, FET, and op-amp.
EC-206A.2	Interpret and analyze BJT and FET amplifiers for small signals and high frequency signals.
EC-206A.3	Analyze the concept of feedback and its use in the design of oscillators.
EC-206A.4	Design various application based on amplifying devices.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-206A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
EC-206A.2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
EC-206A.3	3	3	-	2	-	-	-	-	-	-	-	-	3	-
EC-206A.4	3	3	3	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	**2**

EC-208LA	Analog Circuits Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

List of experiments:

1. To design a simple common emitter (CE) amplifier circuit using BJT and find its gain and frequency response. To design a differential amplifier using BJT and calculate its gain and frequency response.
2. To design a BJT emitter follower and determine is gain, input and output impedances.
3. To design and test the performance of Phase shift Oscillator using Op-Amp 741.
4. To design and test the performance of Wien bridge oscillator using Op-Amp 741.
5. To design and test the performance of BJT - RC Phase shift Oscillator for $f0 \leq 10$ KHz.
6. To design and test the performance of BJT – Hartley Oscillators for RF range $f0 \geq 100$KHz.
7. To design and test the performance of BJT – Colpitt Oscillators for RF range $f0 \geq 100$KHz.
8. To design an astable multivibrator using 555 timer.
9. To design a monostable multivibrator using 555 timer.
10. To design Schmitt trigger using Op-amp and verify its operational characteristics.
11. To design an adder circuit using Op-Amp to add three dc voltages.
12. To design a subtractor using Op-Amp to subtract DC voltages v1 and v2.

Reference Books:

1. Millman & Halkias: Integrated Electronics, TMH.
2. Boylestad & Nashelsky: Electronic Devices & Circuit Theory, PHI.
3. S Salivahanan and N Naresh Kumar, Electronics devices and circuits, McGraw Hill,1998.

Analog Circuits Lab (EC-208LA)

COs

EC-208LA.1	Understand the basic electronics components and Simulation Software.
EC-208LA.2	Design amplifier and oscillators based on op-amps and BJT.
EC-208LA.3	Construct application circuits based on op-amps like adder, subtractor, integrator etc.
EC-208LA.4	Develop application circuit based on 555 timers.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-208LA.1	3	-	-	-	**-**	**-**	**-**	1	2	1	**-**	-	3	-
EC-208LA.2	3	3	3	2	**-**	**-**	**-**	1	2	1	**-**	2	3	2
EC-208LA.3	3	3	3	2	**-**	**-**	**-**	1	2	1	**-**	2	3	2
EC-208LA.4	3	3	3	2	**-**	**-**	**-**	1	2	1	**-**	-	3	2
AVG	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**1**	**-**	**2**	**3**	**2**

EC-210A	MICROPROCESSORS AND MICROCONTROLLER						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

UNIT-I

Evolution of Microprocessor, Introduction to 8-bit Microprocessor 8085 architecture, Pin Details 8085 Microprocessor, 8086 Architecture description of data registers, address registers; pointer and index registers, PSW, Queue, BIU and EU, 8086 Pin diagram descriptions. Generating 8086 CLK and reset signals using 8284. WAIT state generation. Microprocessor BUS types and buffering techniques, 8086 minimum mode and maximum mode CPU module, 8086 CPU Read/Write timing diagrams in minimum mode and maximum mode.

UNIT-II

8051 Architecture, On-chip memory organization – general purpose registers, SFR registers, Internal RAM and ROM, Oscillator and Clock circuits. Pin Diagram of 8051, I/O Pins, Port, Connecting external memory, Counters and Timers, Purpose of TCON & TMOD registers, Serial data transmission/reception and transmission modes, Purpose of SCON & PCON registers, Different Types of Interrupts, Purpose of Time Delays, 8051 addressing modes.

UNIT-III

8086 Instruction format, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, transfer of control instructions; process control instructions. 8051 Data transfer instructions, arithmetic and logical instructions, Jump and Call instructions, I/O port, Timer and Counter programming, Serial port and Interrupt programming, Assembly language programs.

UNIT-IV

Memory devices, Address decoding techniques, Interfacing SRAMS; ROMS/PROMS, 8086 Interrupt mechanism; interrupt types and interrupt vector table. Intel's 8255 - description and interfacing with 8086, ADCs and DACs, - types operation and interfacing with 8086.

Interfacing of Matrix Keyboards, ADC, DAC, Temperature Sensor, Stepper Motor with 8051.

Text Books:

1. D.V. Hall, Microprocessors and Interfacing, McGraw Hill 2nd ed.
2. Kenneth Ayala," The 8051 Microcontroller" 3rd ed. CENGAGE Learning.
3. M.A. Mazidi, J.G. Mazidi, R. D. McKinlay," The 8051 Microcontroller and Embedded systems using assembly and C" -2nd Ed, Pearson Education.
4. Liu, Gibson, "Microcomputer Systems: The 8086/88 Family", 2nd Edition, PHI,2005.
5. Barry B. Brey, "The Intel Microprocessor8086/8088, 80186", Pearson Education, Eighth Edition, 2009.
6. Uffenback, "The 8086 Family Design" PHI, 2nd Edition.

Reference Books:

1. Mke Predko, "Programming and Customizing the 8051 Microcontroller", TMH.
2. Manish K Patel,"Microcontroller based embedded system", McGraw Hill Education.

MICROPROCESSOR & MICROCONTROLLER(ECE-210A)

COs

ECE-210A.1	Summarize the detailed architecture of microprocessor (8085, 8086).
ECE-210A.2	Understand the detailed architecture of microcontroller 8051.
ECE-210A.3	Classify and explain the instruction set and programming concepts in assembly language.
ECE-210A.4	Apply the programming tools to Interface peripherals with microprocessor

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECE-210A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECE-210A.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECE-210A.3	3	3	3	2	-	-	-	-	-	-	-	-	3	2
ECE-210A.4	3	3	3	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	**2**

EC-212LA	MICROPROCESSORS AND MICROCONTROLLER LAB						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

List of experiments

For 8086 Microprocessor write an Assembly Language Program to

1 Add / Sub two 16 bit numbers.
2 Multiply two 16 bit unsigned/ signed numbers.
3 Divide two unsigned/ signed numbers (32/16 , 16/8, 16/16, 8/8)
4 Find smallest/ largest number from array of n numbers.
5 Arrange numbers in array in ascending/ descending order.
6 Convert Hex to Decimal, Decimal to Hex.
7 Compare two strings using string instructions / without using string instructions.
8 Display string in reverse order, string length, Concatenation of two strings.
9 To find 1's and 2's complement of a number.
10 To find the Fibonacci Series.
11 To find Log of a given number using look up table.
12 To find Factorial of a number.
13 To write an ALP using 8051 Microcontrollers to perform addition, subtraction, multiplication and division of two eight bit numbers.
14 To write an ALP using 8051 Microcontrollers to perform logical operation i.e., AND, OR, XOR and Complement of two eight bit numbers.
15 To write an ALP using 8051 Microcontrollers to perform multi byte addition and subtraction of unsigned number.
16 To write an embedded C program using 8051 Microcontrollers for interfacing LCD to display message "LCD Display" on LCD screen.
17 To write an embedded C program using 8051 Microcontrollers for interfacing keypad to port P0 .Whenever a key is pressed; it should be displayed on LCD.
18 To write an embedded C program using 8051 Microcontrollers for interfacing a switch and a buzzer to two different pins of a Port such that the buzzer should sound as long as the switch is pressed.
19 To write an embedded C program using 8051 Microcontrollers for interfacing stepper motor to rotate clockwise and anticlockwise directions.
20 To write an embedded C program using 8051 Microcontrollers for interfacing relay and buzzer.

Reference Books:

1. Kenneth Ayala," The 8051 Microcontroller" 3rd ed. CENGAGE Learning.
2. M.A. Mazidi, J.G. Mazidi, R. D. McKinlay," The 8051 Microcontroller and Embedded systems using assembly and C" -2nd Ed, Pearson Education.

MICROPROCESSORS AND MICROCONTROLLER LAB (EC-212LA)

COs

EC-212LA.1	Understand basic concept of 8085, 8086 Microprocessors and 8051 Microcontrollers.
EC-212LA.2	Develop an assembly language program for 8086 Microprocessors as well as C language program for 8051 Microcontroller.
EC-212LA.3	Experiment with interfacing the various Peripheral to 8086 Microprocessors and 8051 Microcontrollers.
EC-212LA.4	Design the systems based on 8051 Microcontrollers.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-212LA.1	3	-	-	-	-	**-**	**-**	**1**	**2**	**1**	**-**	-	3	-
EC-212LA.2	3	3	3	2	-	**-**	**-**	**1**	**2**	**1**	**-**	-	3	-
EC-212LA.3	3	3	-	2	3	**-**	**-**	**1**	**2**	**1**	**-**	2	3	2
EC-212LA.4	3	3	3	2	3	**-**	**-**	**1**	**2**	**1**	**-**	2	3	2
AVG	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**1**	**2**	**1**	**-**	**2**	**3**	**2**

EC-214A	ELECTROMAGNETIC FIELD THEORY						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

UNIT I

Review: vector analysis in all the three coordinate system, line, surface & volume integrals, gradient, divergence & curl of a vector & their physical significance, Gauss Divergence theorem, Stokes theorem.

Gauss law in electrostatics & its applications, uniform line, surface & volume charge distributions, concepts of electric field & electric potentials, electric field & potential due to a linear dipole, method of images.

UNIT II

Biot Savart's law, Amperes circuital law & its applications. Boundary conditions for both the electric & magnetic fields at the interface of various types of media. Laplace, Poisson's equation & continuity equation. Faraday's & Lenz's laws, How Maxwell fixed Ampere's law, Maxwell's equations in differential & integral forms & their physical significance in circuit theory, retarded potentials.

UNIT III

Plane & uniform plane waves and their properties, waves equations in various media. . Polarisation & its types. Intrinsic impedance, propagation constant. Reflection & refraction of uniform plane waves at the interface of conductor- dielectric & dielectric - dielectric (both normal and oblique incidence). Relaxation time ,skin effect, skin depth & surface impedance, Poynting vector theorem & its physical significance.

