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.

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

BS – 201A	Optics and Waves						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To introduce the fundamentals of wave and optics for the applications in Engineering field.						
Course Outcomes							
CO 1	Familiarize with basic phenomenon used in propagation of waves.						
CO 2	Introduce the fundamentals of interference, diffraction, polarization and their applications.						
CO 3	To make the students aware to the importance of Laser in technology.						

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.*

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

EC-201A	Electronic Devices						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs.
Course Outcomes (CO)							
CO1	To understand the concept of carrier transport phenomena in semiconductors and diodes such as p-n junction diode and tunnel diode.						
CO2	To understand the detailed operation of BJT and calculation of its parameters using transistor models.						
CO3	To understand the operation, characteristics & parameters of FET and MOSFET.						
CO4	To understand the concept of different types of regulated power supplies and Op-Amp based voltage regulators						

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.

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

EC-203LA	Electronic Devices Lab						
Lecture	Tutorial	Practical	Credit	Practical	Minor Test	Total	Time
-	-	2	1	60	40	100	3 Hrs.
Course Outcomes (CO)							
CO1	To teach the students how to experimentally plot 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.						
CO2	To teach the students how to experimentally find the values of various parameters of Transistor such as voltage gain, current gain etc.						
CO3	To teach the students how to plot the input and output characteristics of FET and MOSFET by experimental method.						
CO4	To experimentally teach the students the concept of different configurations of regulated power supplies using Zener diodes and Op-Amp.						

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.

Note: Atleast ten (10) experiments from the above list are mandatory to perform for the students.

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

Course Outcomes (CO)	
CO1	Students will be able to understand the basic logic gates and will be able to apply minimization techniques for reducing a function upto six variables.
CO2	Students will be able to design combinational circuits and applications related to them.
CO3	Students will be able to write the truth table, excitation table, characteristic equations of various flip flops and to design the sequential circuits using Flip flops.
CO4	Students will be able to familiarize with varied memory types and various A/D, D/A Converters and their characteristics.

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

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

EC-207LA	Digital Electronics Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	**Students will be able to verify truth tables of basic logic gates and design various gates using universal gates.**						
CO2	**Students will be able to design various combinational circuits and verify their operation.**						
CO3	**Students will be able to design different sequential circuits by using flip flops and verify their operation.**						
CO4	**Students will be to study and design various encoders and decoders.**						

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.

Note: Atleast ten (10) experiments from the above list are mandatory to perform for the students.

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

Course Outcomes (CO)

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

CO1	**Analyze different types of signals.**
CO2	**Represent continuous and discrete systems in time and frequency domain using different transforms.**
CO3	**Understand sampling theorem and its implications.**

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.

Note: Question paper template will be provided to the paper setter.

ECE-211LA	Signals & Systems Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	**To understand the basic concepts of software.**						
CO2	**To explore properties of various types of signals and systems.**						
CO3	**To explore different properties of signals and systems.**						
CO4	**To understand the concept of sampling in time and frequency domain.**						

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

Note: Atleast ten (10) experiments from the above list are mandatory to perform for the students.

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

Course Outcomes (CO)	
CO1	To understand the concept of network topologies and the network analysis in the time domain for solving simple and complex circuits.
CO2	Describe the circuit element models, network analysis using Laplace transform and time domain behavior from the pole-zero plots.
CO3	Describe the characteristics & parameters of two port networks.
CO4	To understand the concept of filters and synthesis of one port networks.

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.

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

ES-219A	Essentials of Information Technology						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs.
Course Outcomes (CO)							
CO1	Develop basic computational thinking. Learn how to reason with variables, state transitions, conditionals, and iteration						
CO2	Understand the notion of data types, and higher order data structures such as lists, tuples, and dictionaries.						
CO3	Develop a basic understanding of computer systems -architecture, OS, mobile and cloud computing.						
CO4	Learn basic SQL programming						

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 Organisation: 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.

MC-901A	Environmental Sciences						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**0**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To learn the multidisciplinary nature, scope and importance of Environmental sciences.						
Course Outcomes (CO)							
CO1	The students will be able to learn the importance of natural resources.						
CO2	To learn the theoretical and practical aspects of eco system.						
CO3	Will be able to learn the basic concepts of conservation of biodiversity.						
CO4	The students will be able to understand the basic concept of sustainable development.						

UNIT 1

The multidisciplinary nature of environmental studies, Definition, Scope and Importance, Need for public awareness, Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

(a) Forest Resources: Use and over-exploitation, deforestation, case studies. Timber eztraction, mining, dams and their effects on forests and tribal people.
(b) Water Resources: Use & over-utilization of surface & ground water, floods, drought, conflicts over water, dams-benefits and problems.
(c) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
(d) Food Resources: World Food Problems, changes caused by agriculture and overgazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
(e) Energy Resources: Growing energy needs, renewable & non-renewable energy sources, use of alternate energy sources. Case studies.
(f) Land Resources: Land as a resource, land, degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyle.

UNIT II

Ecosystem-Concept of an ecosystem. Sturcture and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological Succession, Food Chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest Ecosystem, (b) Grassland Ecosystem, (c) Desert Ecosystem and (d) Aquatic Ecosystems (ponds, streams, lakes, rivers, oceans, esturaries

Field Work: Visit to a local area to document Environment assets-river/forest/grassland/hill/mountain, Visit to a local polluted site-Urban /Rural Industrial/Agricultural, Study of common plants, insects and birds, Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

UNIT III

Biodiversity and its conservation: Introduction, Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversityof global, National and local levels. India as a mega-diversity nation Hot spots of Biodiversity, Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts, Endangered and endemic species of India, Conservation of Biodiversity- In situ and Ex-Situ conservation of biodiversity.

Environmental Pollution Definition: Cause, effects and control measures of (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards

Solid waste management- cause, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides

UNIT IV

Social Issues and the Environment. From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns, Case Studies: Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies: Wasteland Reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public Awareness, Human population and the Environment, Population growth, variation among nations, Population explosion-Family Welfare Programme, Environment and human health. Human rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human Health, Case Studies, Drugs and their effects; Useful and harmful drugs, Use and abuse of drugs, Stimulant and depressan drugs, Concept of drug de-addiction, Legal position on drugs and laws related to drugs.

Suggested Books

- Environmental Studies- Deswal and Deswal. Dhanpat Rai and Co.
- Environmental Science and Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India.
- Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
- Environmental Science- Botkin and Keller. 2012. Wiley , India

Note: The Examiner will be given the question paper template to set the question paper.

BS-207A	APPLIED AND COMPUTATIONAL MATHEMATICS						
LECTURE	TUTORIAL	PRACTICAL	CREDIT	MAJOR TEST	MINOR TEST	TOTAL	TIME
3	-	-	3	75	25	100	3 H
Purpose	The objective of this course is to familiarize the prospective Engineers with ordinary and partial differential equations, Laplace Transform which allow deterministic mathematical formulations of phenomena in engineering processes and to study numerical methods for the approximation of their solution. More precisely, the objectives are as under:						

Course Outcomes	
CO 1	To introduce the Ordinary & Partial Differential Equations, its formation and solutions for multivariable differential equations originated from real world problems.
CO 2	To study some extended topics in calculus essential for computations w.r.t. parameter variations ,vectors and field theory.
CO 3	Introduction about the concept of Laplace transform and how it is useful in solving the definite integrals and initial value problems.
CO 4	To introduce the tools of numerical methods in a comprehensive manner those are used in approximating the solutions of various engineering problems.

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 1/3rd 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.

Note: The Examiner will be given the question paper template to set the questions.

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

Course Outcomes (CO)	
CO1	To learn digitization of analog signal by pulse modulation system and analyze their system performance
CO2	To analyze different baseband transmission schemes and their performance.
CO3	To learn and understand different digital modulation schemes and compute the bit error performance
CO4	To analyze different modulation tradeoffs and different equalization techniques.

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

EC-204LA	COMMUNICATION LAB						
Lecture	Tutorial	Practical	Credit	Practical	Minor Test	Total	Time
-	-	2	1	60	40	100	3 Hrs.
Course Outcomes (CO) Upon completion of the course, students will be able to							
CO1	Generate and analyze Analog Modulated and demodulated Signals.						
CO2	Test & observe the outputs of different types of analog detectors.						
CO3	Generate and analyze digital Modulated and demodulated Signals.						
CO4	Test & observe the outputs of different types of digital detectors.						

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.

Note: At least ten (10) experiments from the above list are mandatory to perform for the students.

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

EC-206A	Analog Circuits						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs.
Course Outcomes (CO)							
CO1	To make the students understand the analysis of various BJT and FET amplifiers using small signal models.						
CO2	To teach the students the concept of describe the frequency response of multistage amplifiers and the detailed concept of feedback topologies.						
CO3	To make the students learn various oscillator circuits using both Op-Amp and BJT.						
CO4	To teach the students the various application circuits of Op-Amp and designing for a given specification.						

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.

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

EC-208LA	Analog Circuits Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	**To design and calculate the gain , frequency response etc. of the various configuration of transistor amplifier.**						
CO2	**To make students Design various RC oscillators using Op-Amp 741 for a given frequency of oscillation.**						
CO3	**To make students Design various RC oscillators using BJT for a given frequency of oscillation.**						
CO4	**To teach the students the design of various Op-Amp circuits such as adder, subtractor etc.**						

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 ≤ 10 KHz.
6. To design and test the performance of BJT – Hartley Oscillators for RF range f0 ≥100KHz.
7. To design and test the performance of BJT – Colpitt Oscillators for RF range f0 ≥100KHz.
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.

Note: Atleast ten (10) experiments from the above list are mandatory to perform for the students.

EC-210A	MICROPROCESSORS AND MICROCONTROLLER						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	**Acquired knowledge about the architecture of Microprocessors and Microcontrollers.**						
CO2	**Acquired knowledge about instruction set and programming concept of Microprocessors and Microcontrollers in assembly and C language.**						
CO3	**To understand peripheral interfacing with Microprocessors and Microcontrollers.**						
CO4	**To design the systems /models based on Microprocessors and Microcontrollers**						

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.

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

EC-212LA	MICROPROCESSORS AND MICROCONTROLLER LAB						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	**To familiarization with 8085, 8086 Microprocessors and 8051 Microcontrollers.**						
CO2	**Ability to write an assembly language program for 8086 Microprocessors as well as C language program for 8051 Microcontroller.**						
CO3	**Ability to interfacing the various Peripheral to 8086 Microprocessors and 8051 Microcontrollers.**						
CO4	**Ability to design the systems based on 8051 Microcontrollers.**						

List of experiments to be performed using 8086 and 8051 Microcontrollers

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.

Note: Atleast ten (10) experiments from the above list are mandatory to perform for the students.

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)

ES -208A	BASICS OF ANALOG COMMUNICATION						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs.
Course Outcomes (CO):Upon completion of the course, students will be able to							
CO1	Describe different types of noise and predict its effect on various analog communication systems.						
CO2	Understand and analyze various Amplitude modulation and demodulation methods.						
CO3	Understand and analyze Angle modulation and demodulation methods.						
CO4	Understand the concepts of Transmitters and Receivers and their circuits.						

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

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

MC-902A	Constitution of India					
Lecture	**Tutorial**	**Practical**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To know the basic features of Constitution of India**					
Course Outcomes						
CO1	**The students will be able to know about salient features of the Constitution of India.**					
CO2	**To know about fundamental duties and federal structure of Constitution of India.**					
CO3	**To know about emergency provisions in Constitution of India.**					
CO4	**To know about fundamental rights under constitution of India.**					

UNIT-I

1. Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India.
2. Scheme of the fundamental rights

UNIT - II

3. The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.
4. Parliamentary Form of Government in India – The constitution powers and status of the President of India

UNIT - III

5. Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India.
6. Emergency Provisions: National Emergency, President Rule, Financial Emergency. Local Self Government – Constitutional Scheme in India.

UNIT-IV

7. Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19.

