Sri Chandrasekharendra Saraswathi Viswa MahaVidyalaya

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Department of Electronics and Communication Engineering

CURRICULUM & SYLLABUS FOR PART TIME

B.E. Electronics and Communication Engineering

(Choice Based Credit System)

(With effect from AY 2025-26)

Part Time- B.E. (Electronics and Communication Engineering)
Curriculum (2025-26) onwards

Semester-I

Sl.No	Course Code	Course Name	Category	Hours per week			C	IA	EA	TM
				L	T	P				
1.		Probability andStatistics	BSC	2	1	0	3	40	60	100
2.		Electronic Devices	PCC	3	0	0	3	40	60	100
3.		Digital System Design	PCC	3	0	0	3	40	60	100
4.		Signals And Systems	PCC	3	0	0	3	40	60	100
5.		Network Theory	PCC	3	0	0	3	40	60	100
6.		Electronic Devices Laboratory	PCC	0	0	2	1	40	60	100
7.		Digital System Design Laboratory	PCC	0	0	2	1	40	60	100
			Total	**14**	**1**	**4**	**17**	-	-	

Semester-II

Sl.No	Course Code	Course Name	Category	Hours per week			C	IA	EA	TM
				L	T	P				
1.		Analog Electronics	PCC	3	0	0	3	40	60	100
2.		Analog And Digital Communication	PCC	3	0	0	3	40	60	100
3.		Microprocessor And Microcontrollers	PCC	3	0	0	3	40	60	100
4.		Measurements and Instrumentation	ECS	3	0	0	3	40	60	100
5.		Electromagnetic Fields and waveguides	PCC	3	0	0	3	40	60	100
6.		AnalogElectronics Laboratory	PCC	0	0	2	1	40	60	100
7.		Analog And Digital Communication Laboratory	PCC	0	0	2	1	40	60	100
8.		Microprocessor and Microcontrollers Laboratory	PCC	0	0	2	1	40	60	100
			Total	**15**	**0**	**6**	**18**	-	-	

Semester-III

Sl.No	Course Code	Course Name	Category	Hours per week			C	IA	EA	TM
				L	T	P				
1.		Microwave Engineering	PCC	3	0	0	3	40	60	100
2.		Digital Signal Processing	PCC	3	0	0	3	40	60	100
3.		Computer Aided System Design	PCC	3	0	0	3	40	60	100
4.		Professional Elective Course -I	PEC	3	0	0	3	40	60	100
5.		Open Elective Course-I	OEC	3	0	0	3	40	60	100
6.		Electromagnetic Fields and Microwave Laboratory	PCC	0	0	2	1	40	60	100
7.		Digital Signal Processing Laboratory	PCC	0	0	2	1	40	60	100
8.		Computer Aided System Design Laboratory	PCC	0	0	2	1	40	60	100
				15	**0**	**6**	**18**	-	-	

Semester-IV

Sl.No	Subject Code	Subject Name	Category	Hours per week			C	IA	EA	TM
				L	T	P				
1.		Control Systems	PCC	3	0	0	3	40	60	100
2.		Computer Networks	PCC	3	0	0	3	40	60	100
3.		Professional Elective Course -II	PEC	3	0	0	3	40	60	100
4.		Embedded Systems	PCC	3	0	0	3	40	60	100
5.		Principles of Management and Professional Ethics	HSMC	3	0	0	3	40	60	100
6.		Computer Networks Lab	PCC	0	0	2	1	40	60	100
7.		Embedded Systems Design Laboratory	PCC	0	0	2	1	40	60	100
8.		VLSI Design Lab	PCC	0	0	2	1	40	60	100
			Total	**15**	**0**	**6**	**18**	-	-	

Semester-V

Sl.No	Course Code	Course Name	Category	Hours per week			C	IA	EA	TM
				L	T	P				
1.		Professional Elective Course -III	PEC	3	0	0	3	40	60	100
2.		Professional Elective Course- IV	PEC	3	0	0	3	40	60	100
3.		Computer Architecture	PCC	3	0	0	2	40	60	100
4.		Open Elective Course - II	OEC	3	0	0	3	40	60	100
5.		Optical Communication	PEC	3	0	0	3	40	60	100
6.		Optical Communication Laboratory	PCC	0	0	2	1	40	60	100
		Total		**15**	**0**	**2**	**15**			

Semester-VI

Sl.No	Course Code	Course Name	Category	Hours per week			C	IA	EA	TM
				L	T	P				
1.		Professional Elective Course V	PEC	3	0	0	3	40	60	100
2.		Professional Elective Course VI	PEC	3	0	0	3	40	60	100
3.		Industrial IOT	PEC	3	0	0	3	40	60	100
4.		Open Elective Course III	OEC	3	0	0	3	40	60	100
5.		Mini Project/Project Work [Phase 1]	PII	0	0	0	3	40	60	100
		Total		**12**	**0**	**0**	**15**	**-**	**-**	