.UNIT IV

Distributed parameters, circuit parameters, concepts of voltage & current flow on a transmission line, Transmission line equations, characteristic impedance. Reflection of transmission line, maxima & minima, standing wave ratio of a transmission line. Impedance matching, Smith's chart & its computational applications.

Concept of Wave Guide and TE, TM and TEM modes in rectangular and circular wave guide. Cut off and guide wave length.

References:

1. Fields and Waves by D.K. Cheng. (Pearson Education)
2. Electomagnetics by J.D. Krauss(TMGH)
3. Principles of Electomagnetics by Sadiku (Oxford Univ. Press)

ELECTROMAGNETIC FIELD THEORY (EC-214A)

COs

EC-214A.1	Summarize the concept of Vector Calculus and Coordinate Systems.
EC-214A.2	Interpret the concept of Electrostatic Field with its application.
EC-214A.3	Understand the concept of Magneto-static Field with its application and study of Maxwell Equation.
EC-214A.4	Apply the Maxwell Equation to analyze uniform plane waves and its propagation in different mediums.
EC-214A.5	Explain the basic fundamentals of Transmission Lines & waveguide with properties.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-214A.1	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	3	**-**
EC-214A.2	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	1	3	**-**
EC-214A.3	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	1	3	**-**
EC-214A.4	3	3	1	1	**-**	**-**	**-**	**-**	**-**	**-**	**-**	1	3	**-**
EC-214A.5	3	3	1	1	**-**	**-**	**-**	**-**	**-**	**-**	**-**	1	3	**-**
AVG	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**

ES -208A	BASICS OF ANALOG COMMUNICATION						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**

Unit-I

Communication system and Noise: Constituents of communication system, Modulation, Bandwidth requirement, Noise, Classification of noise, Resistor noise, Multiple resistor noise sources, Noise Temperature, Noise bandwidth, Noise figure, its calculation and measurement, Bandpass noise representation, Noise calculation in Communication Systems: Noise in Amplitude Modulated System, Noise in angle modulated systems.

Analog Modulation Techniques: Theory of amplitude modulation, AM power calculations, AM modulation with a complex wave, Concepts of angle modulation, Theory of frequency modulation, Mathematical analysis of FM, Spectra of FM signals, Narrow band FM, Wide band FM, Phase modulation, Phase modulation obtained from frequency modulation, Comparison of AM, FM & PM.

Unit-II

AM Transmission: Generation of Amplitude Modulation, Low level and high level modulation, Basic principle of AM generation, Square law modulation, Vander bijl modulation, Suppressed carrier AM generation (Balanced Modulator) ring Modulator.

AM Reception: Tuned Ratio Frequency (TRF) Receiver, Super heterodyne Receiver, RF Amplifier, Image Frequency Rejection, Cascade RF Amplifier, Frequency Conversion and Mixers, Tracking & and Alignment, IF Amplifier, AM detectors, Distortion in diode detectors, AM receiver characteristics.

Unit-III

FM Transmission: FM allocation standards, Generation of FM by direct method, Varactor diode Modulator, Indirect generation of FM, The Armstrong method RC phase shift method, Frequency stabilized reactance FM transmitter, FM stereo transmitter, Noise triangle.

FM Reception: Direct methods of Frequency demodulation, Frequency discrimination (Balanced slope detector), Foster seelay of phase discriminator, Ratio detector, Indirect method of FM demodulation, FM detector using PLL, Pre-emphasis / de-emphasis, FM receiver, FM stereo receiver.

Unit-IV

SSB Transmission: Introduction, Advantages of SSB Transmission, Generation of SSB, The Filter method The Phase Shift Method, The Third Method, Pilot Carrier SSB, Vestigial Side-band Modulation (VSB), VSB-SC, Application of AM and FM in TV transmission.

SSB Reception: SSB Product Demodulator, Balanced Modulator as SSB Demodulator, Pilot Carrier SSB Receiver, Modern Communication Receiver.

Analog Pulse Modulation: Introduction, Pulse amplitude modulation (PAM), PAM Modulator Circuit, Demodulation of PAM Signals, Pulse Time Modulation (PTM): Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), PWM and PPM Demodulator,

Text Books

1. Kennedy, G., Electronic Communication Systems, McGraw-Hill (2008) 4th ed.
2. Lathi.B.P.,Modern Digital and Analog Communications Systems 3rd ed.

Reference Books:

1.Taub, H., Principles of Communication Systems, McGraw-Hill (2008) 3rd ed.
2. Haykin, S., Communication Systems, John Willey (2009) 4th ed.
3. Proakis, J. G. and Salehi, M., Fundamentals of Communication Systems, Dorling Kindersley (2008) 2nd ed.
4. Mithal G K, Radio Engineering, Khanna Pub.
5. Singh & Sapre—Communication Systems: 2/e, TMH

Basics of Analog Communication (Subject code: ES-208A)

COs

ES-208A.1	Summarize different types of noise and its effect on communication systems.
ES-208A.2	Analyze different modulation techniques with their comparison.
ES-208A.3	Understand the concept of different radio Transmitters and Receivers.
ES-208A.4	Classify different Analog pulse modulation techniques and their comparative analysis

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ES-208A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ES-208A.2	3	2	-	-	-	-	-	-	-	-	-	-	3	1
ES-208A.3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ES-208A.4	3	-	-	-	-	-	-	-	-	-	-	-	3	-
AVG	**3**	**2**	-	-	-	-	-	-	-	-	-	-	**3**	**1**

5th Sem

S.No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	HM-903A	Soft Skill & Interpersonal Communication	3:0:0	3	3	75	25	0	100	3
2	EC-303LA	Electromagnetic Waves Lab	0:0:2	2	1	-	40	60	100	3
3	EC-305A	Computer Organization & Architecture	3:0:0	3	3	75	25	0	100	3
4	EC-307A	Information Theory and Coding	3:0:0	3	3	75	25	0	100	3
5	EC-309A	Digital Signal Processing	3:0:0	3	3	75	25	0	100	3
6	EC-311LA	Digital Signal Processing Lab	0:0:2	2	1	0	40	60	100	3
7	ECP*	Program Elective-I	3:0:0	3	3	75	25	0	100	3
8	ECO*	Open Elective-I	3:0:0	3	3	75	25	0	100	3
9	**EC-313A	Industrial Training-II	2:0:0	2	-	-	*100	-	*100	3
10	***MC-903A	Essence of Indian Traditional Knowledge	3:0:0	3	-	100	-	0	100	3
		Total		**27**	**20**	**550**	**230**	**120**	**900**	

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**EC-313 is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

***MC-903 is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

LIST OF OPEN ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
V	ECO-1A	Computer Networks
	ECO-2A	Mechatronics
	ECO-3A	Electronic Measurement and Instruments
	ECO-4A	Renewable Energy Resources
MOOC1		

LIST OF PROGRAM ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
V	ECP-1A	Probability Theory & Stochastic Processes
	ECP-2A	Speech and Audio Processing
	ECP-3A	Introduction to MEMS
	ECP-4A	Power Electronics
	ECP-5A	VLSI Technology

HM-903A	Soft Skills & Interpersonal Communication							
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Practical	Total	Time
3	0	0	3	75	25	-	100	3 Hrs.

Unit-I

Communication: Introduction Verbal, Non-Verbal, kinesics, proxemics, chronemics, Types of communication, extra personal communication, intrapersonal communication, intrapersonal communication, mass communication, Creativity in communication, Role of communication, flow of Communication and its need, Persuasive communication and negotiation; Time management in Persuasive communication, Importance of Persuasive Communication

Unit-II

Barriers in the way of communication, noise, intrapersonal barriers, interpersonal barriers, organizational barriers, Extra personal barriers, Basics of communication: importance of communication, process of communication, objectives and characteristics of communication, Communication skills: Accent, Intonation, Phonetics, Speaking skills, Confidence, clarity, Fluency, Quality, pronunciation

Unit-III

Personality Development; what is personality? Role of personality, Heredity, Environment, situation, Basics of personality, Soft skills; Needs and training, Activity in soft skills, Organizational skill; introduction and its need ,basics principles for Organization skills, Stress management; Introduction, Stress at home and office, Stress prevention, analyze the model of stress.

Unit-IV

Group discussion, form of Group discussion, strategy for Group discussion, discussing problems and solution, Oral presentation, introduction, planning, Occasion, Purpose, Modes of delivery, Resume making; Purpose of Resume, Resume design and structure, contents in Resume, types of resume, Job interview, introduction, objective of Interview, types of interview, stages of interview, Face to face interview and campus interview

Text Books:

1.Technical Communication Principles and Practice by Meenakshi Raman and Sangeeta Sharma by Oxford Publication

Reference Books:

1.Personality Development and soft skills by Barun K. Mitra, Oxford Publication

2.Communication Skills For Engineers by C.Muralikrishna and Sunita Mishra, Pearson Pub.

Soft Skills & Interpersonal Communication (HM-903A)	
COs	
HM-903A.1	Remember basic concepts related to communication for better learning.
HM-903A.2	Understand the process of communication and utilizing it in public speaking.
HM-903A.3	Create the personality traits for implementing it in daily life.
HM-903A.4	Analyze of speaking skills through Group Discussions and mock interviews practices.
HM-903A.5	Evaluate of the organizational skills through formal presentations.
HM-903A.6	Apply writing skills in developing resume for placements.

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**P09**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
HM-903A.1	-	-	-	-	-	-	-	2	-	-	-	-	-	-
HM-903A.2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
HM-903A.3	-	-	-	-	-	-	-	3	2	-	-	2	-	-
HM-903A.4	-	-	-	-	-	-	-	1	2	3	-	2	-	-
HM-903A.5	-	-	-	-	-	-	-	2	2	3	-	2	-	-
HM-903A.6	-	-	-	-	-	-	-	-	2	-	-	2	-	-
AVG	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**-**	**2**	-	-

EC-305A	Computer Organization and Architecture							
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Practical	Total	Time
3	-	-	3	75	25	-	100	3 Hrs.

UNIT-I

Basic Structure of Computer Hardware and Software: Introduction to basic computer architecture, register transfer, bus and memory transfers, arithmetic, logic and shift micro operations. Central Processing Unit: Introduction, general register organization, stack organization, instruction formats, addressing modes, data transfer and manipulation, program control, RISC, Macros and Subroutines.