8. Scope of the Right to Life and Personal Liberty under Article 21.

Text Books

1. Constitution of India. Prof.Narender Kumar (2008) 8th edition. Allahabad Law Agency**.**

Reference Books:

1. The constitution of India. P.M. Bakshi (2016) 15th edition. Universal law Publishing.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination

Semester V (w.e.f. session 2021-2022)

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	HTM-901A	Universal Human Values II : Understanding Harmony	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-313A 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-903A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Modified Scheme of Studies/Examination

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

HTM-901A	Universal Human Values II: Understanding Harmony						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3.0**	**75**	**25**	**100**	**3 Hours**
Purpose	Purpose and motivation for the course, recapitulation from Universal Human Values-I						
Course Outcomes (CO)							
CO 1	Development of a holistic perspective based on self-exploration about themselves (human being),family, society and nature/existence.						
CO 2	Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.						
CO 3	Strengthening of self-reflection.						
CO 4	Development of commitment and courage to act.						

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for ValueEducation

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment ofaspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at variouslevels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrarinessin choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as thefoundational values of relationship

14. Understanding the meaning of Trust; Difference between intention and competence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the othersalient values in relationship
16. Understanding the harmony in the society (society being an extension of family): Resolution,Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- fromfamily to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value inrelationships. Discuss with scenarios. Elicit examples from students' lives

Module 4: Understanding Harmony in the Nature and Existence - Whole existence asCoexistence

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" canbe used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on ProfessionalEthics

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. todiscuss the conduct as an engineer or scientist etc.

READINGS:

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J CKumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

MODE OF CONDUCT

Lecture hours are to be used for lecture/practice sessions.

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at handand motivating students to reflect, explore and verify them.

Practice hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elementsto help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions, the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenariosmay be used to initiate discussion. The student is encouraged to take up" ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Practice experiments are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based onbasic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, including HSS faculty. Teacherpreparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemedessential.

ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by

faculty mentor: 5 marks

Self-assessment: 5 marks

Assessment by peers: 5 marks

Socially relevant project/Group Activities/Assignments: 10 marks

Semester End Examination: 75 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

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.
Course Outcomes At the end of this course students will demonstrate the ability to								
CO1	*To understand the concept of basics of computer hardware & software*							
CO2	*To understand the concept of control design & processor design*							
CO3	*To familiarize with the concept of various memory systems.*							
CO4	*To familiarize with the concept of system organisation.*							

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.

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.
Course Outcomes						
CO1	Acquire knowledge to understand the concept of information and entropy					
CO2	Ability to analyze and understand Shannon's theorem for coding					
CO3	Foster ability to identify basic errors Calculation of channel capacity					
CO4	To develop skills to apply coding techniques					

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.

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
Course Outcomes At the end of this course students will demonstrate the ability to								
CO1	Obtain Z-transformation of discrete time signals							
CO2	Obtain DFT and FFT of discrete time signals							
CO3	Implement structures for different discrete time systems							
CO4	Design of FIR and IIR digital filters for various applications							

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 and W. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

MC-903A		Essence Of Indian Traditional Knowledge						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Practical	Total	Time
3	-	-	-	100	-	-	100	3
Purpose	To impart basic principles of thought process, reasoning and inferencing.							
Course Outcomes								
CO2	The students will be able to understand, connect up and explain basics of Indian Traditional knowledge in modern scientific perspective.							

Course Contents

- Basic structure of Indian Knowledge System: अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) ६वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
- Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
- Fritzof Capra, *Tao of Physics*
- Fritzof Capra, *The Wave of life*
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyanidhi Prakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi Prakashan, Delhi 2016
- P B Sharma (English translation), *Shodashang Hridayan*

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

Note: The paper setter will set the paper as per the question paper template provided.

ECP-1A	Probability Theory &Stochastic Processes						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3Hr**
Purpose	**To familiarize the students with the basics of Probability Theory &Stochastic Processes**						
Course Outcomes							
CO1	**Develop an understanding to the basic concepts of Sets, Probabilities &Random Variables.**						
CO 2	**To understand various distribution functions &bounds.**						
CO 3	**To analyze and appreciate various Random Sequences and theorems.**						
CO 4	**To apply various Random Processes &Power Spectral Density to real life problems.**						

Unit-I

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models. Discrete random variables, probability mass function, probability distribution function,example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions

Unit-II

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds

Unit-III

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

Unit-IV

Random process. Stationary processes. Mean and covariance functions. Ergodicity, Transmission of random process through LTI. Power spectral density.

Text Books:

1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," ThirdEdition, Pearson Education

2. A. Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.

Reference Books:

1. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International,
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
3. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

ECP-2A	SPEECH and AUDIO PROCESSING						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3**
Course Objectives	To enlighten the students about the fundamentals of speech and audio processing.						
Course Outcomes At the end of this course the student should be able to							
CO1	Mathematically model the speech signal						
CO2	Analyze the quality and properties of speech signal.						
CO3	Modify and enhance the speech and audio signals.						
CO4	To understand various speed coding standards.						

Unit-I

Introduction- Speech production and modeling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters,convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Unit-II

Linear Prediction of Speech- Basic concepts of linear prediction; LinearPrediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Unit-III

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Unit-IV

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zerostate method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP. Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards.

Text/Reference Books:

1. “Digital Speech” by A.M.Kondoz, Second Edition (Wiley Students Edition), 2004.
2. “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, W.C. Chu,WileyInter science, 2003.

ECP-3A	Introduction to MEMS						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Major Test**	**Minor Test**	**Total**	**Time**	**Credit**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**	**3**
Course Outcomes							
CO1	**Students will be using knowledge of mathematics, science, and engineering to understand various MEMS devices.**						
CO2	**Students be able to Appreciate the underlying working principles of MEMS and NEMS devices.**						
CO3	**Understanding basic principles of bulk micromachining and clean rooms practices**						
CO4	**Understand Design and model of MEM devices.**						

UNIT-I

Introduction: MEMS definition, classification of MEMS, Historical Background, Established applications of MEMS, modern MEMS applications, Miniaturization issues, Micro/Nano Sensors, Actuators and Systems overview, Multidisciplinary nature of MEMS – principles and examples of Micro sensors and micro actuators.

UNIT-II

Scaling laws in miniaturization - scaling advantages and issues, influence of scaling on material properties, scaling in mechanical systems, scaling in fluidic systems, scaling chemical and biological systems, scaling in heat conducting and heat convection.

UNIT-III

Basic MEMS fabrication methods: MEMS Fabrication Methods, Oxidation, Deposition Techniques, Photolithography, Materials for Micromachining, Substrates, additive Films and Materials, Bulk Micromachining, Wet Etching Dry Etching, Surface Micromachining, Fusion Bonding, High-Aspect- Ratio-Micromachining, LIGA, Laser Micromachining, Computer Aided Design, Assembly and System Integration, Multi-Chip Modules, Passivation and Encapsulation,

UNIT-IV

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.

ECP-4A	POWER ELECTRONICS						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Major Test**	**Minor Test**	**Total**	**Time**	**Credit**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**	**3**
Course Outcomes							
CO1	**Acquire knowledge about Build and test circuits using power devices such as SCR**						
CO2	**Ability to analyze Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters**						
CO3	**Foster ability to Learn how to analyze these inverters and some basic applications**						
CO4	**To develop skills to build, and Design SMPS.**						

UNIT-I

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT : structure, Characteristics, operation, Brief introduction to power devices: TRIAC, MOS controlled thyristor (MCT), Thyristor Triggering circuit, Thyristor commutation circuit, Uses and design of snubber circuits for thyristor, power MOSFETs and IGBT. Fast recovery diodes and schottky diodes.

UNIT-II

Rectifiers types: Controlled and Uncontrolled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE loads. Analysis of load voltage, load current and derivation of load form factor and ripple factor, Effect of source impedance on the performance of the controlled rectifiers, Analysis of three phase half wave controlled rectifiers with R load, Analysis of three phase half wave controlled rectifiers with R load.

UNIT-III

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control strategies for choppers, Detailed analysis of Type A chopper. Step up chopper. Inverters: Types of inverters, operating principle, Single phase half bridge inverter, Single phase full bridge inverter.

UNIT-IV

AC Voltage Controllers: Types of AC voltage controllers: symmetrical and asymmetrical controllers, Principle of phase control, ON-OFF control, Single phase ac voltage controller with R load. Cycloconverters: Principle of cycloconverter operation, step up and step down cycloconverters, Output voltage equation for a cycloconverter, Applications: Switching Power Supplies, SMPS, UPS.

Text /Reference Books:

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand& Co.
4. V.R.Moorthi, “Power Electronics”, Oxford University Press.
5. Cyril W., Lander,” Power Electronics”, edition III, McGraw Hill.

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**
Course Outcomes							
CO1	**Students will be able estimate oxide thickness, growth rate, etch rate, deposition rate, and perform pattern etching etc. using knowledge of mathematics, science, engineering and practices.**						
CO2	**Students can design and conduct experiments such as oxidation, metallization and analyze growth / deposition rate, thickness etc.**						
CO3	**Shall be able to understand system, design such as CVD reactor, PVD chamber etc.**						
CO4	**Understanding of fabrication sequence of CMOS and NMOS , PMOS Integrated circuits.**						

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.

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
Purpose	To familiarize the students with the concepts of basic computer networks used in communication. Also familiarize the students with the various layers of OSI and TCP/IP model.							
	Course Outcomes							
CO1	To understand the concept of basics of computer networks and physical layer& media.							
CO2	To understand the concept and processes of data link layer and medium access sublayer.							
CO3	To familiarize with the concept and design issues of network, transport & session layer and presentation layer.							
CO4	To familiarize with the concept and protocols of application layer.							

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 TelephoneSystem, 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

ECO-2A	MECHATRONICS						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	-	-	3	75	25	100	3

Course Outcomes

The Objective of this course is to make the students aware about Mechanical and Electronic Instruments together for different applications. This course will help students to build the fundamental concepts of inter disciplinary problems. **At the end of this course the student should be able**

CO1	To understand Mechatronics System and its applications.
CO2	To understand the operations of different Sensors and Transducers and their applications.
CO3	To understand the Electrical and Mechanical Actuation Systems operations and their uses.
CO4	To understand the basic structure of PLC and its applications and designing examples of Mechatronics Systems.

UNIT-I

INTRODUCTION TO MECHATRONICS: Definition, Evolution, Scope, Mechatronics Design Elements, Examples, and Applications; Measurement Systems; Control Systems: Open and Close Loop Systems, Block Diagram of Feedback Control System.

UNIT-II

TRANSDUCERS AND SENSORS: Transduction Principle, Classification of Transducers, Selection Parameters, Resistive, Inductive, Capacitive, Piezoelectric, Photoelectric, Measurement of Flow and Level; Sensors: LVDT, LMDT, Proximity, Force, Pressure, Pneumatic, Light, Touch and Tactile, Ultrasonic and Voice Recognition etc.

UNIT-III

ACTUATORS: Actuator Types and Application Areas, Electromechanical Actuators, Electrical Actuators : Servo and Stepper Motors; Pneumatic and Hydraulic Actuators, Piezoelectric Actuators, Magnetostrictive actuators, Memory-metal Actuators, Ion-exchange Polymer-metal Composite; Mechanical Actuators: Mechanism, Kinematics Chains, Bearings, Belt Drives, Chains and Chain Drives, Pulleys, Cams and Gears.

UNIT-IV

PLC AND MECHATRONIC SYSTEM DESIGN: Microprocessors, Microcontrollers; PLC**:** Introduction, Basic Structure, Input/Output Processing, Programming, Mnemonics, Timers, Internal Relays and Counters, Data Handling, Analog Input/Output, Selection of a PLC, Advantages and Uses; Design of Mechatronic Systems: Mechatronics design elements, Embedded system, MEMS, Robotics; Description of Designing a Mechatronic System: Automatic Camera, Washing Machine and List of some other Mechatronic Systems.