Semester-VII

Sl.No	Course Code	Course Name	Category	Hours per week			C	IA	EA	TM
				L	T	P				
1.		Professional Elective Course VII	PEC	3	0	0	3	40	60	100
2.		Project Work - Phase2	PII	0	0	0	15	40	60	100
		Total		**3**	**0**	**0**	**18**	**-**	**-**	

Total: 120 Credits

LIST OF PROFESSIONAL ELECTIVES COURSES [PEC]

Professional Elective Course–I		
Sl.No	**Course Code**	**Course Name**
1.		Antennas and Propagation
2.		Information Theory and Coding
3.		Introduction to MEMS

Professional Elective Course–II		
Sl.No	**Course Code**	**Course Name**
1.		VLSI Design
2.		Multimedia Compression Techniques
3.		Nano Electronics

Professional Elective Course–III		
Sl.No	**Course Code**	**Course Name**
1.		Digital Image and Video Processing
2.		Wireless Sensor Networks
3.		ASIC design
4.		Advanced Microcontrollers

Professional Elective Course–IV		
Sl.No	**Course Code**	**Course Name**
1.		Mobile Communication and Networks
2.		CMOSIC Design
3.		Speech and Audio Processing
4.		High Speed Electronics

Professional Elective Course–V		
Sl.No	**Course Code**	**Course Name**
1.		Bio-Medical Electronics
2.		Mixed Signal Design
3.		Adaptive Signal Processing
4.		RF Design

Professional Elective Course–VI		
Sl.No	**Course Code**	**Course Name**
1.		Neural Networks and Fuzzy Logic
2.		4G LTE Cellular Systems
3.		Error Correcting Codes
4.		VLSI Testing

Professional Elective Course–VII		
Sl.No	**Course Code**	**Course Name**
1.		Satellite Communication
2.		Radar and Navigational Aids
3.		Wavelets and itsA pplications
4.		Software Defined Radio

LIST OF OPEN ELECTIVES COURSES [OEC]

Open Elective Course–I		
Sl.No	Course Code	Course Name
1.		Disaster Management
2.		Cryptography & Network Security
3.		PLC & Data Acquisition Systems
4.		Nano science
5.		Autotronics

Open Elective Course–II		
Sl.No	Course Code	Course Name
1		Remote Sensing & GIS
2		Big data Analytics
3		Computer Integrated Manufacturing
4		Operational Research
5		3D Printers & Applications

Open Elective Course–III		
Sl.No	Course Code	Course Name
1		Sensors & Actuators
2		ADHOC Networks
3		Artificial Intelligence
4		Total Quality Management
5		Global Positioning Systems

SEMESTER - I

Course Code		L	T	P	C	IA	EA	TM
Course Name	PROBABILITY AND STATISTICS	3	1	0	4	40	60	100
Course Category	BASIC SCIENCE COURSE	Syllabus Revision						
Pre-requisite	Collection of data,CountingTechniques,Permutation and combination							

Course Objectives:

The course should enable the students

1. To introduce fundamental concepts of probability theory, including conditional probability, Bayes' theorem, and random variables.
2. To familiarize students with discrete and continuous probability distributions and their applications.
3. To develop an understanding of statistical measures such as central tendency, dispersion, correlation, and regression.
4. To equip students with techniques for curve fitting and conducting large sample hypothesis testing.
5. To enable students to perform small sample hypothesis tests using t, F, and chi-square distributions.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Apply basic concepts of probability, including Bayes' theorem and moment generating functions, to analyze random events.	K1
CO2	Use standard discrete and continuous probability distributions to model and solve real-world problems.	K3
CO3	Compute and interpret statistical measures such as mean, variance, correlation, regression, skewness, and kurtosis.	K3
CO4	Perform curve fitting using least squares and conduct large-sample hypothesis testing.	K4
CO5	Apply small-sample tests such as t-test, F-test, and chi-square test for inference and decision-making.	K5

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	S	S	S	S	M	M	M	-	M	M	M	M	M	-	S
CO2	S	S	S	S	M	M	M	-	M	M	M	M	M	-	S

CO3	S	S	S	S	M	M	M	-	M	M	M	L	L	-	S
CO4	S	S	S	S	M	M	M	-	M	M	M	L	L	-	S
CO5	S	S	S	S	M	M	M	-	M	M	M	L	M	M	S

UNIT-I	Probability	12Hours

Introduction to Probability,Probability spaces, conditional probability, Bayes' Theorem, Discrete and Continuous one dimensional random variables - Expectations, Moments, Variance of a sum, Moment generating function, Tchebyshev's Inequality.

UNIT-II	Probability Distributions	12Hours

Discrete Distributions – Binomial, Poisson and Negative Binomial distributions, Continuous Distributions - Normal, Exponential and Gamma distributions.