UNIT-II

Control Design: Micro programmed control, control memory, address sequencing, micro program example, design of control unit, Hardwired Control: design methods, Multiplier Control Unit, CPU Control unit.

Processor Design: Decimal arithmetic unit –BCD adder, BCD subtraction, decimal arithmetic operations, Forms of Parallel processing classification of Parallel structures, Array Processors, Structure of general purpose Multiprocessors.

UNIT-III

Memory Organization:

Memory hierarchy, device characteristics, auxillary memory, associative memory, cache memory, virtual memory, memory management, hardware multiprocessor architectures and their characteristics, interconnection structures, Random access memories: semiconductor RAMS, Serial-access Memories – Memory organization, Main Memory Allocation.

UNIT-IV

System Organization:

Pipeline and Vector Processing: Parallel processing, pipelining, arithmetic pipeline, instruction pipeline, RISC pipeline, vector processing, array processors, Input-output Organization: Peripheral devices, input- output interface, asynchronous data transfer, modes of transfer, priority interrupt, DMA,

Text Books:

1. Morris Mano, “Computer System Architecture”, PHI.

2. J.F. Heys, “Computer Organization and Architecture”, TMH.

Reference Books:

1. J. Hennessy and D. Patterson, Computer Architecture A Quantitative Approach, 3rd Ed, Morgan Kaufmann, 2002.

Computer Organization and Architecture (EC-305A)

COs

ECE-305A.1	Understand the concept of basics of computer hardware & software.
ECE-305A.2	Interpret the design concept of control & processing units.
ECE-305A.3	Familiarize with the memory organization & interfacing; compare various memory systems.
ECE-305A.4	Outline the concept of parallel processing, pipelining and input output organization.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECE-305A.1	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
ECE-305A.2	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
ECE-305A.3	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
ECE-305A.4	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
AVG	**2.5**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

EC-307A	INFORMATION THEORY AND CODING					
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Major Test	Minor Test	Total	Time
3	0	0	75	25	100	3 Hr.

UNIT – I

Probability, random variables, Probability distribution functions and probability density functions, Expectation, moments, Random Processes, mean and Auto Correlation, Stationary and ergodicity, Information theory : the definition of information, the zero-memory information source, entropy for discrete ensembles; properties of entropy, Shannon's noiseless coding theorem; Encoding of discrete sources,

UNIT-II

Properties of codes: Introduction, types of codes: uniquely decodable codes, instantaneous codes, construction of an instantaneous code, Kraft inequality: statement and discussion and Proof, Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

UNIT – III

Coding information sources: The average length of a code, Shannon's First Theorem, Finding binary compact codes-Huffman codes, Code efficiency and redundancy; Channels and mutual information: Information channels, Binary symmetric channels, Probability relations in a channel, A priori and A posteriori entropies, Mutual information, properties of mutual information, types of channels: Noiseless, deterministic, Cascaded channels, Channel capacity.

UNIT – IV

Channel Coding: Shannon second theorem for Noisy channels, Introduction to error control coding, Types of codes, Maximum Likelihood decoding, Linear block codes, Error detecting and correcting capabilities of a block code, Hamming code, cyclic code, Convolutional arithmetic codes.

Text/Reference Books:

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

Information Theory & Coding (EC-307A)

COs

ECE-307A.1	Understand the basic concepts of probability & Random Process.
ECE-307A.2	Apply the concept of Information Theory to analyze the channel performance.
ECE-307A.3	Design source coding techniques to improve the channel performance.
ECE-307A.4	Develop the linear block codes and convolution codes for error detection and correction.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECE-307A.1	3	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
ECE-307A.2	3	2	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	2	-
ECE-307A.3	3	1	3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	2
ECE-307A.4	3	-	3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	2	-
AVG	**3**	**1.5**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

EC-309A		Digital Signal Processing						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Practical	Total	Time
3	-	-	3	75	25	-	100	3

Unit-I

Discrete Transforms: Z- transform and its properties, Inversion of Z-transform, One sided Z- transform and solution of differential equations. Analysis of LTI systems in Z-domain, causality, stability, schur-cohn stability test, relationship between Z-transform and Fourier transform.

Frequency Selective Filters: All pass filters, minimum-phase, maximum-phase and mixed- phase systems, Goertzel algorithm, Chirp Z-transform, applications of Z-Transform.

Unit-II

Frequency Domain Sampling and DFT: DTFT, DFT, properties, Linear filtering using DFT, Frequency analysis of signals using DFT, radix 2 and radix-4 FFT, computation of DFT of real sequences.

Implementation Structures of Discrete Time Systems: Direct form, cascade form, frequency sampling and lattice structures for FIR systems. Direct forms, transposed form, cascade form parallel form. Lattice and lattice ladder structures for IIR systems.

Unit-III

Design of FIR Filters: Characteristics of practical frequency selective filters, types of FIR filters, filter design specifications such as peak pass band ripple, minimum stop band attenuation etc., alternation theorem. Design of FIR filters using windowing method, frequency sampling method and Park-McClellan's method. Design of optimum equiripple FIR filters. Comparison of design methods for FIR filters. Effect of finite register length in FIR filter design.

Unit-IV

Design of IIR Filters: Design of IIR filters from analog filters, Design by approximation of derivatives, Impulse Invariance Method, Bilinear Transformation Method, Least Square Methods. Characteristics of Butterworth, Chebyshev and Elliptical analog filters, Frequency transformations, design of IIR filters in frequency domain.

Text/Reference Books:

1. J. G. Proakis and D.G. Manolakis, “Digital Signal Processing: Principles, Algorithms And Applications”, 4th ed. Prentice Hall.
2. A.V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Prentice Hall, 1989.
3. S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.
4. L. R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Prentice Hall, 1992.
5. J. R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, “Digital Signal Processing”, John Wiley & Sons, 1988.

Digital Signal Processing (EC-309A)

COs

EC-309A.1	Apply Z-transformation & its properties for the analysis of discrete time signals & systems
EC-309A.2	Solve DFT for frequency domain analysis of signals & linear filtering.
EC-309A.3	Compare & Use the realization methods to design structures for FIR & IIR systems
EC-309A.4	Differentiate & Design IIR & FIR filters with given specifications

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-309A.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
EC-309A.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
EC-309A.3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
EC-309A.4	-	3	3	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	**3**	**2**

ECP-5A	VLSI Technology						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Major Test**	**Minor Test**	**Total**	**Time**	**Credit**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**	**3**

UNIT-I

Crystal growth: monolithic and hybrid ICs, crystal growth, Czochralski technique of crystal growth, wafer preparation and specifications, defects, measurements of parameters of crystals, Fabrication steps, Oxidation: Theory of growth of Silicon dioxide layer, oxidation kinetics, Dry, wet and high pressure oxidation, plasma oxidation, properties of oxidation, defects induced due to oxidation.

UNIT -II

Epitaxial process: Epitaxy and its concept, Growth kinetics of epitaxial growth, Low temperature epitaxy, growth chemistry of Si epitaxial layer, apparatus for epitaxial layer, MBE system Diffusion process: Diffusion models of solid, Fick's theory of diffusion, Solution of Fick`s law, diffusion parameters measurements, Ion implantation: Scattering phenomenon, range theory, channeling, implantation damage, ion implantation systems, Annealing.

UNIT-III

Lithography: Optical and non-optical lithography, electron, X-ray and ion-beam lithography, contact/proximity and projection printers, alignment. Photoresist and Etching: Types of photoresists, polymer and materials, Etching- Dry & Wet etching, basic regimes of plasma etching, reactive ion etching and its damages, lift-off, and sputter etching.

UNIT-IV

Metallization: Applications and choices, physical vapor deposition, patterning, VLSI process fabrication steps: PMOS, NMOS and CMOS IC technology, Packaging: Package types, packaging design consideration, VLSI assembly technologies. Yield and reliability in VLSI.

SUGGESTED BOOKS:

1. S.M. SZE, VLSI Technology, McGraw Hill. 2009, 2nd Edition
2. S. K. Gandhi, VLSI Fabrication Principles, Wiley, 2nd edition
3. S.A. Campbell, The Science and Engineering of Microelectronic Fabrication ,Oxford 2008,2nd edition
4. Sedra & Smith, Microelectronic Circuits 2004, Oxford, 5th edition
5. J.D. Plummer, Silicon VLSI Technology: Fundamentals, Practice, and Modeling, Pearson.

VLSI Technology (ECP-5A)

COs

ECP-5A.1	Understand the basic concepts in VLSI, purification process of Silicon and fabrication processes involved in Integrated Circuits
ECP-5A.2	Choose the appropriate technique of single crystal growth with given wafer specifications.
ECP-5A.3	Apply existing mathematical models, to estimate the thickness of oxide layer, etch rate, deposition rate.
ECP-5A.4	Compare processes of doping, lithography, etching and metallization and assess the suitability of a process for fabrication.
ECP-5A.5	Design the fabrication steps for a device with the knowledge of fabrication processes

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECP-5A.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
ECP-5A.2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
ECP-5A.3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
ECP-5A.4	-	3	-	-	-	-	-	-	-	-	-	-	-	-
ECP-5A.5	-	-	3	-	-	-	-	-	-	-	-	-	3	-
AVG	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	**3**	-

ECO-1A		Computer Networks						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Practical	Total	Time
3	-	-	3	75	25	-	100	3 Hrs

Unit – I

Introduction: Introduction to Computer Networks, Protocols and standards, Network Models: The OSI Model, TCP/IP protocol suite, Introduction to addressing.

Physical Layer and Media: Guided &Unguided media, Circuit Switching and Packet Switching, The Telephone System, ATM.

Unit -II

The Data Link Layer: Data Link Layer Design issues, Data link control: Framing, Flow & Error control, Noiseless channels, Noisy channels, HDLC, Point to Point protocols.

The Medium Access Sublayer: Aloha Protocols, LAN Protocols: wired LAN's, Wireless LAN.