Text Books:

1. *R. K. Rajput, "A Textbook of Mechatronics", S. Chand & Company Pvt. Ltd, 2015.*
2. *Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", Tata McGraw-Hill publishing company Ltd, 2003.*
3. *M.D.Singh & J.G. Joshi, " Mechatronics" , PHI Learning Private Limited, 2015.*

Reference Books:

1 *Devdas Shetty & Richard A.Kolk, "Mechatronics System Design", PWS Publishing Company (Thomson Learning Inc.).*

2 *William Bolton, "Mechatronics Electronics Control systems in Mechanical and Electrical Engineering", Prentice Hall.*

ECO- 3A	Electronic Measurement and Instruments						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Purpose	**To familiarize the students with the concepts of Electronics Measurements like measurement of voltage, current & resistance etc.**						
Course Outcomes							
CO1	**Students will learn the techniques of measurement of resistance using different bridges**						
CO2	**AC Bridges & Voltage Indicating & Recording Devices will be introduced to the students**						
CO3	**Students will be able to recognize the functioning of different Analog & Digital Instruments**						
CO4	**Transducers & Data Acquisition Systems will be introduced to the students**						

Unit-I

Measurement and Error: Functional elements and generalized configuration of a measuring Instrument, Characteristics of instruments, errors in measurements and their statistical analysis.

Measurement of Resistance: Wheat stone bridge, Carey-Foster Bridge, Kelvin double bridge, Measurement of Insulation resistance.

Unit-II

Bridges: Maxwell Inductance bridge. Maxwell Inductance Capacitance Bridge, Anderson's Bridge, Hay's Bridge, De-Sauty's Bridge, Schering's bridge and Wein's bridge.

Voltage Indicating and Recording Devices: Analog voltmeters and Potentiometers, Self balancing potentiometer and X-Y recorders, Galvanometers - Oscillographs, Cathode - Ray Oscilloscopes, Magnetic Tape Recorders.

Unit-III

Electronic Instruments: Wave analyzer, Distortion meter: Q-meter. Measurement of Op-Amp parameters.

Digital Instruments: Digital Indicating Instruments, Comparison with analog type, digital display methods, digital methods of time and frequency measurements, digital voltmeters.

Unit-IV

Transducers: Classification of Transducers, Strain Gauge, Displacement Transducers - Capacitive Transducers, LVDT, Piezo-electric Transducers, Temperature Transducers – resistance thermometer, Thermocouples and Thermistors, Liquid level measurement Low pressure (vacuum) measurement.

Data Acquisition Systems: A to D and D to A converters, Analog and Digital Data Acquisition Systems, Multiplexing, Spatial Encoders, Telemetry.

Text Book:

1. A Course in Electrical and Electronics Measurements and Instrumentation: A.K. Sawhney; Dhanpat Rai & Sons.

Reference Books:

1. Electronics Instrumentation and Measurement Techniques: Cooper W.D & Helfrick A.D.; PHI Doeblin E.O., Measurement Systems: Application & Design, Mc Graw Hill.

ECO-4A	Renewable Energy Resources						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hour**
Course Outcomes							
CO 1	**To understand the energy demand of world, nation and available resources to fulfill the demand**						
CO 2	**To know about the conventional energy resources and their effective utilization**						
CO 3	**To acquire the knowledge of modern energy conversion technologies**						
CO 4	**To be able to understand and perform the various characterization techniques of fuels**						
CO5	**To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively.**						

Unit-I

Introduction: Energy demand of world and country and gap analysis, Fossil fuel based systems, Impact of fossil fuel based systems, Non conventional energy – seasonal variations and availability, Renewable energy– sources and features, Hybrid energy systems. Distributed energy systems and dispersed generation (DG).

Unit-II

Solar thermal systems: Solar radiation spectrum, Radiation measurement , Technologies, Applications, Heating, Cooling, Drying, Distillation, Power generation; Costing : Life cycle costing (LCC),Solar thermal system

Solar Photovoltaic systems ,Operating principle, Photovoltaic cell concepts ,Cell, module, array, Series and parallel connections, Maximum power point tracking, Applications ,Battery charging, Pumping , Lighting,Peltier cooling , Costing: Life cycle costing ,Solar PV system

Unit-III

Microhydel: Operating principle, Components of a microhydel power plant, Types and characteristics of turbines, Selection and modification, Load balancing, Costing: Life cycle costing –Microhydel Wind ; Wind patterns and wind data, Site selection, Types of wind mills , Characteristics of wind generators, Load matching, Life cycle costing - Wind system LCC.

Unit-IV

Biomass: Learning objectives, Operating principle, Combustion and fermentation, Anaerobic digester, Wood gassifier, Pyrolysis, Applications, Bio gas, Wood stoves, Bio diesel, Combustion engine, Life cycle costing - Biomass system LCC

Hybrid Systems, Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles

Suggested Books:

1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 2003
2. Mittal K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi,2003
3. Ramesh R & Kumar K U, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004
4. Wakil MM, Power Plant Technology, Mc Graw Hill Book Co, New Delhi, 2004.

EC-303LA	Electromagnetic Waves Lab						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
		3	1.5	40	60	100	3 Hour
Purpose	To give the students an idea about the study and analysis of components used in Microwave Engineering						
Course Outcomes							
CO1	*Students will learn the steps to analyze electric field behavior.*						
CO2	*Students will be able to characterize standing wave ration and reflection Coefficient.*						
CO3	*Students will learn the steps to analyze types of waveguide.*						
CO4	*Students will be able to find the unknown impedances in a transmission line.*						

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 TE_{10} mode using microwave bench.
7. Design & Characterization of Circular Waveguide using HFSS.
8. Design & Characterization of Microstrip Line using HFSS.
9. To measure unknown impedance with Smith Chart.
10. Desgin & Characterization of Microstrip line using simulation software.

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
Course Outcomes At the end of this course students will demonstrate the ability to								
CO1	Plot different discrete time signals							
CO2	Verify the aliasing effects							
CO3	Design digital FIR filters for various applications							
CO4	Design digital IIR filters for various applications							

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.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Modified Scheme of
Studies/Examination Semester VI
(w.e.f. session 2020-2021)

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.**

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Modified Scheme of Studies/Examination

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**
Purpose	To make the students conversant with the basics concepts of organizational culture and behavior for nurturing their managerial skills.						

Course Outcomes

At the end of this course the student should be able to

CO1	An overview about organizational behavior as a discipline and understanding the concept of individual behavior.
CO2	Understand the concept and importance of personality, emotions and its importance in decision making and effective leadership.
CO3	Enabling the students to know about the importance of effective motivation and its contribution in group dynamics and resolving conflicts.
CO4	Understand how to overcome organizational stress by maintaining proper organizational culture and effective communication

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.

Note: The paper setter will set the paper as per the question paper template provided.

EC-302A	Control System Engineering (6th Semester)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hours**
Purpose	The purpose of this course is to create awareness about the various types of control systems with the techniques to analyze them so that the learner is able to mathematically design and evaluate the conditions for which a control system can provide stable output with improved performance.						
CO1	Learner will be able to design and simplify the mathematical and graphical models of a control system through block diagram and signal flow graph method.						
CO2	Learner can evaluate the conditions for which a system can work under stable conditions in time domain.						
CO3	Learner will know about easier graphically methods to evaluate the conditions of stability in frequency domain.						
CO4	Learner will able to apply the compensation technique using state variable approach to covert an unstable system into a stable system under certain conditions.						

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.

EC-306A	Verilog HDL						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3**
Course Objectives	To familiarize the students with the conventions of the Verilog HDL programming, algorithmic levels of abstraction for modelling digital hardware systems, the concept of test-benches to create testing behavioral environments for simulation based verification.						
Course Outcomes At the end of this course the student should be able to							
CO1	To understand the constructs and conventions of the Verilog HDL programming.						
CO2	To understand the structural, register-transfer level (RTL), and algorithmic levels of abstraction for modelling digital hardware systems.						
CO3	To design and modelling of combinational and sequential digital systems						
CO4	To apply the concept of test-benches to create testing behavioral environments for simulation based verification.						

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.
Behavioralmodelling: 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.

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**
CO1	To describe, design, simulate, and synthesize circuits using the Verilog hardware							
CO2	To design and modelling of combinational and sequential digital system.							
CO3	To develop program codes for synthesis-friendly combinational and sequential logic.							
CO4	To understand the advanced features of Verilog HDL and be able to write optimized codes for complex systems.							

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.

EC-304LA	Control System Engineering Lab						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
		3	1.5	40	60	100	3 Hour
Purpose	To make students capable to design solutions for Control System engineering problems and design system components or processes that meet the specified needs of modern automated engineering industries.						
Course Outcomes							
CO1	Students will be able to execute time response analysis of a second order control system using MATLAB						
CO2	Students will be able to design Lag, Lead, Lead-Lag compensators and verify experimental results using MATLAB.						
CO3	Analyze toque- speed characteristics of DC and AC servomotors.						
CO4	Analyze and interpret stability of the system through Root Locus, Bode plot and Nyquist plot.						

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.

ECP-6A	Antennas & Propagation							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**		**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**		**100**	**3 Hrs.**
Purpose	*To familiarize the students with: Antennas used for various applications, performance parameters of antenna, methods of analysis of antenna, and different ways of propagating the signal.*							
CO1	*To Understand the structure and properties of various antennas.*							
CO2	*To understand the performance parameters of antenna.*							
CO3	*To design antenna of required specifications.*							
CO4	*To understand the different ways of signal propagation.*							

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.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. 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.

ECP-7A	CMOS Design					
Lecture	**Tutorial**	**Practical**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
		Course Outcomes				
CO1	Student will be able to analyze MOS transistor characteristics					
CO2	Student will be able to design CMOS invertor of specific characteristics					
CO3	Student will be able to design combinational CMOS circuit of given boolean equation					
CO4	Student will be able to design sequential CMOS circuit of given specification					

Unit- I

Introduction: Overview of VLSI Design Methodologies, VLSI Design flow, Design hierarchy, VLSI Design styles.
MOS Transistor: MOS structure, MOS system under external bias, structure and operation of MOSFET, C-V characteristics.

Unit- II

MOS Invertors: Introduction, resistive load invertor, invertor with n-type MOSFET load, CMOS invertor: circuit operation, noise margin, design of invertor, power and area consideration. .

Unit -III

Combinational MOS Logic: nMOS logic circuits with depletion nMOS load, CMOS logic circuits, complex logic circuits, CMOS pass gates

Unit-IV

Sequential MOS Logic circuits: Behaviour of bistable elemens, SR latch circuit, clocked latch and flip flop, CMOS D Latch and edge triggered flip flop

Text Books:
1. S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, MH, 2002.

Reference Books:
1. N. Weste, K. Eshraghian and M. J. S. Smith, Principles of CMOS VLSI Design : A Systems Perspective, Second Edition (Expanded), AW/Pearson, 2001.
2.J. P. Uyemura, CMOS Logic Circuit Design, Kluwer, 1999.

ECP-8A		Biomedical Electronics						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Practical	Total	Time
3	-	-	3	75	25	-	100	3
Course Outcomes At the end of this course students will demonstrate the ability to								
CO1	Understand and explain the concept of biomedical signals, electrodes and Instrumentation							
CO2	Understand and explain the physiological transducers and recording systems							
CO3	Understand and explain biomedical recorders and patient monitoring systems							
CO4	Understand and explain cardiac pacemakers, defibrillator and patient safety							

UNIT-I

Introduction: Role of technology in medicine, physiological systems of the body, sources of biomedical signals, basic medical instrumentation and their performance requirements, intelligent medical instrumentation systems, consumer and portable medical equipment, implantable medical devices, role of engineers in healthcare facilities.

Bioelectric Signals and Electrodes: Origin of bioelectric signals, recording electrodes, silver- silver chloride electrodes, electrodes for ECG, electrodes for EMG, electrical conductivity of electrode jellies and creams, microelectrodes.

UNIT-II

Physiological Transducers: Definition, classification and performance characteristics of transducers, displacement, position and motion transducers, pressure transducers, transducers for body temperature measurement, photoelectric transducers, optical fiber sensors, biosensors, smart sensors.

Recording System: Basic recording system, general considerations for signal conditioners, preamplifiers, sources of noise in low level measurements, biomedical signal analysis and processing techniques, the main amplifier and driver stage, writing systems.

UNIT-III

Biomedical Recorders: Electrocardiograph, vectorcardiograph (Vcg), phonocardiograph (Pcg), digital stethoscope, electroencephalograph (Eeg), electromyograph.

Patient Monitoring Systems: System concepts, cardiac monitor, bedside patient monitoring systems, central monitors, measurement of heart rate, measurement of temperature, measurement of respiration rate, catheterization laboratory instrumentation, ambulatory monitoring instruments.

UNIT-IV

Cardiac Pacemakers and Defibrillators: Need for cardiac pacemaker and defibrillator, external pacemakers, implantable pacemakers, pacing system analyzer, DC defibrillator, implantable defibrillators, types of defibrillators, defibrillator analyzer.

Patient Safety: Electric shock hazards, leakage currents, safety codes for electromedical equipment, electrical safety analyzer.

Text/Reference Books:

1. R S Khandpur: Handbook of biomedical instrumentation, 3rd ed., McGraw Hill Education.
2. Joseph D. Bronzino: The biomedical engineering handbook, 2nd ed., CRC Press.

ECP-9A		Scientific Computing						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Practical	Total	Time
3	-	-	3	75	25	-	100	3
Course Outcomes At the end of this course students will demonstrate the ability to								
CO1	To understand the concept of computational linear algebra and apply the matrix decompositions techniques to solve the problems of linear algebra							
CO2	To understand the concept of Scientific computing and will be able to find the solution of linear and non linear equations							
CO3	To learn the concept of Vector functions, partial derivatives, gradient and tangent planes							
CO4	To understand the various numerical techniques for solving differential equations and use MATLAB to visualize the solutions practically.							

Unit -I

Introduction to Computational Linear Algebra

Fundamental algorithms in computational linear algebra with relevance to all science concentrators. Basic linear algebra and matrix decompositions (Cholesky, LU, QR, etc.), round-off errors and numerical analysis of errors and convergence. Iterative methods and conjugate gradient techniques. Computation of eigenvalues and eigenvectors, and an introduction to least squares methods

Unit –II

Introduction to Scientific Computing

Numerical computations; Includes instruction for programming in MATLAB. Applications solution of linear equations (with vectors and matrices) and nonlinear equations (by bisection, iteration, and Newton's method),interpolation, and curve-fitting, difference equations, iterated maps, numerical differentiation and integration, and differential equations.

Unit –III

Vector Functions; Derivatives,tangent vector velocity,acceleration,arc length of space curve,curvature and normal vectors,functions of two or more variables,limits and continuity,partial derivatives,directional derivatives,gradient and tangent planes,second derivative ,maxima,minima,sable point

Unit -IV

Introduction to Numerical Solution of Differential Equations Fundamental numerical techniques for solving ordinary and partial differential equations. Overview of techniques for approximation and integration of functions Differential equations,First Order differential equations,variables separable form,solution of first order linear equation,second and higher order equations,solution of constant coefficient second order equation, Solution of two-point boundary value problems, introduction to methods for solving linear partial differential equations.

Text/Reference Books:

1. Calculus and Analytical Geometry (9th Edition) Thomas and Finney Pearson Education
2. Calculus (5th Edition) James Stewart
3. Advanced Engineering Mathematics (8th Edition) Erwin Kreyszig John Willey and Sons
4. Linear Algebra (2nd edition) Hoffman and Kunz Prentice Hall International
5. Linear Algebra Peter D.Lax
6. Differentials Equations with applications and Historical notes. Simmons G.F

ECO-5A	Data Structures						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Major Test**	**Minor Test**	**Total**	**Time**	**Credit**
3	**-**	**-**	**75**	**25**	**100**	**3 Hr.**	**3**
		Course Outcomes					
CO1	Student will be able to determine the time complexity of various operations on arrays						
CO2	Student will be able to select appropriate data structure for given application						
CO3	Student will be able to create link list and apply various operations.						
CO4	Student will be able to evaluate the traversal of binary trees and represent graphs						

Unit- I

Introduction: Concept of Data Structures, Design of suitable algorithm, algorithm analysis.
Arrays: 1-D arrays: Traversal, Selection, Searching, Insertion, Deletion and Sorting. Multi-D arrays, representation of arrays in physical memory, application of arrays

Unit- II

Stacks and Queues: Stacks: Stack operations, Application of Stacks, Queues: operations, circular queue, priority queue, deque
Pointers: Introduction, pointer variable, pointers and arrays, array of pointers, pointers and structures

Unit -III

Linked Lists: Introduction, Operations: Creation, Traversal, Searching, Insertion and Deletion. Circular and Doubly linked list, linked stacks and queues.

Unit-IV

Trees: Basic terminology, binary trees, representation of binary trees: linear and linked, traversal of binary trees
Graphs: graph terminology, representation of graphs: array based, linked list based, set based.

Text Books:
1.Data Structures using C by A. K. Sharma , Pearson Publication
2.Theory & Problems of Data Structures by Jr. Symour Lipschetz, Schaum's outline by TMH.
Reference Books:
1.Data Structures using C by A. M. Tenenbaum, Langsam, Moshe J. Augentem, PHI Pub
2.Data Structures and program design in C by Robert Kruse, PHI Expert Data Structures with C by R.B. Patel

ECO-6A	Multimedia Communication						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
PO	To familiarize the students with the concepts of basic multimedia communication systems and various compression algorithms of text, audio, image and video.						
Course Outcomes (CO)							
CO1	Students will understand the concept of multimedia communication system along with its applications and networks in detail.						
CO2	Students will be able to learn the concept of compression in detail. They will understand the techniques of text and image compression.						
CO3	In this outcome students will be well prepared of audio and video compression.						
CO4	Students will understand the concept internet, its applications and CBIR systems						

UNIT-I

Multimedia Communication: Introduction, Multimedia networks: Telephone networks, Data networks, Television Networks, ISDN, B-ISDN. Multimedia Applications: Interactive applications over theinternet and Entertainment applications.

Digitization Principles, Representation of Text, Images, Audio and Video.

UNIT-II

Text Compression: Compression principles, Text Compression techniques: Static Huffman Coding, Dynamic Huffman Coding, Arithmetic Coding, Lempel Ziv and Lempel Ziv welsh coding.

Image Compression: Graphics interchange format, Tagged image file format, Joint Photographic Experts Group (JPEG).

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UNIT-III

Audio Compression: Differential Pulse Code Modulation, Adaptive Differential PCM, Adaptive Predictive coding, linear predictive coding and MPEG audio coders,

Video Compression: Video Compression principles, Frame types, Motion estimation and compensation, Implementation Schematics of I, P and B frames, H.261, H.263.

UNIT-IV

Multimedia Synchronization: Basic definitions and requirements Time stamping and Pack architecture.

Internet Applications: Domain name System, Electronic Mail, Internet Telephony, Content Based Image Retrieval Systems

Text Books:

1. Multimedia communications: Fred Halsall; Pearson Education Asia.

Reference Books:

1. Multimedia Systems" by Ralf Steinmetz and Klara Nahrstedt
2. Multimedia Systems, Standards, and Networks" by A. Puri and T. Chen

ECO-7A	Consumer Electronics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Course Outcomes							
CO1	To understand fundamentals of Monochrome and Colour TV systems.						
CO2	To understand television receivers and digital TV systems.						
CO3	To understand audio fundamentals and systems.						
CO4	To maintain various electronic home appliances.						

UNIT-I

Monochrome TV Systems and Colour TV Systems: Monochrome picture signal transmission and reception, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution, Composite video signal, vestigial sideband transmission. Colour theory, Grassman's Law, hue, brightness, saturation, luminance and chrominance, Different types of TV camera tube, channel bandwidth.

UNIT-II

Television Receivers: Monochrome and colour picture tube, receiver controls, remote control, Television standards: PAL, SECAM, NTSC.

Digital TVs: working principle of HDTV, Principle and working of LCD and LED TV, Block diagram and working principle of OLED.

UNIT-III

Audio Fundamentals: Basic characteristics of sound signal: level and loudness, pitch, frequency response, fidelity and linearity, Reverberation, Microphone: working principle, characteristics, Types: carbon, condenser, crystal, electrostatic. Loudspeakers: working principle, Types: electrostatic, dynamic, permanent magnet.

UNIT-IV

FAX, Microwave Oven: types, single chip controllers, Washing Machine: wiring diagram, electronic controller for washing machine, types of washing machine, Air conditioner and Refrigerators: Components features, types and applications, Digital camera, ATM.

TEXT BOOKs:

- R.R. Gulati "Modern Television practices", New Age International Publication (P) Ltd. New Delhi Year 2011, latest edition.
- S.P. Bali., "Consumer Electronics", Pearson Education, 2010, latest edition.

REFERENCES:

- R Bali and S.P. Bali “Audio video systems : principle practices & troubleshooting”, Khanna Book Publishing Co. (P) Ltd., 2010Delhi , India, latest edition.
- R.G. Gupta “Audio video systems”, Tata Mc graw Hill, New Delhi, India 2010, latest edition.
- Jerry Whitaker & Blair Benson “Mastering Digital Television”, McGraw-Hill Professional, 2010 , latest edition.

ECO-8A	Transducers & Its Applications						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3		**-**	**3**	**75**	**25**	**100**	**3**
Purpose	**Understanding the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities and how to use them to measure these quantities.**						
Course Outcomes							
CO 1	**Explain the principles of operation of the sensor parameters and generators**						
CO 2	**Interpretation of the measurement results by using transducers.**						
CO 3	**Development of measurement schemes for different non electrical quantities**						
CO 4	**Assimilating knowledge about the implementation of sensors and transducers.**						

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.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based) KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VII (w.e.f. session 2021-2022)

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-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.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based) KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VIII (w.e.f. session 2021-2022)

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.**

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based) KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination

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

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	
CO1	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.
CO2	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.
CO3	To understand different laws related to the Intellectual Property ,copyright act,trademarks,patent act,duration of patents law and policy considerations
CO4	Underastand New Developments in IPR ,administration of patent system,IPR of biological systems etc.

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

ECO-9A	BIOINFORMATICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**The Purpose of this course to provide focus on the key concepts of Bioinformatics like biological databases, Sequence Alignment, Phylogenetic Analysis, Plasmid Mapping And Primer Design and Predictive Methods using nucleotide sequences and protein sequences**						
Course Outcomes							
CO1	Students will be able to illustrate with the basic principles of various types of databases						
CO2	Students will be able to perform various tools related to sequence alignment and statistical significance of alignment						
CO3	Student will develop the knowledge of various software tools for sequence analysis and primer designing						
CO4	Students will be able to differentiate between predictive methods for nucleotides and protein sequence analysis						

UNIT I

Databases

a. Sequence Databases: introduction of Databases, primary and secondary databases, nucleotide and protein sequence databases: Genbank, EMBL, DDBJ, Swissprot, pfam, PIR

b. Structure Databases: Introduction to structures. PDB (Protein Data bank) Molecular Modeling database at NCBI. , visualizing structural information.

c. Sequence and Structure File Formats.

The Entrez system: Integrated information axis, Information retrieval from biological database, sequence database beyond NCBI. Medical databases.

UNIT II

Sequence Alignment AND Database Searches

Introduction, the evolutionary basis of sequence alignment, Type of Aligmnents, Pair-wise Alignment, Multiple Alignment, The modular nature of proteins, Optimal alignment methods, substitution scores and gap penalties, statistical significance of alignment. FASTA, BLAST, low-complexity regions, repetitive elements, Tool of multiple sequence alignment: CLUSTAL W/X, progressive alignment method.