Unit -III

Network Layer: Forwarding, Flow Control, Error Control, Multicast routing, IPv4 addresses, IPv6 addresses, internetworking, SNMP, ARP

Transport & Session Layer, Presentation Layer: Flow Control and Congestion Control at the Transport Layer, Transmission Control Protocol – Basic Features, TCP Congestion Control, cryptography

Unit-IV

Application Layer: Design issues, file transfer, access and management, electronic mail, WWW & HTTP

Text Books:

1. Forouzan B.A, Data Communications and Networking, Tata-Mc-Graw Hill.

2. Tanenbaum A.S, Computer Networks, PHI.

Reference Books:

1. Stallings W, Data and Computer Communications, PHI.

2. Leon –Garcia, Computer Networks, Mc Graw Hill

Computer Networks (ECO-1A)

COs

ECO-1A.1	Interpret the basic concepts of computer networks and physical layer.
ECO-1A.2	Understand & Compare OSI model and TCP/IP model.
ECO-1A.3	Analyze the design issues and concepts of different layers of OSI model.
ECO-1A.4	Illustrate the various protocols of different layers of OSI model.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECO-1A.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
ECO-1A.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
ECO-1A.3	-	3	-	-	-	-	-	-	-	-	-	-	2	-
ECO-1A.4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	**3**	**2.5**	-	-	-	-	-	-	-	-	-	-	**2**	-

EC-311LA	Digital Signal Processing Lab							
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Practical	Total	Time
-	-	2	1	-	40	60	100	3

List of Experiments

1. Write a program to plot the following functions: a) impulse function b) unit step c) unit ramp d) exponential and e) sinusoidal
2. Write a program to plot real part, imaginary part, magnitude and phase spectra of an exponential function.
3. Study the aliasing effect by using a sinusoidal signal. Show the plots of' continuous time signal, sampled signal and reconstructed signals by using subplot.
4. Write a program to compute and plot the convolution of two signals.
5. Define a function to compute the Z-transform of a finite length signal.
6. Verify the properties of Discrete Fourier Transform (DFT).
7. Study of different window functions available for design of FIR filters.
8. Design of FIR filters by using windowing method.
9. Design of equiripple FIR filter.
10. Study of magnitude and phase response of Butterworth, Chebyshev and Elliptic filters.
11. Design of IIR filters by using different analog filter approximation method.

Digital Signal Processing Lab (EC-311LA)

COs

EC-311LA.1	Plot fundamental discrete time signals using MATLAB.
EC-311LA.2	Use appropriate in built functions of MATLAB to interpret z Transforms, DFT, convolution & aliasing effects.
EC-311LA.3	Analyze the magnitude & Phase response of signals & filters using MATLAB.
EC-311LA.4	Design digital IIR & FIR filters for given specification using MATLAB.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-311LA.1	3	-	-	-	3	**-**	**-**	1	1	**-**	**-**	**-**	3	-
EC-311LA.2	-	3	-	-	3	**-**	**-**	1	1	**-**	**-**	**-**	3	-
EC-311LA.3	-	3	-	-	3	**-**	**-**	1	1	**-**	**-**	**-**	-	3
EC-311LA.4	-	-	3	-	3	**-**	**-**	1	1	**-**	**-**	**-**	-	3
AVG	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**3**	**3**

EC-303LA	Electromagnetic Waves Lab						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
		3	1.5	40	60	100	3 Hour

List of Experiments:

1. Measurement of Electric Field between Parallel Conductors.
2. To Determine Electric Field Pattern between Two Circular Electrodes.
3. Experimentally determine the standing wave ration and reflection Coefficient in a transmission line.
4. Measurement of Dielectric Constant.
5. Design & Characterization of Rectangular Waveguide for dominant mode using HFSS.
6. Experimentally determine the frequency & Wavelength in a rectangular waveguide working in TE10 mode using microwave bench.
7. Design & Characterization of Circular Waveguide using HFSS.
8. Design & Characterization of Micro strip Line using HFSS.
9. To measure unknown impedance with Smith Chart.
10. Design & Characterization of Micro strip line using simulation software.

ELECTROMAGNETIC WAVE LAB (EC-303LA)

COs

EC-303LA.1	Understand the basics of HFSS Software
EC-303LA.2	Demonstrate the Electric Field Pattern for Conductor and Electrodes
EC-303LA.3	Design and analyze the characteristics of various type of waveguide and Microstrip Lines using HFSS
EC-303LA.4	Determine experimentally dielectric constant, SWR and reflection Coefficient

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-303LA.1	2	-	-	-	3	**-**	**-**	1	1	**-**	**-**	**-**	2	-
EC-303LA.2	3	-	-	-	3	**-**	**-**	1	1	**-**	**-**	**-**	2	-
EC-303LA.3	-	3	3	-	3	**-**	**-**	1	1	**-**	**-**	**-**	-	3
EC-303LA.4	2	-	-	-	3	**-**	**-**	1	1	**-**	**-**	**-**	2	-
AVG	**2.3**	**3**	**3**	**-**	**3**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**2**	**3**

6th Sem

S. No.	Course No.	Subject	L:T: P	Hours / Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	HM-901A	Organizational Behavior	3:0:0	3	3	75	25	0	100	3
2	EC-302A	Control System Engineering	3:0:0	3	3	75	25	0	100	3
3	EC-304LA	Control System Engineering Lab	0:0:3	3	1.5	-	40	60	100	3
4	EC-306A	Verilog HDL	3:0:0	3	3	75	25	0	100	3
5	EC-308LA	Verilog HDL Lab	0:0:3	3	1.5	-	40	60	100	3
6	EC-310LA	Mini Project/Electronic Design Workshop	0:0:4	4	2	-	40	60	100	3
7	ECP*	Program Elective-II	3:0:0	3	3	75	25	0	100	3
8	ECO*	Open Elective-II	3:0:0	3	3	75	25	0	100	3
		Total		**25**	**20**	**375**	**245**	**180**	**800**	

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section. Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.**

LIST OF OPEN ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
VI	ECO-5A	Data Structures
	ECO-6A	Multimedia Communication
	ECO-7A	Consumer Electronics
	ECO-8A	Transducers and Their Applications
	MOOC	

LIST OF PROGRAM ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
VI	ECP-6A	Antennas and Propagation
	ECP-7A	CMOS Design
	ECP-8A	Bio-Medical Electronics
	ECP-9A	Scientific Computing

HM-901A	Organizational Behaviour						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	-	-	3	75	25	100	3

UNIT-I

Introduction to organizational behavior: Concept and importance of organizational behavior, role of Managers in OB, foundations or approaches to organizational behavior, challenges and opportunities for OB.

Foundation of individual behavior: Biographical characteristics, concept of abilities and learning, learning and learning cycle, components of learning, concept of values and attitude, types of attitude, attitude and workforce diversity.

UNIT-II

Introduction to personality and emotions: Definition and Meaning of Personality, Determinants of Personality, Personality Traits Influencing OB, Nature and Meaning of Emotions, Emotions dimensions, concept of Emotional intelligence.

Perception and individual decision making: meaning of perception, factors influencing perception, rational decision making process, concept of bounded rationality. Leadership-trait approaches, behavioural approaches, situational approaches, and emerging approaches to leadership.

UNIT-III

Motivation: Concept and theories of motivation, theories of motivation-Maslow, two factor theory, theory X and Y, ERG Theory, McClelland's theory of needs, goal setting theory, application of theories in organizational scenario, linkage between MBO and goal setting theory, employee recognition and involvement program.

Foundations of group behavior and conflict management: Defining and classifying of groups, stages of group development, Informal and formal groups- group dynamics, managing conflict and negotiation, a contemporary perspective of intergroup conflict, causes of group conflicts, managing intergroup conflict through resolution.

UNIT-IV

Introduction to Organizational Communication: Meaning and importance of communication process, importance of organizational communication, effective communication, organizational stress: definition and meaning sources and types of stress, impact of stress on organizations, stress management techniques.

Introduction to Organization Culture: Meaning and nature of organization culture, types of culture, managing cultural diversity, managing change and innovation-change at work, resistance to change, a model for managing organizational change.

Text Books:

1. Colquitt, Jason A., Jeffery A. LePine, and Michael Wesson. Organizational Behavior: Improving Performance and Commitment in the Workplace. 5th ed. New York: McGraw-Hill Education, 2017.
2. Hitt, Michael A., C. Chet Miller, and Adrienne Colella. Organizational Behavior. 4th ed. Hoboken, NJ: John Wiley, 2015.
3. Robbins, Stephen P., and Timothy Judge. Organizational Behavior. 17th ed. Harlow, UK: Pearson Education, 2017. Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.

Reference Books:

1. Schermerhorn, Hunt and Osborn, Organisational behavior, John Wiley.
2. Udai Pareek, Understanding Organisational Behaviour, Oxford Higher Education.
3. Mc Shane & Von Glinov, Organisational Behaviour, Tata Mc Graw Hill.
4. Aswathappa, K., Organisational Behaviour– Text and Problem, Himalaya Publication.

Organizational Behaviour (HM-901A)

COs

HM-901A.1	Apply organizational behaviour as a discipline and understanding the concept of individual behaviour.
HM-901A.2	Evaluate the concept and understand importance of personality, emotions and its importance in decision making and effective leadership.
HM-901A.3	Acquire the knowledge of effective motivation and its contribution in group dynamics and resolving conflicts.
HM-901A.4	Understand how to overcome organizational stress by maintaining proper organizational culture and effective communication

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
HM-901A.1	-	-	-	-	-	-	-	3	-	-	-	3	-	-
HM-901A.2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
HM-901A.3	-	-	-	-	-	-	-	-	3	-	3	3	-	-
HM-901A.4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
AVG	-	-	-	-	-	-	-	**3**	**3**	**3**	**3**	**3**	-	-

EC-302A	Control System Engineering (6th Semester)						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	-	-	3	75	25	100	3

UNIT-I

Introduction: The Control system-Open loop & Closed loop, servomechanism, Stepper motor. Mathematical Models of Physical Systems: Differential equation of physical systems, Transfer Function, Block Diagram Algebra, Signal Flow-Graphs, Mason's Formula & its application. Feedback Characteristics of Control Systems: Feedback and Non-Feedback systems, Effects of Feedback on sensitivity (to parameter variations), Stability, Overall gain etc.

UNIT-II

Time Response Analysis: Standard test signals, Time response of first order and second order systems, Steady-State Errors and Error Constants, Design Specification of second-order- systems. Stability: The concept of stability, necessary conditions for stability, Hurwitz Stability Criterion, Routh Stability Criterion, Relative Stability Analysis. The Root Locus Technique: The Root Locus Concept, Construction

/development of Root loci for various systems, Stability considerations. Proportional, Integral and Derivative Controllers.

UNIT-III

Frequency Response & Stability Analysis: Correlation between Time and Frequency response, Polar Plots, Nyquist plots, Bode Plots, Nyquist Stability criterion, Gain margin & Phase margin, relative stability using Nyquist Criterion, frequency response specifications.

UNIT-IV

Compensation of Control Systems: Necessity of Compensation, Phase Lag compensation, Phase Lead Compensation, Phase Lag Lead Compensation, Feedback Compensation. State Variable Analysis: Concept of State, State Variable and State Model, State Models for Linear Continuous Time Systems, Diagonalization, Solution of state equations, Concept of Controllability and Observability.

Text Book: *Control System Engg.: I. J. Nagrath & M.Gopal; New Age India.*

Reference Books:

1.Automatic Control Systems: B.C. Kuo; PHI. 2.Modern Control Engg: K. Ogata; PHI.

3.Control Systems: Principles & Designing : Madan Gopal; TMH.

CONTROL SYSTEM ENGINEERING (ECE-302A)

COs

EC-302A.1	Illustrate the various techniques to estimate the transfer function of a system.
EC-302A.2	Understand and analyze the system stability in time and frequency domain
EC-302A.3	Design and analyze a control system based on given specification.
EC-302A.4	Apply state space analysis for analyzing the performance of control system.
EC-302A.5	Use the knowledge of compensation technique to design compensator with the given specification.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-302A.1	3	-	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	-
EC-302A.2	3	3	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	-
EC-302A.3	-	3	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3
EC-302A.4	3	2	-	1	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3
EC-302A.5	3	-	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3
AVG	**3**	**2.6**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

EC-306A	Verilog HDL						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3**

Unit- I

Introduction: Introduction, conventional approach to digital design, VLSI design, ASIC design flow, Role of HDL, Conventional Data flow, ASIC data flow, Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools, Test Benches.

Language constructs and conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks.

Unit-II

Gate level modelling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flip-flops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Design of Basic Circuits.

Behavioral modelling: Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Examples, Assignments with Delays, Wait construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non-blocking Assignments, The case statement, Simulation Flow, if and ifelse constructs, assign-deassign construct, repeat construct, for loop, the disable construct, while loop, forever loop, parallel blocks, force-release construct, Event.

Unit-III

Modelling at data flow level: Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators, Additional Examples.

Switch level modelling: Introduction, Basic Transistor Switches, CMOS Switch, Bi-directional Gates, Time Delays with Switch Primitives, Instantiations with Strengths and Delays, Strength Contention with Trireg Nets.

Unit-IV

Functions, tasks, and user defined primitives: Introduction, Function, Tasks, User- Defined Primitives (UDP), FSM Design (Moore and Mealy Machines).

System tasks, functions, and compiler directives: Introduction, Parameters, Path Delays, Module Parameters, System Tasks and Functions, File-Based Tasks and Functions, Compiler Directives, Hierarchical Access, General Observations.

Text Books:

1. T. R. Padmanabhan, B. Bala Tripura Sundari (2004), Design through Verilog HDL, Wiley & SonsEducation, IEEE Press, USA.
2. J. Bhaskar (2003), A Verilog Primier, 2nd edition, BS Publications, India.

Reference Books:

1. Samir Palnitkar (2013), Verilog HDL, Pearson India.
2. Stephen. Brown, ZvonkoVranesic (2005), Fundamentals of Logic Design with Verilog, Tata McGraw Hill, India.
3. Charles H. Roth (2004), Digital Systems Design using VHDL, Jr. Thomson Publications, India.

Verilog HDL (EC -306 A)

COs

EC-306A.1	Understand the constructs and conventions of the Verilog HDL programming
EC-306A.2	Differentiate between the structural, register-transfer level (RTL), and algorithmic levels of Abstraction for modeling digital hardware systems.
EC-306A.3	Design and modeling of combinational and sequential digital systems (Finite State Machines)
EC-306A.4	Apply the concept of test-benches to create testing behavioral environments for simulation based verification.
EC-306A.5	Implement the concepts of UDPs , tasks, function and compiler directives to improve the design.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-306A.1	3	-	-	-	3	-	-	-	-	-	-	-	2	2
EC-306A.2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
EC-306A.3	-	-	3	-	3	-	-	-	-	-	-	-	2	2
EC-306A.4	3	-	-	-	3	-	-	-	-	-	-	-	2	2
EC-306A.5	3	-	-	-	-	-	-	-	-	-	-	-	2	-
Avg	**2.7**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

EC-308LA	Verilog HDL Lab							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**3**	**1.5**	**0**	**40**	**60**	**100**	**3 Hour**

List of Experiments:

1. Write a Program to implement logic gates.
2. Write a Program to implement half-adder.
3. Write a Program to implement Full-adder.
4. Write a Program to implement 4 bit addition/subtraction.
5. Write a Program to implement a 3:8 decoder.
6. Write a Program to implement an 8:1 mulltiplexer.
7. Write a Program to implement an 1:8 demultiplexer.
8. Write a Program to implement 4 bit comparator.
9. Write a Program to implement Mod-10 up counter.
10. Write a Program to perform serial to parallel transfer of 4 bit binary number.
11. Write a program to perform parallel to serial transfer of 4 bit binary number
12. Write a program to implements 8 bit ALU containing 4 arithmetic & 4 logic operation.

VERILOG HDL Lab (EC-308LA)

COs

EC-308LA.1	Demonstrate the understanding of basic language elements of Verilog HDL.
EC-308LA.2	Interpret the working at different levels of abstraction in Verilog HDL.
EC-308LA.3	Design & Develop Models for Combinational & Sequential circuits using Verilog programming
EC-308LA.4	Use test benches to analyze the design in terms of timing requirements

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-308LA.1	3	**-**	-	**-**	3	**-**	**-**	1	1	**-**	**-**	**-**	**-**	**-**
EC-308LA.2	3	**-**	-	**-**	3	**-**	**-**	1	1	**-**	**-**	**-**	**-**	**-**
EC-308LA.3	3	**-**	3	**-**	3	**-**	**-**	1	1	**-**	**-**	**-**	2	2
EC-308LA.4	3	**-**	3	**-**	3	**-**	**-**	1	1	**-**	**-**	**-**	2	2
AVG	**3**	-	**3**	-	**3**	-	-	**1**	**1**	-	-	-	**2**	**2**

EC-304LA	Control System Engineering Lab						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
		3	1.5	40	60	100	3 Hour

List of Experiments:

1. Using MATLAB obtain time response of a second order system in case of under damped, over damped and critically damped systems.

2. To design a passive RC lead compensating network for the given specifications and to obtain its frequency response.

3. To design a passive RC lag compensating network for the given specifications and to obtain its frequency response.

4. To obtain torque speed characteristics of AC servo motor.

5. To obtain torque speed characteristics of DC servo motor.

6. To determine frequency response of a second order system and evaluation of Frequency domain specifications.

7. To simulate a DC position control system and hence to find the step response using MATLAB.

8. Obtain the phase margin and gain margin for a given transfer function by drawing bode plots and verify the same using MATLAB.

9. To obtain Root locus of a given T. F. and hence finding breakaway point, intersection point on imaginary axis and to draw the Nyquist plot for the given transfer function using MATLAB.

10. To digitally simulate the time response characteristics of Linear SISO systems using state variable formulation.

11. Experiment to draw the frequency response of a given lead-lag compensating network.

Control System Engineering Lab (EC-304LA)	
	COs
EC-304LA.1	Execute time response analysis of a second order control system using MATLAB
EC-304LA.2	Design Lag, Lead, Lead-Lag compensators and verify experimental results using MATLAB.
EC-304LA.3	Design a controller with required specification using PI,PD and PID controller.
EC-304LA.4	Analyze and interpret stability of the system through Root Locus, Bode plot and Nyquist plot.

Cos/PO/PSO	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
EC-304LA.1	3	3	-	**-**	3	**-**	**-**	1	1	**-**	**-**	**-**	-	2
EC-304LA.2	-	-	3	**-**	3	**-**	**-**	1	1	**-**	**-**	**-**	3	2
EC-304LA.3	-	-	3	**-**	3	**-**	**-**	1	1	**-**	**-**	**-**	3	2
EC-304LA.4	-	3	-	**-**	3	**-**	**-**	1	1	**-**	**-**	**-**	3	2
AVG	**3**	3	**3**	-	**3**	-	-	**1**	**1**	-	-	-	**3**	**2**

ECP-6A	Antennas & Propagation							
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test		Total	Time
3	0	0	3	75	25		100	3 Hrs.

Unit-I

Fundamental concept: Physical concept of radiation, Retarded potential, Radiation pattern, near- and far-field regions. **Antenna Parameters:** Radiation Resistance, Gain, Directive Gain, Power Gain, Directivity, Efficiency, Beam width, Effective Height, Effective Aperture, Bandwidth and Antenna Temperature.

Radiation from Wires: Radiation from Hertzian Dipole, Short Dipole, Monopole Antenna, Folded Dipole Antenna and Half Wave Dipole.

Unit-II

Antenna Arrays: Uniform Linear Arrays - Broadside Arrays, Endfire Arrays. Analysis of arrays of 2 Isotropic Sources - Different Cases, Analysis of arrays of N Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Binomial Array, Chebyshev Array. **TV Transmission & Reception Antennas:** Turnstile Antennas, Yagi-Uda antennas. **Standard Antennas:** Loop Antenna (Rectangular & Circular), Helical Antenna, Biconical Antenna.

Unit-III

Aperture & Slot Antennas: Radiation from Rectangular Apertures, Uniform and Tapered Aperture, Horn antenna, Reflector Antenna , Cassegrain and Gregorian Feeding Structures, Rectangular Slot Antenna.

Broadband Antennas: Huygens' Principle, The frequency independent concept: Rumsey's principle, Frequency Independent Planar Log Spiral Antenna, Frequency independent conical spiral antenna, Log periodic antenna, Lens Antenna.