Phylogenetic Analysis:

Elements of phylogenetic models, phylogenetic data analysis: alignment, substitution model building, tree building and tree evaluation, building the data model (alignment), determining the substitution model, tree-building methods, searching for trees, rooting trees, evaluation trees and data, phylogenic software (PHYLIP). phylogenetics online tool.

UNIT III

Sequence Analysis Using Software Resources :

Introduction. The Wisconsin package, the Seq Lab environment, analyzing sequences with operations and Wisconsin package programmes, viewing output, monitoring programme progress and troubleshooting problems, annotating sequences and graphically displaying annotations in the Seqlab Editor, saving sequences in the Seq Lab Editor, Example of analysis that can be undertaken in Seqlab,

UNIT IV

Plasmid Mapping And Primer Design

Restriction mapping, Mac Vector and OMIGA. primer design for PCR Sequencing, primer design programs and software.

Predictive Methods using nucleotide sequences and protein sequences: Predictive methods using nucleotide sequences: Introduction, Gene prediction methods, Computational gene prediction in eukaryotes , identity based on composition, physical properties based on sequence, prediction of protein secondary and tertiary structures. Related software.

Text Books-

1. Bioinformatics by Andreas D.Boxevanis. Wiley Interscience, 4th edition 2020.

2. Essential bioinformatics by Jin Xiong. Cambridge Uni Press 2020

3. Biocomputing Informatics and The Genome Projects by Smith D.W., Academic Press, 2014.

4. Bioinformatics: A Biologists Guide to Computing and the Internet. by Stuart M. Brown, NKU Medical Center, NY USA, 2000.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

ECO-10A	Electro-Mechanical Energy Conversion						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3**
Purpose	**To provide the constructional and working knowledge of various EMEC Devices.**						
Course Outcomes							
CO 1	**To study various fundamental concepts of EMEC& DC machines.**						
CO 2	**To study fundamental concepts and characteristics of Induction Machines.**						
CO 3	**To study the basics of S**ynchronous Machines						
CO 4	**To study working idea of some special electric motors with applications.**						

UNIT-I(Qualitative analysis only)

Introduction: Basic principles, conservation of energy, physical phenomenon involved in conversion, energy balance, energy stored in magnetic field, principles of Generating and motoring, prime movers, necessity of starters in motoring.

DC MACHINES:

DC generator: Basic construction, theory and working, commutation,generated EMF equation,Demagnetizing and cross magnetizing ampere turns, armature reaction,voltage build-up,brief idea of load characteristics of shunt, series and compound generator.

DC motor: Basic construction, theoryand working, concept of back EMF, torque and power equations, brief idea of load characteristics of shunt, series and compound motor, armature and field control methods of speed control of a DC shunt motor,3 point starter.

UNIT-II(Qualitative analysis only)

INDUCTION MACHINES:

3-phase induction motors:Rotating magnetic field, Basic construction, theory and working ofsquirrel cage and phase wound rotor types of3-phase I.M., slip, Torque- slip and load characteristics. Blocked rotor tests power and BHP developed at shaft. Star delta starting.

Single phase Induction Motor: Basic construction of, double revolving field theory, working of a capacitor start capacitor run Single phase Induction motor.

UNIT-III (Qualitative analysis only)

SYNCHRONOUS MACHINES:

Synchronous generator (alternator): Basic construction, theory and working, types of rotors&excitation systems.

Synchronous motor:Basic construction, theory and working of, locking operation, speed torque characteristics, V- Curves. Hunting -causes and remedies.

UNIT-IV(Qualitative analysis only)

SPECIAL ELECTRICAL MACHINES:

Basic concept and workingideas of:Stepper motor, permanent magnet brushless DC motor, permanent magnet synchronous motor, hysteresis motor, synchronous reluctance motor, repulsion motor.

Industrial and domestic applications and comparison of various types of motors.

Text/Reference Books

1. D.P Kothari and I.J Nagrath, “Electric Machines”, Tata McGraw Hill Publishers
2. P.S Bhimbra, “Electric Machines”, Khanna Publisher
3. AshfaqHussain, “Electric Machines”, DhanpatRai and Company
4. Fitzgerald &Kingsley, Electrical Machines, MGH publications.

ECO-11A	Operating Systems						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hr.
Course Outcomes							
CO1		Student will be able to understand structure and function of OS.					
CO2		Student will be able to understand the concept of OS					
CO3		Student will be able to understand the concurrent processing					
CO4		Student will be able to understand scheduling and deadlock in OS.					

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

Note: Question paper template will be provided to the paper setter.

ECO-12A	Wavelets						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3**
Purpose	**To understand the concept of wavelet theory and applications.**						
Course Outcomes **At the end of this course, student will be able to**							
CO 1	Interpret stationary and non-stationary signals						
CO 2	Construct continuous wavelet transform						
CO 3	Develop discrete wavelet transform						
CO 4	Apply wavelets in different applications						

Unit-I

Introduction Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Time- frequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.

Unit-II

Continuous Wavelet Transform Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.

Unit-III

Discrete Wavelet Transform And Filter banks Orthogonal and bi- orthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform.

Unit-IV

Multi Resolution Analysis Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets, Application of wavelets in signal de-noising.

TEXT BOOKS:

1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.
2. Wavelets and Sub band Coding, M. Vetterli and J. Kovacevic, Prentice Hall, 1995.
3. Wavelet transforms: Introduction, Theory and applications, Raghuveer rao and Ajit S.Bopardikar, Pearson Education Asia, 2000.

REFERENCES:

1. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.
2. Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, Jean- Michel Poggi, John Wiley & Sons, 2010 .
3. A premier on Wavelets and their scientific applications, J S Walker, CRC press, 2002.
4. Wavelets and signal processing: An application based introduction, Stark, Springer, 2005.
5. A friendly guide to Wavelets, Gerald keiser, Springer, 2011.
6. Multirate Systems and Filter Banks, P. P. Vaidyanathan, Pearson Education, 2004. Wavelets : from math too practice, Desanka.P.Radunovik, springer, 2009.
7. Insight into wavelets from theory to practice, K P Soman and KL Ramachandran, PHI, 2008.

ECO-13A	Soft Computing						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3Hr
Purpose	To familiarize the students with the basics of Soft Computing						
Course Outcomes							
CO1	Motivation and historical background of Soft Computing.						
CO 2	Application of Fuzzy logic.						
CO 3	Biologically inspired algorithm such as neural networks, genetic algorithms, ant colony optimization, and bee colony optimization.						
CO 4	Hybrid systems of neural network, genetic algorithms and fuzzy systems.						

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.

ECO-14A	Neural Networks and Fuzzy Logic						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	Understand the concept of Artificial Intelligence, search techniques and knowledge representation issues						
CO2	Understanding reasoning and fuzzy logic for artificial intelligence						
CO3	Students will be able to learn defuzzification and fuzzy measures						
CO4	Students will be able to learn the applications of fuzzy logic and hybrid soft computing techniques						

UNIT I – INTRODUCTION

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models - important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

UNIT II - NEURAL NETWORKS

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks – adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hop field networks, iterative auto associative memory network & iterative associative memory network – unsupervised learning networks: Kohonen self organizing feature maps, LVQ – CP networks, ART network.

UNIT III - FUZZY LOGIC

Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

UNIT IV - HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

References:

・Elaine Rich and Kevin Knight “Artificial Intelligence”, 2nd Edition, Tata Mcgraw-Hill, 2005.

・Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2009.

Text book(s) and/or required material

1. T1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
2. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition. Reference Books: 1. Bart Kosko, ―Neural network and Fuzzy System‖ - Prentice Hall-1994.
2. J.Klin and T.A.Folger, ―Fuzzy sets‖ University and information- Prentice Hall -1996.
3. J.M.Zurada, ―Introduction to artificial neural systems‖-Jaico Publication house,Delhi 1994.
4. VallusuRao and HayagvnaRao , ―C++ Neural network and fuzzy logic‖-BPB and Publication, New Delhi,1996.
5. Intelligent Systems and Control-http://nptel.ac.in/courses/108104049/16

ECO-15A	Statistics and Operational Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	The Objective of the paper is to introduce the basic concepts of Operational Research and linear programming to the students						
CO2	Student will be able to learn and apply different methods to solve Linear Programming Problem.						
CO3	Student will be able to learn moments, standard deviation ,correlation ,regression						
CO4	Students will be able large sample test for single proportion ,difference of means, difference of proportions						

UNIT-I

Basics of Operational Research: Origin & Development of Operational Research, Definition and Meaning of Operational Research, Different Phases of an Operational Research Study, Scope and Limitations of Operational Research, Mathematical Modeling of Real Life Problems.

UNIT-II

Linear Programming Problem: Formulation, solution by Graphical Method, Theory of Simplex Method, Simplex Algorithm, Two phase Method, Charnes-M Method, Degeneracy,

UNIT-III

Basic Statistics: Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

UNIT-IV

Test of significance: Basic terminology, large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit

References /Suggested Readings:

1. G. Hadley: Linear Programming. Narosa, Reprint, 2002.
2. G. Hadley: Linear Algebra, Narosa, Reprint, 2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
5. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 9th Edition,2010.
6. Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, 2005.

F.S. Hillier. G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata Mc-Graw Hill, 2010.

ECO-16A	Mixed Signal Design						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Purpose	This course teaches how in real life applications both analog and digital circuits can be implemented for various system design.						
Course Outcomes							
CO1	To know basics and working of various Switched-Capacitor Circuits.						
CO2	To understand various PLL circuits.						
CO3	To gain knowledge on various D/A and A/D converters.						
CO4	To apply knowledge of different architectures in mixed signal circuits for real life problems.						

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

ECO-17A	Blockchain Technology						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3Hr
Course Outcomes							
CO1	Understand how blockchain systems (mainly Bitcoin and Ethereum) work						
CO 2	To securely interact with them						
CO 3	Design, build, and deploy smart contracts and distributed applications						
CO 4	Integrate ideas from blockchain technology into their own projects.						

Unit I

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. • Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

Unit II

Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

Unit III

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

Unit IV

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

Text Book

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

2. Reference Books

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,”Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

ECP-10A	Fiber Optic Communications						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	**Students will be able to understand the structure of fiber and the mechanism of light travelling in the fiber.**						
CO2	**Students will be able to analyze various losses associated with fibers.**						
CO3	**Students will learn about the optical sources and optical detecters.**						
CO4	**Students will be able to understand the various components and devices required in making optical networks**						

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

ECP-11A	Mobile Communication and Networks						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	-	-	3	75	25	100	3 Hrs.
Course Outcomes (CO) To expose the students to the most recent technological developments in Mobile communication systems..							
CO1	To familiarize the students with the fundamental concepts of wireless, cellular technology And signal propagation in mobiles						
CO2	Students will able to learn the detail knowledge of GSM and GPRS.						
CO3	After this unit students will understand the wireless access techniques and standards						
CO4	Students will understand the concept of mobile receivers.						

UNIT-I

Cellular concepts: Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Signal propagation: Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models

UNIT-II

Mobile System and Network Architectures GSM Services and Features – GSM system Architecture, GSM radio subsystem, Frame structure for GSM, Signal processing in GSM, GPRS Network architecture, GPRS services and features, 3G UMTS network architecture, UMTS services and features.

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UNIT-III

Wireless Standards Multiple access techniques: FDMA, TDMA and CDMA, Wireless networking, Design issues in personal wireless systems, Cordless systems and Wireless Local Loop (WLL), IEEE 802.16 Fixed Broadband Wireless Access standard, Mobile IP and Wireless Application protocol**.**

UNIT-IV

Receiver structure: Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

Text Books

1. Rappaport, T.S., "Wireless Communications", Principles and Practice, Prentice Hall, NJ, 1996.
2.William Stallings, "Wireless Communication and Networking", Pearson Education, 2002.

ECP – 12A	Adaptive Signal Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	To understand various stochastic processes and models in adaptive signal processing.						
CO2	To understand the analysis of wiener filters, the concept of the linear prediction and steepest descent algorithms.						
CO3	To use Least-Mean-Square (LMS) & Recursive Least-Squares (RLS) algorithms for specific engineering problems.						
CO4	To apply the concept robustness and analysis the Finite-Precision effects on LMS and RLS algorithms.						