Microstrip/Patch Antennas: Basic configurations of patch antennas: Rectangular, Circular. Different Feeding Techniques. Method to Analyze Patch antenna: Transmission Line Model.

Unit-IV

Propagation of Radio Waves: Introduction, Ground Wave Propagation, Space Wave Propagation and Sky Wave Propagation: Virtual Height, Critical Frequency, Maximum Usable Frequency (MUF) – Skip Distance, Fading, Multi Hop Propagation, Duct Propagation, Troposcatter Propagation, Flat Earth and Curved Earth Concept,.

REFERENCES:

1. J. D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. Antenna & Wave Propagation- K.D. Prasad, Satya Parkashan.
4. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
5. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
6. A.R.Harish, M.Sachidananda, Antenna and Wave Propagation, Oxford University Press.

ANTENNA & PROPAGATION (ECP-6A)

COs

ECP-6A.1	Outline the various parameters of antenna and analyze the performance.
ECP-6A.2	Understand array design principle and design the antenna arrays
ECP-6A.3	Familiarize with the requirements, principals, and structures of different antennas.
ECP-6A.4	Design patch antenna of required specifications.
ECP-6A.5	Classify& compare the different modes of electromagnetic wave propagation.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECP-6A.1	3	3	-	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	-
ECP-6A.2	3	-	3	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3
ECP-6A.3	3	-	-	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	-
ECP-6A.4	-	-	3	**-**	2	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	3
ECP-6A.5	3	-	-		-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	-
AVG	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

ECO-8A	Transducers & Its Applications						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3		**-**	**3**	**75**	**25**	**100**	**3**

Unit-I

Definition of transducer. Advantages of an electrical signal as out-put. Basic requirements of transducers, Primary and Secondary Transducer, Analog or digital types of transducers. Resistive, inductive, capacitive, piezoelectric, photoelectric and Hall Effect tranducers.

Unit-II

Measurement of Pressure – Manometers, Force summing devices and electrical transducers **Measurement of Temperature** – Metallic resistance thermometers, semi conductor resistance sensors (Thermistors), thermo-electric sensors, pyrometers.

Unit-III

Measurement of Displacement – Potentiometric resistance type transducers, inductive type transducers, differential transformer (L.V.D.T), capacitive transducers, Hall effect devices, strain gage transducers.

Measurement of Velocity – variable reluctance pick up, electromagnetic tachometers, photoelectric tachometer, toothed rotor tachometer generator.

Unit-IV

Measurement of Force – Strain-gage load cells, pneumatic load cell, LVDT type force transducer. **Measurement of Torque** – Torque meter, torsion meter, absorption dynamometers, inductive torque transducer, digital methods.

Suggested Books:

1. B.C. Nakra, K.K. Chaudhry, “Instrumentation Measurement and Analysis,” Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Thomas G. Beckwith etc. all, “Mechanical Measurements (International Student Edition), Addison-Wesley Longman, Inc. England.
3. A.K. Sawhney, “ A Course in Electrical and Electronic Measurements and Instrumentation,” Dhanpat Rai & Sons, Delhi-6.

Transducer & its applications (ECO-8A)

COs

ECO-8A.1	Understand the principles of operation of the various sensor.
ECO-8A.2	Interpretation of the measurement results of transducers.
ECO-8A.3	Outline the measurement schemes for different non-electrical quantities
ECO-8A.4	Compare the different measurement schemes used for non-electrical quantities.

Cos/PO/PSO	PO1	PO 2	PO3	PO4	PO 5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
ECO-8A.1	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
ECO-8A.2	-	3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	-
ECO-8A.3	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
ECO-8A.4	3	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	-
AVG	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

Mini Project/Electronic Design Workshop (EC-310LA)

COs

EC-310LA.1	Understand &Identify the basic active and passive components.
EC-310LA.2	Design and Simulate Core Electronic Circuits.
EC-310LA.3	Analyze the circuits and troubleshoot faults/errors if any
EC-310LA.4	Develop presentation and interpersonal communication skills through project work.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-310LA.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
EC-310LA.2	-	-	3	-	3	1	1	1	-	-	-	-	3	3
EC-310LA.3	-	3	-	3	-	-	-	-	-	-	-	-	3	3
EC-310LA.4	-	-	-	-	-	-	-	-	3	3	1	2	3	3
AVG	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**3**	**3**	**1**	**2**	**3**	**3**

7th Sem

S. No.	Course No.	Subject	L:T: P	Hours/ Week	Credits	Examination Schedule (Marks)				ıration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	HM-904A	Intellectual Property Rights for Technology Development & Management	3:0:0	3	3	75	25	0	100	3
2	ECP*	Program Elective-III	3:0:0	3	3	75	25	0	100	3
3	ECP*	Program Elective-IV	3:0:0	3	3	75	25	0	100	3
4	ECP*	Program Elective Labs-V	0:0:4	4	2	-	40	60	100	3
5	ECO*	Open Elective-III	3:0:0	3	3	75	25	0	100	3
6	EC-401LA	Project Stage-I	0:0:8	8	4	-	40	60	100	3
7	**EC-403A	Industrial Training-III	2:0:0	2	-	-	*100	-	*100	3
		Total		**26**	**18**	**300**	**180**	**120**	**600**	

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**EC-403A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

8th Sem

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration Of Exam. (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	**ECP***	**Program Elective-VI**	**3:0:0**	**3**	**3**	**75**	**25**	**0**	**100**	**3**
2	**ECP***	**Program Elective-VII**	**3:0:0**	**3**	**3**	**75**	**25**	**0**	**100**	**3**
3	**ECO***	**Open Elective-IV**	**3:0:0**	**3**	**3**	**75**	**25**	**0**	**100**	**3**
4	**ECO***	**Open Elective-V**	**3:0:0**	**3**	**3**	**75**	**25**	**0**	**100**	**3**
5	**EC-402LA**	**Project Stage-II**	**0:0:10**	**10**	**5**	**-**	**40**	**60**	**100**	**3**
6	**ECP***	**Program Elective Labs-VIII**	**0:0:4**	**4**	**2**		**40**	**60**	**100**	**3**
		Total		**26**	**19**	**300**	**180**	**120**	**600**	

***The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

LIST OF OPEN ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
VII	**Open Elective-III**	
	ECO-9A	Bio-informatics
	ECO-10A	Electromechanical Energy Conversion
	ECO-11A	Operating Systems
VIII	**Open Elective-IV**	
	ECO-12A	Wavelets
	ECO-13A	Soft Computing
	ECO-14A	Neural Networks and Fuzzy Logic
	Open Elective-V	
	ECO-15A	Statistics and Operational Research
	ECO-16A	Mixed Signal Design
	ECO-17A	Blockchain Technology

LIST OF PROGRAM ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
VII	**Program Elective-III**	
	ECP-10A	Fiber Optic Communications
	ECP-11A	Mobile Communication and Networks
	ECP-12A	Adaptive Signal Processing
	ECP-13A	Nano electronics
	Program Elective-IV	
	ECP-14A	Microwave Theory and Techniques
	ECP-15A	Embedded systems
	ECP-16A	Robotics
	ECP-17A	Digital Image Processing
	Program Elective Labs-V	
	ECP-14LA	Microwave Communication Lab
	ECP-15LA	Embedded System Lab
	ECP-16LA	Robotics Lab
	ECP-17LA	Digital Image Processing Lab
VIII	**Program Elective –VI**	
	ECP-18A	Wireless Communication
	ECP-19A	Biomedical Signal Processing
	ECP-20A	Machine Learning
	ECP-21A	Artificial Intelligence
	ECP-22A	Internet of Things
	Program Elective –VII	
	ECP-23A	Error correcting codes
	ECP-24A	Satellite Communication
	ECP-25A	High Speed Electronics
	ECP-26A	Software Defined Radio
VIII	**Program Elective Labs-VIII**	
	ECP-18LA	Wireless Communication Lab
	ECP-19LA	Biomedical Lab
	ECP-20LA	Machine Learning Lab
	ECP-21LA	Artificial Intelligence Lab
	ECP-22LA	Internet of Things Lab
	ECP-23LA	Augmented Reality/Virtual Reality Lab

7th Sem

HM-904A	Intellectual Property Rights for Technology Development & Management						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hr.
Course Outcomes							

Unit-I

Nature of Intellectual Property: Patents, Designs, Trade 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-II

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit-III

Law relating to Intellectual property: Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet –Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies;

Unit-IV

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.

Text Books/Reference Books:-

- T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
- Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co
- Bare text (2005), Right to Information Act
- O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
- Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House
  Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill

Intellectual Property Rights for Technology Development & Management (HM-904A)

COs

HM-904A.1	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
HM-904A.2	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
HM-904A.3	Understand different laws related to the Intellectual Property ,copyright act, trademarks, patent act, duration of patents law and policy considerations
HM-904A.4	Understand New Developments in IPR ,administration of patent system, IPR of biological systems etc.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
HM-904A.1	-	-	-	-	-	-	-	3	-	-	-	-	-	-
HM-904A.2	-	-	-	-	-	-	-	3	-	-	-	-	-	-
HM-904A.3	-	-	-	-	-	-	-	3	-	-	-	-	-	-
HM-904A.4	-	-	-	-	-	-	-	3	-	-	-	-	-	-
AVG	-	-	-	-	-	-	-	**3**	-	-	-	-	-	-

ECP-10A	Fiber Optic Communications						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hr.

UNIT – I

INTRODUCTION : Optical Fibers: Structure, Propagation within the fiber, Numerical aperture of fiber, acceptance angle, step index and graded index fiber, Modes of propagation in the fiber, Single mode and multi mode fibers. Splices and connectors. Optical Power Launching and Coupling. Fiber-to-fiber joints.

UNIT –II

LOSSES IN OPTICAL FIBER : Attenuation, Absorption Losses, Scattering Losses, Leaky modes, Mode coupling losses, Bending Losses, Combined Losses in the fiber.

DISPERSION EFFECT : Effect of dispersion on the pulse transmission Intermodal dispersion, Material dispersion, Wave guide dispersion, Polarization Mode Dispersion, Total dispersion, Transmission rate. Dispersion Shifted Fibers, Dispersion Compensating Fibers.

UNIT – III

LIGHT SOURCES : LEDS, Laser Action in semiconductor Lasers, Semiconductor Lasers for optical communication – Laser modes, Spectral Characteristics, Power Voltage Characteristics, Frequency response.

DETECTORS : P-I-N Photodiode, APD, Noise Analysis in detectors, Coherent and non-coherent detection, Infrared sensors. Bit error rate.

UNIT – IV

The fiber-optic Communication System: Design considerations of fiber optic systems: Analog and digital modulation. Optical Devices: Optical coupler, space switches, linear divider-combiners, WDM: strategy, wavelength division multiplexer and demultiplexer, optical amplifier

OPTICAL NETWORKS: Elements and Architecture of Fiber-Optic Network, Optical link network-single hop, multihop, hybrid and photonic networks.

Suggested Books:

John Power, An Introduction to Fiber optic systems, McGraw Hill International.
John Gowar , Optical communication Systems.
R. Ramaswamy, Optical Networks, Narosa Publication
John M. Senior,Optical Fiber Communication
Gerd Keiser, Optical Fiber Communication

COs	Fiber Optic Communications (ECP-10A)
ECP-10A.1	Understand the structure of fiber with various modes of propagation and the concept of light travelling in the fiber.
ECP-10A.2	Analyze the concept of various losses and dispersion effect associated with fibers.
ECP-10A.3	Compare the characteristics of the various light sources and detectors.
ECP-10A.4	Evaluate the role of various components used to design fiber optics communication system.
ECP-10A.5	Design optical networks based on desired parameters.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECP-10A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECP-10A.2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
ECP-10A.3	-	-	3	-	-	-	-	-	-	-	-	-	3	-
ECP-10A.4	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECP-10A.5	-	-	-	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

ECP-14A	Microwave Theory and Techniques						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**

UNIT-I

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands, Applications of Microwaves: Civil and Military, Medical, EMI/ EMC, Effect of Microwaves on Human Body. Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave Transmission.

Review of waveguides in brief, Coaxial Transmission Line, Strip line, Microstrip line.

Microwave Resonators: Cavity Resonators: Rectangular, Cylindrical, and Coaxial, Excitation and Coupling of cavities, Q factor.

UNIT-II

Microwave Measurements: Measurement of frequency, impedance (using slotted section) Attenuation, power, dielectric constant, measurement of V.S. W. R., Insertion loss and Permeability.

Microwave Generators: Construction, characteristics, operating principle and typical applications of Klystron(two cavity, multicavity), Reflex Klystron, Magnetron(Cylindrical magnetron and description of Πmode applications) and Traveling Wave Tube(TWT).

UNIT-III

Matrix Description of Microwave Circuits: Scattering Matrix: properties, measurement of scattering coefficients, scattering matrices for common microwave systems.

Passive and Active Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, E Plane and H-Plane Tee, Magic Tee, Attenuator, Isolators, Circulator and Phase Shifter. Microwave Active Components: Diodes, Transistors, Design Considerations of Filters, Amplifiers, Oscillators and Mixers (in Brief).

UNIT-IV

Solid State Microwave Devices: Transferred Electron Devices-Gunn Diode: Negative Differential Resistance Phenomenon, High Field Domain Formation. Avalanche Transit Time Devices: IMPATT, TRAPATT, BARITT diodes, Tunnel Diode, PIN Diode, Parametric amplifiers

Text Book: David M. Pozar, Microwave Engineering, John Wiley and sons Inc.

Reference Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, Prentice-Hall of India.
2. Das. Annapurna & Sisir K. Das, Microwave Engineering, Tata McGraw-Hill.
3. R.E. Collins, Microwave Circuits, McGraw Hill.

COs	Microwave Theory and Techniques (ECP-14A)
ECP-14A.1	Understand the basic concepts of waveguides and cavity resonators.
ECP-14A.2	Measure the various microwave parameters.
ECP-14A.3	Categorize the conventional methods to generate the microwave signal.
ECP-14A.4	Analyze the Microwave components using scattering parameters.
ECP-14A.5	Compare the characteristics of various types of solid state and avalanche transit time devices.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECP-14A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECP-14A.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECP-14A.3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECP-14A.4	3	3	-	2	-	-	-	-	-	-	-	-	3	1
ECP-14A.5	3	-	-	-	-	-	-	-	-	-	-	-	3	-
AVG	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**

ECP-14LA	Microwave Communication Lab						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Practical	Minor Test	Total	Time
-	-	4	2	60	40	100	3 Hrs.

List of Experiments:

1. To study microwave components.
2. To study the characteristics of the reflex Klystron tube and to determine its electronic tuning range.
3. To determine the frequency and wavelength in a rectangular waveguide working in TE 10 mode.
4. To determine the standing wave ratio and reflection coefficient.
5. To study the I-V characteristics of gunn diode.
6. To study the magic Tee.
7. To study the isolator and attenuator.
8. To measure the coupling coefficient and directivity of a waveguide directional coupler.
9. To measure the polar pattern and the gain of a waveguide horn antenna.
10. To measure the insertion loss and attenuation.

COs	Microwave Communication Lab (ECP-14LA)
ECP-14LA.1	Understand the basic microwave components.
ECP-14LA.2	Analyze the basic microwave components.
ECP-14LA.3	Examine the various characteristics of various antennas.
ECP-14LA.4	Prepare the lab report according to the various observations during experiment conduction.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECP-14LA.1	3	-	-	-	-	-	-	-	2	-	-	-	3	-
ECP-14LA.2	3	2	-	-	-	-	-	-	2	-	-	-	3	-
ECP-14LA.3	3	2	-	-	-	-	-	-	2	-	-	-	3	-
ECP-14LA.4	-	-	-	-	-	-	-	1	-	-	-	-	-	-
AVG	**3**	**2**	-	-	-	-	-	**1**	**2**	-	-	-	**3**	-

COs	Project Stage-I (EC-401LA)
EC-401LA.1	Defining the project statement through literature survey.
EC-401LA.2	Apply appropriate modern tool to execute the project work.
EC-401LA.3	Analyze the application of project with appropriate societal and environmental consideration.
EC-401LA.4	Develop presentation and interpersonal communication skills.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-401LA.1	3	3	-	-	-	-	-	-	-	-	-	-	3	3
EC-401LA.2	3	-	3	-	3	-	-	-	-	-	1	2	3	3
EC-401LA.3	-	-	-	-	-	1	1	1	-	-	-	-	3	3
EC-401LA.4	-	-	-	-	-	-	-	1	3	3	1	2	3	-
AVG	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**1.00**	**1.00**	**1.00**	**3.00**	**3.00**	**1.00**	**2.00**	**3.00**	**3.00**

ECO-11A	Operating Systems						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**

Unit- I

Introduction: OS functions: as user/computer interface, interaction with OS, commands, efficient resource manager, security and protection, evolution of OS, OS structure and future trends.

Unit- II

OS Prerequisites: Important software resources, interaction with OS in mainframe systems: PSW, controlling i/o, interrupt, interrupt priority, interrupt cycle. Fundamental concept related to IPC.

Unit -III

Concurrent Processing : Introduction, process concept, process control block, exec sys, concurrent program, process state transitions, hierarchy of processes.

Unit-IV

Scheduling: CPU scheduling algorithms: allocation of different resources, scheduling queues, different scheduling algorithms.

Deadlock: Introduction, deadlock and starvation, resource allocation graph, way to solve dedlock.

Text Books:

1. P. P Choudhary, Operating Systems by PHI Learning Pvt Ltd.

Reference Books:

1. Operating Systems : Internals and Design Principles, William Stallings, Pearson
2.Operating System Concepts", Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, Wiley

CO	Operating System (ECO-11A)
ECO-11 A.1	Understand the fundamentals of OS.
ECO-11 A.2	Demonstrate the concept of interrupts in OS and inter process communication.
ECO-11 A.3	Identify the use of concurrent processing in OS.
ECO-11 A.4	Apply CPU scheduling strategies to solve deadlocks in OS.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECO-11 A.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
ECO-11 A.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
ECO-11 A.3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
ECO-11 A.4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
AVG	**3**	**2**	-	-	-	-	-	-	-	-	-	-	-	-

8th Sem

ECO-13A	Soft Computing						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3Hr

Unit-I

Soft Computing and Artificial Intelligence: Introduction of Soft Computing, Soft Computing vs. Hard Computing, Various Types of Soft Computing Techniques, Applications of Soft Computing, AI Search Algorithm, Predicate Calculus, Rules of Interference, Semantic Networks, Frames, Objects, Hybrid Models

Unit-II

Artificial Neural Networks and Paradigms: Introduction to Neuron Model, Neural Network Architecture, Learning Rules, Perceptrons, Single Layer Perceptrons, Multilayer Perceptrons, Back propagation Networks, Kohnen'sself-organizing networks, Hopfield network, Applications of NN.

Unit-III

Fuzzy Logic: Introduction, Fuzzy sets and Fuzzy reasoning, Basic functions on fuzzy sets, relations, rule-based models and linguistic variables, fuzzy controls, Fuzzy decision making, applications of fuzzy logic.

Unit-IV

Genetic Algorithms and Swarm Optimizations: Introduction, Genetic Algorithm, Fitness Computations, Cross Over, Mutation, Evolutionary Programming, Classifier Systems, Genetic Programming Parse Trees, Variants of GA, Applications, Ant Colony Optimization, Particle Swarm Optimization, Artificial Bee Colony Optimization.

Text Books:

1. Simon S. Haykin, Neural Networks, Prentice Hall, 2nd edition.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill.
3. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y.

Reference Books:

1. Zimmermann, “Fuzzy Set Theory and its Application”, 3rd Edition.
2. B. Yegnanrayana , “Artificial Neural Networks” , PHI.
3. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House.
4. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall.