Unit -I

Stochastic Processes and Models: Partial Characterization of a Discrete-Time Stochastic Process, Mean Ergodic Theorem, Correlation Matrix, Correlation Matrix of Sine Wave Plus Noise, Stochastic Models, Wold Decomposition, Asymptotic Stationarity of an Autoregressive Process, Yule—Walker Equations.
Wiener Filters: Linear Optimum Filtering: Statement of the Problem, Principle of Orthogonality, Minimum Mean-Square Error, Wiener-Hopf Equations, Error-Performance Surface, Multiple Linear Regression Model.

Unit -II

Linear Prediction: Forward Linear Prediction, Backward Linear Prediction, Levinson-Durbin Algorithm, Properties of Prediction-Error Filters, Schur-Cohn Test.
Method of Steepest Descent: Basic Idea of the Steepest-Descent Algorithm, The Steepest-Descent Algorithm Applied to the Wiener Filter, Stability of the Steepest-Descent Algorithm, Example, The Steepest-Descent Algorithm as a Deterministic Search Method, Virtue and Limitation of the Steepest- Descent Algorithm.

Unit -III

The Least-Mean-Square (LMS) Algorithm: Signal-Flow Graph, Optimality Considerations, Applications, Statistical Learning Theory, Transient Behavior and Convergence Considerations, Efficiency.
The Recursive Least-Squares (RLS) Algorithm: Some Preliminaries, The Matrix Inversion Lemma, The Exponentially Weighted RLS Algorithm, Selection of the Regularization Parameter, Update Recursion for the Sum of Weighted Error Squares, Example: Single-Weight Adaptive Noise Canceller.

Unit -IV

Robustness: Robustness, Adaptation, and Disturbances, Robustness: Preliminary Considerations Rooted in H∞ Optimization, Robustness of the LMS Algorithm, Robustness of the RLS Algorithm, Comparative Evaluations of the LMS and RLS Algorithms from the Perspective of Robustness.

Finite-Precision Effects: Quantization Errors, Least-Mean-Square (LMS) Algorithm, Recursive Least- Squares (RLS) Algorithm, Summary and Discussion.

TEXT BOOKS:

1. S. Haykin, Adaptive filter theory,Pearson

REFERENCE BOOKS:

1. T. Adali and S. Haykin, Adaptive Signal Processing, WileyIndia
2. B. Widrow and S.D. Stearns, Adaptive signal processing, PrenticeHall.

Course No.	Course Title	Teaching Schedule			Allotment of Marks			Duration of Exam (Hrs.)
		L	T	P	Major Test	Minor Test	Total	
ECP-13A	Nano electronics	3	0	0	75	25	100	3
Course Outcomes								
CO 1	Students will Understand the basic physics behind the nanoelectronics devices							
CO 2	Students be able learn various classification of the nano-materials.							
CO 3	To Understand various fabrication methods of nonmaterials.							
CO 4	Students will learn to characterize various nanomaterials using various characterization tools.							

UNIT-I

Introduction to nanotechnology, Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics, Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence

UNIT- II

Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality, Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells.

UNIT-III

Introduction to methods of fabrication of nanomaterials, different approaches, physical vapour deposition, chemical vapour deposition, Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide-dry and wet oxidation methods.

UNIT-IV

Introduction to characterization of nanostructures, tools used for of nano materials characterization: Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Transmission Electron Microscope.

Text Books:

1. J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006
2. W.R. Fahrner, Nanotechnology and Nanoelctronics, Springer, 2005

References:

1. Chattopadhyay, Banerjee, Introduction to Nanoscience & Technology, PHI, 2012
2. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.
3. K. Goser, P. Glosekotter, J. Dienstuhl, Nanoelectronics and nanosystems, Springer 2004.
4. Murty, Shankar, Text book of Nanoscience and Nanotechnology, Universities Press, 2012.
5. Poole, Introduction to Nanotechnology, John Wiley, 2006.
6. Supriyo Dutta, Quantum Transport- Atom to transistor, Cambridge, 2013.

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.**
Course Outcomes							
CO1	Learner will be able to mathematically design basic resonator cavities and will be able to measure microwave parameters such as impedance, frequency and VSWR etc						
CO2	Learner will learn the conventional methods to generate the microwaves.						
CO3	Learner will know about the importance of scattering parameters along with its applications in the analysis of basic microwave components.						
CO4	Learner will learn about transferred electron and avalanche transit time devices in detail.						

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.

ECP-15A	EMBEDDED SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Course Outcomes							
At the end of the course students will be able to							
CO1	Acquire knowledge about different types of Microcontrollers and various Embedded System design examples of real- life problems.						
CO2	Understand the PIC, AVR, ARM and SHARC architectures.						
CO3	Understand different types of I/O devices, Timer Devices and Communication Interfaces.						
CO4	Acquire knowledge about the design of RTOS and various operating systems.						

UNIT I

INTRODUTION: Different types of Microcontrollers, 4-bit, 8-bit, 16-bit, and 32-bit Microcontrollers, Processor Architectures: Harvard & Princeton, CISC & RISC, Microcontrollers Memory Types, Microcontrollers Features, Criteria for Choosing a Microcontroller, Applications of Microcontrollers, Embedded System**:** Definition, Embedded Processors; Hardware Units, Devices and Software Tools in a System, Embedded System on Chip, Complex Systems Design and Processors, Design Challenges, Design Process and Design Examples.

UNIT II

PIC MICROCONTROLLER: Introduction to PIC16 Microcontroller Family, Features of PIC16C74, Architecture and Pin diagram of PIC16C74, Pipelining, Program Memory Considerations, Register File Structure, Addressing Modes, Instruction Sets; Advanced Architectures**:** Only Brief General Architecture of AVR, ARM and SHARC.

UNIT III

COMMUNICATION INTERFACES: I/O Devices Types and Examples, Serial Communication Devices, Parallel Device Ports, Wireless Devices, Timer and Counting Devices, Distributed Networked Embedded System Architecture, Serial Bus Communication Protocols-I^2C, CAN, USB, FireWire and Advanced Buses; Parallel Bus Device Protocols- ISA, PCI, ARM and Advanced Buses; Network Protocols-HTTP, TCP, UDP, IP and Ethernet; Wireless and Mobile System Protocols- IrDA, Bluetooth, 802.11 and Zigbee; Device Drivers.

UNIT IV

RTOS: Architecture of Kernel, Processes, Threads, Task and Thread States, Task and Data, Distinction Between Function, ISR, IST and Task; Semaphores, Mutex, Event Registers, Pipes, Signal, Timers, Memory Management, Priority Inversion Problem, Disabling and Enabling Function, Queues and Mailboxes, Pipe and Sockets Functions;

Basic Design using a RTOS, RTOS Task-Scheduling Model, OS Standards: POSIX, Off- the-Shelf Operating System, Embedded Operating Systems, Real –Time Operating Systems, Handhold Operating Systems.

Text Books:

1. Raj Kamal, "Embedded systems architecture, programming and design", 3rd Ed., McGraw-Hill Companies.
2. John. B. Peatman, "Design with PIC Microcontroller", Pearson Education, 2003.
3. Dr. K.V.K.K. Prasad, "Embedded/Real-Time Systems: Concepts, design and programming", DreamTech Press.

References Books:

1. Myke Predko, “Programming and Customizing the 8051 Microcontroller”, TMH.
2. M.A. Mazidi, R. D. McKinlay,Causey,” The PIC microcontroller and Embedded Systems using assembly and C for PIC18”, 2nd Ed., Pearson.
3. D.P. Kothari, Shriram K. Vasudevan, Sundaram R. M. D., Murali N., “Embedded System”, New Age International (P) Limited, Publishers.
4. Shibu K V, “introduction to Embedded Systems”, 2nd Ed., McGraw Hill Education(India) private Limited.

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

ECP-16A	ROBOTICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Course Prerequisites	Transducers and Microprocessors.						
Course Objectives	To enlighten the students about the fundamentals of robotic systems.						
Course Outcomes							
At the end of this course the student should be able to understand							
CO1	The basic concepts related to the Robot, parts of Robots, End Effectors and to make familiar with the various Drive systems for Robot.						
CO2	The operation of various Sensors and their Applications in Robots.						
CO3	The Machine Vision and its Applications, and various Control Systems used in Robots.						
CO4	The Robot Programming, Artificial Intelligence, Fuzzy Logic, Safety Standards of Robots and Industrial and Non-Industrial applications of Robots.						

UNIT I

FUNDAMENTALS OF ROBOT: Definition, History and Development in Robot Technology, Robot Technology: Characteristics, Basic Components, Robot Anatomy, Robot Generations, Robot Selection, Present and Future Applications.

ROBOTS DRIVE SYSTEMS AND END EFFECTORS: Robot Classification: Arm Geometry, Degrees of Freedom, Power Sources, Types of Motion, Path Control; Robot End Effectors: Mechanical Grippers, Vacuum, Magnetic, Adhesive; Special Purpose Grippers, Process Tooling, Compliance, Robot Drive Systems: Hydraulic, Pneumatic and Electric System.

UNIT II

SENSORS : Requirements of a Sensor, Sensor Classification; **Principle, Advantages, Disadvantages and Applications of the following Sensors**: Position Sensors - Potentiometer, Encoder, LVDT, Resolvers, LMDT and Hall–Effect Sensors; Velocity Sensors: Encoder, Tachometer and Differentiation of position signal; Acceleration Sensors, Force, Pressure Sensors: Piezoelectric, Force Sensing Resistor, Strain Gauge and Antistatic Foam; Torque Sensors, Micro Switches, Visible Light and Infrared Sensors, Touch and Tactile Sensors, Proximity Sensors: Magnetic, Optical, Ultrasonic, Inductive, Capacitive and Eddy Current; Range Finder: Ultrasonic, Light-base and GPS; Sniff Sensors, Taste Sensors, Vision Sensors, Voice Recognition Devices, Voice Synthesizers, RCC.

UNIT III

MACHINE VISION AND CONTROL SYSTEM: Visual Sensing, Architecture of Robotics Vision System, Machine Vision: Image Acquisition - Vidicon Tube and CCD; Digitization, Image Processing: Spatial Domain Operations, Noise Reduction and Edge Detection etc.; Image Analysis: Object Recognition by Features- Template Matching, Discrete Fourier Descriptors and Computed Tomography; Depth Measurement with Vision System, Image Interpretation, Segmentation by Region Growing and Region Splitting, Image Data Compression, Machine Vision Application, Other Optical Methods; Control Systems: Basic Robot Control System, PLC, PID, CNC, MPU, and URC.

UNIT IV

ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND ROBOTS APPLICATIONS: Robot Programming: Programming Methods and Languages, Levels of Robot Programming, Space Position Programming, and Program Statements; Elements of Artificial Intelligence, System Architecture; Fuzzy Logic Control, Application of Fuzzy Logic in Robotics; Robot Safety, Safety Standards; Industrial Applications: Automation in Manufacturing, Robot Applications: Material Handling, Processing Application, Assembly

Application and Inspection Application; Evaluating the Potential of a Robot Application, Future Applications, Challenge, Innovations; Non-Industrial Application.

Text Books:

1. James G. Keramas, “Robot technology fundamentals”, Delmar Publishers.
2. Saeed B. Niku, “Introduction to robotics analysis, control and applications”, 2nd ed., Wiley India.
3. R. K. Mittal, I. J. Nagrath, “Robotics and Control”, TMH Education Pvt.

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

ECP-17A	Digital Image Processing					
Lecture	**Tutorial**	**Practical**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes						
CO1	Student will be able to explain basic concepts of image processing					
CO2	Student will be able to design evaluate image enhancement techniques					
CO3	Student will be able to analyze various compression and morphological operations					
CO4	Student will be able to describe various video processing systems					

Unit – I

Digital image processing fundamentals: Introduction, Image processing applications, Fundamental Steps in Digital Image Processing, Image Sampling and Quantization, Relationships between pixels, Color Fundamentals, color models.

Unit - II

Image Enhancement: Basics of intensity Transformations, Histogram processing, Spatial Domain filtering – Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering.
Frequency Domain Filtering- Sampling and Fourier Transform of sampled functions, 2-D Sampling, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

Unit - III

Image Compression: Fundamentals, Image Compression models, Error Free Compression – Huffman Coding, Arithmetic Coding, LZW Coding, Lossy Compression – Block transform coding.
Morphological Image Processing: Introduction, Erosion and Dilation, Opening and Closing, Hit or Miss Transformations, Boundary Extraction. Image Segmentation: Fundamentals of image segmentation, Point, Line, and Edge Detection.

Unit - IV

Video Processing: video formation, Video Frame classifications- I, P and B frames, Application of motion estimation in video coding, Patterns and Pattern classes - Recognition based on matching.

Text Books:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2018.

Reference Books:

1.Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011
2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.
3. M. Tekalp, Digital Video Processing. Signal Processing Series, Prentice Hall, 1995.
4. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.

Note: Question paper template will be provided to the paper setter.

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

Course Outcomes (CO)

To give the students an idea about the study and analysis of components used in Microwave Engg.

CO1	Students will learn the steps to analyze microwave components.
CO2	Students will be able to find the characteristics of microwave components.
CO3	Students will learn the steps to analyze various antennas.
CO4	Students will be able to find the characteristics of various antennas.

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.

ECP-15LA	Embedded Systems Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **To give the students an idea about the 8051/PIC/AVR/ARM microcontrollers**							
CO1	To familiarization with 8051, PIC, AVR and ARM Microcontrollers.						
CO2	Ability to write an embedded C language and assembly language program for 8051, PIC and AVR Microcontrollers.						
CO3	Ability to interfacing the various Peripheral to 8051, PIC and AVR Microcontrollers.						
CO4	Ability to design the embedded systems based on 8051, PIC and AVR Microcontrollers.						

List of Experiments

1. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing DC motor to rotate clockwise and anticlockwise directions.
2. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing stepper motor to rotate clockwise and anticlockwise directions.
3. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing LCD to display message "WELCOME" on LCD screen.
4. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing a switch and a buzzer at two different pins of a Port such that the buzzer should sound as long as the switch is pressed.
5. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing keypad to port P0.Whenever a key is pressed; it should be displayed on LCD screen.
6. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing LEDs to glow them in different pattern.
7. Write an embedded C program for 8051/PIC/AVR Microcontroller to display 0 to 9 on 7 segment display.
8. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing RTC module to display current date and time on LCD screen
9. Write an embedded C program using 8051/PIC microcontroller for interfacing temperature sensor LM35 to display the current temperature on LCD screen.
10. Design an embedded system for traffic light controller using 8051/PIC Microcontroller

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ECP-16LA	Robotics lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**

Course Outcomes (CO):
To expose the students to the most recent technological developments in industrial Robot.

CO1	**To familiarization with FIRE BIRD Robot.**
CO2	**Abilities to interfacing various peripherals.**
CO3	**Student will be able to write embedded C language programming..**
CO4	**Ability to design the automatic system for robotics based application.**

List of Experiments:

1. To get familiar with the AVR Studio 4.17 IDE and Fire Bird Robot.
2. Write a program for I/O interfacing to sense the pressing of push button Switch.
3. Write a program to alternately blink the set of LED
4. Write a program to display two digit numbers on LCD.
5. Write a program for obstacle detection of Robot
6. Write a program for controlling the speed of Fire Bird Robot.
7. Write a program for PWM based speed control of motor.
8. Write a program to design white line Follower Robot
9. To implement and design social distancing indicator and alarming system.
10. To Study implement the temperature based Fan speed controller.

ECP-17LA	Digital Image Processing Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **To give the students an idea about the study and analysis of digital image processing**							
CO1	Students will be able to explain the basics of Digital Image processing						
CO2	Student will be able to explain sampling and quantization of digital image.						
CO3	Student will be able to analyze the image enhancement operations on digital image.						
CO4	Students will be able to analyze various image analysis and computer vision algorithm						

List of Experiments

1. Study of Image processing toolbox of MATLAB.
2. WAP to read and show various images of at least five different formats.
3. WAP to extract R, G, B component of Color Image.
4. WAP to convert a color image into gray scale and save it in new format.
5. WAP to invert a gray scale image.
6. WAP to implement Morphological operations on an image.
7. WAP to implement Histogram equalization.
8. WAP to implement various edge detection algorithms.
9. WAP to implement image segmentation.
10. WAP to implement boundary extraction of basic structure.

ECP – 18A	Wireless Communication						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	Design wireless sensor network system for different applications under consideration.						
CO2	Understand the hardware details of different types of sensors and select right type of sensor for various applications.						
CO3	Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.						
CO4	Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.						
CO5	Handle special issues related to sensors like energy conservation and security challenges.						

UNIT I :- AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

UNIT II :-SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

UNIT III :-WSN NETWORKING CONCEPTS AND PROTOCOLS

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

UNIT IV:- SENSOR NETWORK SECURITY

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

References:

 H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India, 2012.

 C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.

 F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.

 YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.

ECP-19A	Bio-Medical Signal Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	-	-	**3**	**75**	**25**	**100**	**3**
Purpose	**To understand the concept of Bio-Medical Signal Processing.**						
Course Outcomes **At the end of this course, student will be able to**							
CO 1	Interpret signals and systems						
CO 2	Acquire Biomedical Signals such as ECG						
CO 3	Apply adaptive filtering algorithms in biomedical applications						
CO 4	Analyze different kinds of events and waveforms of biomedical origin						

Unit – I

Signals and Information: Definitions and properties of Laplace transform, Basic of DFT and FFT, z-transform, Sampling theorem.
Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, frequency response, group delay, phase delay, Applications of Digital Signal Processing.

Unit – II

Introduction to Biomedical Signal: General measurement and diagnostic system, classification of signals, introduction to biomedical signals, Biomedical signal acquisition and processing.
ECG: ECG signal origin, ECG parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.

Unit – III

Adaptive Filtering: Introduction, General structure of adaptive filters, LMS adaptive filter, adaptive noise cancellation, cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG.
EEG: EEG signal characteristics, Sleep EEG classification and epilepsy.

Unit – IV

Event Detection and waveform analysis: Need for event detection, Detection of events & waves, Correlation analysis of EEG signals, Identification of heart sounds, Morphological analysis of ECG waves.
Frequency Domain Analysis: Introduction, Spectral analysis, linear filtering, Removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG.

Text Book:

1. Biomedical Signal Analysis" A case study approach, Rangaraj M Rangayyan, John Wiley publications.

Reference Books:

1. "Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I)", Arnon Cohen, CRC press.
2. "Biomedical Signal Processing Principles and Techniques" D.C.Reddy, Tata Mc Graw-Hill
3. "Biomedical Digital Signal Processing", Willis J. Tompkins, PHI

.

ECP-20A	Machine Learning					
Lecture	**Tutorial**	**Practical**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes						
CO1	Recite and understand the knowledge of classification and associated algorithms					
CO2	Explain and apply algorithms of statistical pattern recognition and supervised Learning					
CO3	Explain, implement and apply algorithms of non-parametric learning, feature extraction and selection					
CO4	Understand, explain and apply un-supervised learning, estimation and comparison of different classifiers					

UNIT-I

Classification: The Classification Process, Features, Training and Learning, Supervised Learning and Algorithm Selection, Approaches to Classification, Examples.

Nonmetric Methods: Introduction, Decision Tree Classifier, Information, Entropy, Impurity, Information Gain, Decision Tree Issues, Strengths and Weaknesses, Rule-Based Classifier, Other Methods.

UNIT-II

Statistical Pattern Recognition: Measured Data and Measurement Errors, Probability Theory, Simple Probability Theory, Conditional Probability and Bayes' Rule, Naive Bayes Classifier, Continuous Random Variables, The Multivariate Gaussian, The Covariance Matrix, The Mahalanobis Distance.

Supervised Learning: Parametric and Non-parametric Learning, Parametric Learning, Bayesian Decision Theory, Discriminant Functions and Decision Boundaries, MAP (Maximum A Posteriori) Estimator.

UNIT-III

Nonparametric Learning: Histogram Estimator and Parzen Windows, k-Nearest Neighbor (k-NN) Classification, Artificial Neural Networks, Kernel Machines.

Feature Extraction and Selection: Reducing Dimensionality, Preprocessing, Feature Selection, Inter/Intraclass Distance, Subset Selection, Feature Extraction, Principal Component Analysis, Linear Discriminant Analysis.

UNIT-IV

Unsupervised Learning: Clustering, k-Means Clustering, Fuzzy c-Means Clustering, (Agglomerative) Hierarchical Clustering.

Estimating and Comparing Classifiers: Comparing Classifiers and the No Free Lunch Theorem , Bias and Variance, Cross-Validation and Resampling Methods: The Holdout Method , k-Fold Cross-Validation, Bootstrap, Measuring Classifier Performance, Comparing Classifiers, ROC Curves, McNemar's Test, Other Statistical Tests, The Classification Toolbox, Combining Classifiers.

Text/References Books:

1. Geoff Dougherty: Pattern Recognition and Classification An Introduction, 2013, Springer.

2. Christopher M. Bishop: Pattern Recognition and Machine Learning, Springer.

ECP-21A	Artificial Intelligence						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	To familiarize the students with the fundamental concepts of Artificial Intelligance.						
CO2	Students will able to learn the detail knowledge of Supervised and Unsupervised Learning.						
CO3	After this unit students will be able to understand the concepts of Genetic Algorithm and Object Detection and Tracking						
CO4	Students will be able to understand the concept of Artificial Neural Networks and reinforcement learning.						

UNIT-I

Introduction to Artificial Intelligence, need of AI, Applications of AI, Branches of AI, Defining intelligence using Turing Test, Classification, Preprocessing data, Label encoding, Logistic Regression classifier, Naïve Bayes classifier, Support Vector Machines.

UNIT-II

Regression, Building a single variable regressor, Building a multivariable regressor, Supervised and Unsupervised Learning, Detecting Patterns with Unsupervised Learning, Clustering data with K-Means algorithm, Estimating the number of clusters with Mean Shift algorithm,

UNIT-III

Genetic Algorithms, Fundamental concepts in genetic algorithms, Generating a bit pattern with predefined parameters Object Detection and Tracking: Frame differencing, Tracking objects using colorspaces, Object tracking using background subtraction, Face detection and tracking, Eye detection and tracking.

UNIT-IV

Artificial Neural Networks, Building a Perceptron based classifier, Constructing a single layer neural network, Constructing a multilayer neural network, Reinforcement Learning, Reinforcement learning versus supervised learning, Building blocks of reinforcement learning.

Text Book:

1. Introduction to Artificial Intelligence by Philip C. Jackson · 1974

Reference Book:

2. Artificial Intelligence by Chris Neil · 2020
3. Artificial Intelligence with Python by Prateek Joshi.

ECP -22A	Internet of Things						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	Understand what IoT technologies are used for today, and what is required in certain scenarios.						
CO2	Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.						
CO3	Understand the type of protocols and challenges for designing IoT systems.						
CO4	Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications. Understand operating system requirements of IOT.						

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/

ECP-23A	Error Correcting Codes					
Lecture	**Tutorial**	**Practical**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes						
CO1	Student will be able to evaluate linear codes					
CO2	Student will be able to evaluate cyclic codes					
CO3	Student will be able to evaluate BSH and RS codes					
CO4	Student will be able to evaluate convolution codes					

Unit- I

Basic concepts of linear codes: Three fields, linear codes , generator and parity matrix, dual codes, weights and distances, puncturing codes, extending c odes, shortening codes, direct sums,permutation equivalent codes, Golay codes, RM Codes

Unit- II

Cyclic Codes: polynomials and euclidean algorithm, primitive elements, finite fields, subfields, field automorphism. clotomic cosets and minimal polynomials, factoring x^n -1, zeros of cyclic code, minimum distance of cyclic codes.