COs	Soft Computing (ECO-13A)
ECO-13A.1	**Understand various soft computing techniques and its applications**
ECO-13A.2	**Design and train ANNs by using different learning rules and algorithms**
ECO-13A.3	**Apply different intelligent algorithms in classification, prediction, optimization, pattern recognition applications**
ECO-13A.4	**Design hybrid systems incorporating neural networks, genetic algorithms, fuzzy systems**

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECO-13 A.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
ECO-13 A.2	3	3	**3**	3	-	-	-	-	-	-	-	-	-	3
ECO-13A.3	3	3	-	3	2	-	-	-	-	-	-	-	-	3
ECP-13A.4	3	3	**3**	3	2	-	-	-	-	-	-	-	-	3
AVG	**3**	**3**	**3**	**3**	2	-	-	-	-	-	-	-	-	**3**

ECO-16A	Mixed Signal Design						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**

Unit-I

Switched-Capacitor Circuits

Introduction to Sampling Switches: MOSFETS as switches, speed considerations, precision considerations, charge injection cancellations. Switched-Capacitor Amplifiers: Unity Gain Sampler-Buffer, Noninverting Amplifier, Precision Multiply-by-Two Circuit. Switched-Capacitor Integrator, Switched-Capacitor Common-Mode Feedback.

Unit- II

Phase Locked Loop

Characterization of a comparator, basic CMOS comparator design, analog multiplier design, PLL-simple PLL, charge-pump PLL, Applications of PLL

Unit- III

D/A Converter

Sample-and-Hold Characteristics, DAC Specifications, DAC Architectures: Digital input Code, Resister Steering, R-2R Ladder Networks, Current Steering, Charge-Scaling DACs, Cyclic DACs, Pipeline DACs.

Unit- IV

A/D Converter

ADC Specifications, ADC Architectures: Flash, The Two-Step Flash ADC, The Pipeline ADC, Integrating ADCs, The Successive Approximation ADC, The Oversampling ADC. Applications of DACs and ADCs.

TEXT BOOKS:

1. Jacob Baker, “CMOS circuit design, layout and simulation”, John Wiley India.
2. Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.

REFERENCE BOOKS:

1. CMOS Analog Circuit Design –Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition.
2. Gregorian, Temes, “Analog MOS Integrated Circuit for signal processing”, John Wiley & Sons, 1986.
3. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edition

COs	Mixed Signal Design (ECO-16A)
ECO-16A.1	Interpret the concepts of Mixed signal design.
ECO-16A.2	Understand the architecture of analog and digital circuits for system design.
ECO-16A.3	Analyze the behavior of analog and digital circuits for system design.
ECO-16A.4	Apply knowledge of different architectures in mixed signal circuits for real life applications.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECO-16A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECO-16A.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECO-16A.3	3	3	-	2	-	-	-	-	-	-	-	-	3	-
ECO-16A.4	-	3	3	2	-	-	-	-	-	-	-	-	3	3
AVG	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	**3**

ECP -22A	Internet of Things						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hr.

Unit 1

Introduction to IoT: Defining IoT, Characteristics of IoT, Functional blocks of IoT, Physical and logical design of IoT, Smart cities and IoT revolution, ,Difference between IoT and M2M, M2M and peer networking concepts Ipv4 and IPV6, Software Defined Networks SDN,

Unit 2

Developing IoTs: IoT design methodology, case study on IoT system for weather monitoring. IoT system Management,

Developing IoT applications through embedded system platform: Introduction to sensors, IoT physical devices and endpoints, Raspberry pi, Raspberry pi interfaces, Arduino, arduino interfaces.

Unit 3

Protocols for IoT- messaging protocols, transport protocols, Ipv4, Ipv6, URI, Cloud for IoT: IoT with cloud, challenges, introduction to fog computing, cloud computing,
Challenges in IoT: Design challenges, development challenges, security and legal considerations.

Unit 4

Logic design using Python: Introduction to python, data types, data structures, control flow, functions, modules, file handling and classes., implementing IotT concepts with python,
Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT,

References:

1) A Bahaga, V. Madisetti, “Internet of Things- Hands on approach”, University press, 2014.
2) S.K.Vasudevan, A.S.Nagarajan, “Internet of Things”, Wiley, 2019.
3) CunoPfister, “Getting started with Internet of Things”, Maker Media, 1st edition, 2011. Samuel Greenguard, “Internet of things”, MIT Press, 2015.

Web resources:

1) http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things-1.html
2) https://developer.mbed.org/handbook/AnalogIn
3) http://www.libelium.com/50_sensor_applications
4) M2MLabs Mainspring http://www.m2mlabs.com/framework Node-RED http://nodered.org/

COs	Internet of Things (ECP-22A)
ECP-22A.1	Understand what IoT technologies are used for today, and what is required in certain scenarios.
ECP-22A.2	Design methodology of IoT with case study in IoT weather monitoring.
ECP-22A.3	Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.
ECP-22A.4	Understand the type of protocols and challenges for designing IoT systems.
ECP-22A.5	Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications.
ECP-22A.6	Understand operating system requirements of IOT.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECP-22A.1	3	2	1	-	-	-	-	-	-	-	-	1	3	1
ECP-22A.2	3	2	1	-	2	-	-	-	-	-	-	1	2	2
ECP-22A.3	2	3	2	2	1	-	-	-	-	-	-	2	2	2
ECP-22A.4	2	3	1	1	2	-	-	-	-	-	-	2	3	1
ECP-22A.5	3	1	1	1	-	-	-	-	-	-	-	1	2	2
ECP-22A.6	3	1	1	-	-	-	-	-	-	-	-	1	2	1
AVG	**2.67**	**2.00**	**1.16**	**1.33**	**1.67**	**-**	**-**	**-**	**-**	**-**	**-**	**1.33**	**2.33**	**1.5**

ECP-24A	Satellite Communication						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**

Unit -I

SATELLITE ORBITS: Orbital Mechanics- Kepler's laws ,locating the satellite in the Orbit, locating the satellite with respect to the earth, Orbital elements, look angle determination, Sub satellite point, Azimuth and elevation angle calculation, Orbital perturbations, Longitudinal and Inclination changes; Launches and launch vehicles-ELV's, Placing the satellite into geostationary orbit, Doppler shift, range variations, solar eclipse, sun transit outage.

Unit -II

COMMUNICATION SATELLITES: Satellite Subsystems, Attitude and Orbit Control system (AOCS), Telemetry, Tracking, Command and Monitoring (TTC&M), Power System, Communication Subsystems-description, Transponders, satellite antennas-basic antenna types, basic antennas in practice.

Unit -III

Satellite link design and Satellite access: Basic transmission theory**,** system noise temperature and G/T ratio; Downlink design-link budget; Uplink design; design for specified C/N, uplink and downlink attenuation in rain, communication link design procedure; system design examples.

Unit –IV

Multiple access schemes: FDMA, TDMA, CDMA, DAMA; VSAT systems-basic techniques, VSAT earth station engineering, system design; DBS systems-C-band and Ku band home TV, digital DBS; satellite mobile systems; GPS

Text Books:

1. Timothy Pratt, Satellite Communications, Wiley India edition

Reference Books:D

2. Anil K Maini, Satellite Communication, Wiley India edition.

3. Siegmund M. Redl, Mathias K. Weber, Malcolm W. Oliphant, "An Introduction to GSM", Artech House Publishers, 1995.

4. Kraus, J.D., "Antennas", II Edition, John Wiley and Sons, NY, 1977. 5. Collin, R.E. and Zucker, F., - "Antenna theory: Part I", Tata McGraw Hill, NY, 1969.

COs	Satellite Communication (ECP-24A)
ECP-24A.1	**Understand the basics of satellite communication with its basic terms and laws.**
ECP-24A.2	**Explain the tracking and control processes of communication satellites.**
ECP-24A.3	**Familiarize with the design issues of satellite link design and satellite access.**
ECP-24A.4	**Discuss various multiple access schemes used in satellite communication.**

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ECP-24A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECP-24A.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
ECP-24A.3	3	2	-	-	-	-	-	-	-	-	-	-	3	-
ECP-24A.4	3	-	-	-	-	-	-	-	-	-	-	-	3	-
AVG	**3**	**2**	-	-	-	-	-	-	-	-	-	-	**3**	-

ECP-22LA	Internet of Things Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor test**	**Total**	**Time**
-	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hr.**

List of Experiments

1. Familiarization with concept of IoT, Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/ Buzzer using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF LED/Buzzer.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed.
4. To interface Analog sensors (Temperature/Humidity/ Ultrasonic) with Arduino/Raspberry Pi and write a program to display sensors data on the computer screen.
5. To interface OLED with Arduino/Raspberry Pi and write a program to print sensor data on it.
6. To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Relay when sensor data is detected.
7. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF motor when push button is pressed.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data on smart phone using Bluetooth.
9. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when a 1/0 is received from smart phone using Bluetooth.
10. Write a program to upload sensor data on cloud.
11. Write a program to retrieve sensor data from cloud.

Internet of Things Lab (ECP-22LA)	
ECP-22LA.1	Familiarize with Arduino and Raspberry Pi.
ECP-22LA.2	Implement interfacing different sensors with Arduino and Raspberry Pi
ECP-22LA.3	Understand the concept of cloud.
ECP-22LA.4	Design module based on Internet of Things application

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
ECP-22LA.1	3	2	2	1	-	-	-	-	-	-	-	2	3	2
ECP-22LA.2	2	2	2	3	-	-	-	-	-	-	-	1	2	2
ECP-22LA.3	3	2	2	1	-	-	-	-	-	-	-	1	2	2
ECP-22LA.4	3	2	1	1	-	-	-	-	-	-	-	-	2	3
AVG	**2.75**	**2**	**1.75**	**1.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.33**	**2.25**	**2.25**

COs	Project Stage-II (EC-402LA)
EC-402LA.1	Defining the project statement through literature survey.
EC-402LA.2	Apply appropriate modern tool to execute the project work.
EC-402LA.3	Analyze the application of project with appropriate societal and environmental consideration.
EC-402LA.4	Develop presentation and interpersonal communication skills.

Cos/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC-402LA.1	3	3	-	-	-	-	-	-	-	-	-	-	3	3
EC-402LA.2	3	-	3	-	3	-	-	-	-	-	1	2	3	3
EC-402LA.3	-	-	-	-	-	1	1	1	-	-	-	-	3	3
EC-402LA.4	-	-	-	-	-	-	-	1	3	3	1	2	3	-
AVG	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**1.00**	**1.00**	**1.00**	**3.00**	**3.00**	**1.00**	**2.00**	**3.00**	**3.00**