Unit -III

BCH and RS codes: BCH codes, RS Codes, generalized RS codes, decoding BCH codes,burst error, concatenated and interleaving codes.

Unit-IV

Convolution codes: generator matrices and encoding, veterbi decoding: state diagram, trellis, diagram and viterbi algorithm, canonical generator matrices, free distance.
Soft decision and iterative decoding: AWGN, soft decision viterbi decoding, general viterbi algorithm, two way app decoding.

Text Books:
1.W. Cary Huffman, Fundamentals of Error-Correcting Codes by Cambridge University Press

Reference Books:
1. Ranjan Bose, Information Theory and Coding, McGraw Hill
2. W. Wesley Peterson and E. J. Weldon, *Error-Correcting Codes, The MIT Press*

Note: Question paper template will be provided to the paper setter.

ECP-24A	Satellite Communication						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Purpose	**To familiarize the students with the concepts of Satellite communication and various terms, laws and multiple access schemes used in its working.**						
Course Outcomes							
CO1	**To understand the concept of basics of satellite communication and various basic laws and terms of satellite communication.**						
CO2	**To understand the concept and processes of various communication satellites used in satellite communication.**						
CO3	**To familiarize with the concept and design issues of satellite link design and satellite access.**						
CO4	**To familiarize with the concepts of Multiple access schemes used in satellite communication.**						

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.

ECP-25A	High Speed Electronics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hour**
Course Outcomes							
CO 1	**Understand significance and the areas of application of high-speed electronics circuits.**						
CO 2	**Understand the properties of various components used in high speed electronics**						
CO 3	**Design High-speed electronic system using appropriate components.**						
CO 4	**To be able to understand the effect of scaling on high speed VLSI circuits.**						

UNIT-I

Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature. Contact resistance and interconnection/interlayer capacitances in the Integrated Electronics Circuits.

UNIT-II

Introduction to high-speed digital design: Frequency, time and distance - Capacitance and inductance effects - High seed properties of logic gates - Speed and power - Modelling of wires -Geometry and electrical properties of wires - Electrical models of wires - transmission lines - lossless LC transmission lines - lossy LRC transmission lines

UNIT-III

Devices: Passive and active, Lumped passive devices, Active : low frequency and high frequency models RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers and Power Amplifiers, Class A, B, AB and C, D, E .

UNIT-IV

Impact of scaling on High Speed VLSI Circuit, Inter-Die Variation, Intra-Die Variation, Fail Causes Optimization Techniques for High Speed VLSI: Mathematic Optimization, Circuit optimization, CAD tool for optimization

Books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press
2. . Kerry Bernstein & et. al., High Speed CMOS Design Styles, Kluwer, 1999
3. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
4. Howard Johnson & Martin Graham; High Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993
5. Masakazu Shoji; High Speed Digital Circuits, Addison Wesley Publishing Company, 1996
6. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
7. Howard Johnson & Martin Graham; High Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993
8. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", CambridgeUniversity Press, 2004, ISBN 0521835399.
9. Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5.
10. Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall.

11. Kai Chang, “RF and Microwave Wireless systems”, Wiley.
12. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011 Course Outcomes:

ECP-26A	Software Defined Radio						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To understand the underlying principles of Software Defined Radios and Cognitive Radio Networks.**						
Course Outcomes							
CO1	Understand the principles behind the Software Defined Radios over the conventional Cognitive Radios						
CO2	Ability to analyze Software Defined Networking protocols and cognitive radio techniques						
CO3	Understand the data traversal over SDN						
CO4	Design algorithms for Software Defined Radio and cognitive radio environments						
CO5	Understand the various types of key routing and switching techniques used in adaptive networks.						

UNIT I

SOFTWARE DEFINED RADIO CONCEPTS

Need for Software Radios - Characteristics and Benefits of a Software Radio - Design Principles of a Software Radio - RF Receiver Front-End Topologies - Importance of the Components to Overall Performance - Transmitter Architectures and Their Issues - Noise and Distortion in the RF Chain ADC and DAC Distortion - Flexible RF Systems

UNIT II

SDR AS A PLATFORM FOR COGNITIVE RADIO

Hardware Architecture: Baseband Processors - Hardware Architecture: Multi-Core Systems - Software Architecture: Design Philosophies - GNU Radio - Software Communications Architecture - Application Software - Component Development - Waveform Development - Cognitive Waveform Development

UNIT III

COGNITIVE RADIO: TECHNOLOGIES REQUIRED

Software Capable Radios - Software Programmable Radios - SDR Examples - Aware Adaptive and CRs - Radio Capabilities and Properties Comparison - Spectrum Awareness and Frequency Occupancy - Software Technology - Funding and Researches in CRs - Directions and Standards

UNIT IV

OBJECT ORIENTED REPRESENTATION OF RADIOS

Introduction to Network Resources - Network Resources - Object Oriented Programming - Object Request Broker Architecture - Object Brokers and Software Radios - Mobile Application Environments - Security in Software Radios - Joint Tactical Radio Systems - SCA Architectures.

REFERENCES

1. Software Radio: A Modern Approach to Radio Engineering By Jeffrey H. Reed Pearson Education Low Price Edition

2. “Cognitive Radio Technology”, Bruce A Fette, Academic Press, 2009

3. Cognitive Radio Networks by Wyglinski, Alexander M. Nekovee, Maziar, Hou, Y. Thomas, 2010 Elsevier.

4. “Cognitive Radio, Software Defined Radio and Adaptive wireless system, Huseyin Arslan , Springer, 1 edition ,September 24, 2007

ECP-18LA	Wireless Communication Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**

Course Outcomes (CO)

To give the students an idea about the Wireless communication theory and technology using the NI-Labview software and RF communication module.

CO1	To study the wireless communication using NI-Labview
CO2	To learn about the functioning of Universal Software Radio Peripheral (USRP)
CO3	To learn the implementation of different analog modulation schemes using the USRP
CO4	To learn the implementation of different digital modulation schemes using the USRP.

List of Experiments:

1. Introduction to NI-LabVIEW and familiarization with its basic functions.
2. Study of modulation toolkit and its usage in Wireless Communication.
3. Study the interfacing of hardware (USRP module) with the PC and configuring the same.
4. Implementation of AM using Software Defined Radio (SDR).
5. Implementation of FM using SDR with application such as transfer of files
6. Implementation of M-PSK transmitter using SDR concept.
7. Implementation of M-PSK receiver using SDR
8. Implementation of M-QAM transmitter using SDR.
9. Demonstrates the use of the Bluetooth functions to set up data transfer via Bluetooth between a server VI and a client VI.
10. Design two-dimensional convolution to perform image edge detection.
11. Implementation of M-QAM receiver using SDR.
12. Implementation of PSK Modulation system with Convolutional Coding.
13. Implementation of FSK Modulation system with BCH Coding.
14. Implementation of QAM Modulation system with Golay Coding

ECP-19LA	Biomedical lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **At the end of the course, student will be able to**							
CO1	**Elaborate various biomedical signals**						
CO2	**Acquire and simulate ECG ,EMG and EEG biomedical signals**						
CO3	**Simulate ECG Pulse missing detector**						
CO4	**Demonstrate the functions of defibrillator and pacemaker**						

List of Experiments:

1. Familiarization of various biomedical signals.
2. To simulate Electrocardiogram Waveform
3. To simulate Electroencephalogram Signal
4. To simulate Electromyogram Signal
5. To Simulate Defibrillator
6. To simulate Pacemaker
7. To simulate Haemodialysis Machine
8. To simulate Biopotential Amplifier
9. To simulate ECG Pulse missing detector.
10. To simulate 12 Lead ECG Signals.

ECP-20LA	Machine Learning Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **At the end of the course, student will be able to**							
CO1	Elaborate machine learning fundamentals						
CO2	Implement different classification/regression algorithms						
CO3	Design and develop artificial neural networks for different applications						
CO4	Develop clustering algorithms						

List of Experiments:

1. To get familiarize with machine learning.
2. Implement and demonstratethe FIND-Salgorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file
3. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithmto output a description of the set of all hypotheses consistent with the training examples.
4. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in MATLAB/Python/Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add MATLAB/Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. MATLAB/Java/Python ML library classes can be used for this problem
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

ECP-21LA	Artificial Intelligence Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hr.**
Course Outcomes **At the end of the course student will be able to**							
CO1	Implement AND/OR&NOT gate using single layer perception						
CO2	Implement XOR gate using multilayer perception						
CO3	Demonstrate the function of fuzzification/defuzzification processes						
CO4	Demonstrate different case studies in the domain						

List of Experiments:

1. Implementation of AND/OR/NOT Gate using Single Layer Perceptron
2. Implementation of XOR Gate Using Multi-Layer Perceptron/ Error Back Propagation
3. Implementation of XOR Gate Using Radial Basis Function Network
4. Understanding the concepts of Perceptron Learning Rule
5. Understanding the concepts of Hebbiann Learning Rule
6. Understanding the concepts of Correlation Learning Rule
7. Understanding the working of Kohonen's Self Organising Maps
8. Understanding the functioning of Fuzzification process
9. Implementation of different method of Defuzzification process
10. Case study explaining function of Fuzzy Inference System
11. Case study explaining function of Optical Character Recognition

ECP-22LA	Internet of Things Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor test**	**Total**	**Time**
-	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hr.**
Course Outcome: Students will be able to get the idea of Internet of Things technology.							
CO1	**Student will be able to get familiarize with Arduino and Raspberry Pi**						
CO2	**Student will be able to implement interfacing different sensorss with Arduino and Raspberry Pi**						
CO3	**Student will be able to understand the concept of cloud**						
CO4	**Student will be able to design module based on Internet of Things application**						

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 smartphone using Bluetooth.
10. Write a program to upload sensor data on cloud.
11. Write a program to retrieve sensor data from cloud.

Components required-

1. Arduino with cable
2. Raspberry Pi with cable and memory card
3. Node MCU
4. Sensors-IR, LDR, DHT11 sensor, Push button, Pressure senser, Temperature sensor, Vibration, Rotation, Location, Torque, Sound, Weight etc.
5. Actuators-LED, Buzzer, Relay Switch, Motors, Motor Drivers, OLED, Display, Linear Actuator,
6. Bluetooth Module, Wi-fi Module, Ethernet Module
7. Smart Phone
8. Computer
9. Power Supply-5V, 12V, 3.3V
10. Internet facility

ECP-23LA	Augmented Reality/Virtual Reality Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **To expose the students to the most recent technology i.e. Augmented Reality and Virtual Reality.**							
CO1	**Student will be able to familiarization of basics of Augmented Reality and Virtual Reality**						
CO2	**Student will be able to Design 3D Objects**						
CO3	**Student will be able to get an idea about the Vuforia .**						
CO4	**Student will be able to design Game in Unity 3D Project.**						

List of Experiments

1. To get familiarization with the basics of AR/VR
2. Introduction to Unity 3D, and its game objects, materials, cameras, standard assets, asset store, adjusting size, position and rotation of game objects .
3. Program to Design 3D Modelling, Importing 3D models in Unity 3D, and to add buttons.
4. Program to Design of animating 3D models, adding material to 3d models
5. Program to Design User Interface using Unity 3D and customizing the colour, size, background, text etc. of the UI elements
6. To learn about Scripting, Adding scripts to game objects, controlling objects with scripts, button functionality with scripting.
7. Program to design Prefabs/Physics Elements, Creating prefabs, adding physics to game objects.
8. To learn about Vuforia SDK, Vuforia integration with Unity 3D, selecting a perfect image for AR development.
9. To design 2D game on Unity 3D
10. To learn about Scene Management in Augmented Reality Applications, MultiScene Arrangement in Augmented Reality Applications

Note: the above mentioned experiments are not limited. Teacher may introduce new experiments