UNIT-III	Statistics	12Hours

Measures of Central tendency, Measures of dispersion, co efficient of variation, Moments, Skewness and Kurtosis, Correlation, Rank Correlation and Regression (Bivariate)

UNIT-IV	Testing of Hypothesis-I	12Hours

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

UNIT-V	Testing of Hypothesis-II	12Hours

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

	Total Hours	60Hours

Text Book(s)

1.	T. Veerarajan, Probability, Statistics and Random Processes, Third edition, Tata McGraw-Hill, NewDelhi, 2010.
2	S.P. Gupta, Statistical Methods, 31st edition, Sultan chand and sons, New Delhi, 2002.

Reference Book(s)

1.	Loeve, M. (2012). Probability Theory I. United States: Springer New York.

Course Code		L	T	P	C	IA	EA	TM
Course Name	ELECTRONIC DEVICES	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite	BasicElectrical Engineering							

Course Objectives:

The course should enable the students:

1. To know about semiconductor materials and their types.
2. To design andconstruct diode circuits.
3. To learn fundamentals of transistor and its variants.
4. To study frequency response of amplifiers under small signal conditions.
5. To understand construction and characteristics of JFET and MOSFET.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Characterize the types of semiconductors.	K1
CO2	Design and construct circuitsusing various diodes.	K2
CO3	Design and construct circuits using BJT.	K2
CO4	Design and construct transistor amplifiers using h-parameters.	K4
CO5	Understand the characteristics of JFET and MOSFET.	K2

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2	PSO 3
CO1	S	S	-	-	-	-	-	-	-	-	-	L	-	-	-
CO2	S	S	S	M	-	-	-	-	-	-	-	L	L	-	S
CO3	S	S	-	L	-	-	-	-	-	-	-	L	M	-	S
CO4	S	S	S	M	-	-	-	-	-	-	-	L	M	M	S
CO5	S	S	-	-	-	-	-	-	-	-	-	L	-	-	S

UNIT-I	SEMICONDUCTOR MATERIALS	9 Hours
Elemental & compound semiconductor materials , Bonding forces and Energy bands in intrinsic and extrinsic silicon, Charge carrier in semiconductors , carrier concentration, Junction properties, Equilibrium condition, biased junction, Steady state condition, breakdown mechanism (Rectifying Diodes, Zener Diodes), Metal Semiconductor Junction. Special diodes: Tunnel diodes, Varactor diodes, Schottky diode, Photo diodes, Photo detector, LED, Solar cell.		
UNIT-II	DIODE CIRCUITS	9 Hours
Ideal and Practical diode, Clipper, Clamper. Power Supply: Rectifiers-Halfwave, Full wave, Bridge rectifier, filter circuits, Voltage regulation using shunt & series regulatorcircuits, Voltage regulationusingIC723		
UNIT-III	FUNDAMENTALS OF BJT	9 Hours
Construction, basic operation, current components and equations, CB, CE and CC configuration, input and output characteristics, Early effect, Region of operations: active, cut-off and saturation region. BJT as an amplifier and switch - Photo transistor, Uni-junction Transistor (UJT) and Thyristors: UJT: Principle of operation, characteristics, UJT relaxation oscillator		
UNIT-IV	SMALL SIGNAL ANALYSIS	9 Hours
Small signal Amplifier, Amplifier Bandwidth, Hybrid model, analysis of transistor amplifier using h-parameter, Multistage Amplifier: Cascading amplifier, Boot-strapping Technique, Darlington amplifier and Cascode amplifier, Coupling methods in multistage amplifier, Low and high frequency response, Hybrid π model, Current Mirror circuits.		
UNIT-V	FETCONSTRUCTION	9 Hours
JFET Construction, n-channel and p-channel, transfer and drain characteristics, parameters, Equivalent model and voltage gain, analysis of FET in CG, CS and CD configuration. Enhancement and Depletion MOSFET drain and transfer Characteristics. **Integrated Circuit Fabrication Process:** oxidation, diffusion, ion implantation, photolithography, etching,chemical vapor deposition, sputtering, twin-tub CMOS process		
	Total Hours	45 Hours

Text Book(s)	
1.	Donald .A. Neamen, Electronic Circuit Analysis and Design –2 nd Edition, Tata Mc Graw Hill, 2009.
Reference Book(s)	
1.	Salivahanan, Kumar & Vallavaraj, “Electronic Devices and Circuits”, TMH, 2016.
2.	Theodore F. Bogart, Jeffrey S. Beasley, “Guillermo Rico Electronic Devices & Circuits”, PHI, 2014.
3.	Millman & Halkias, “Electronic Devices and Circuits”, TMH, 2013.

Course Code		L	T	P	C	IA	EA	TM
Course Name	DIGITAL SYSTEM DESIGN	3	0	0	3	40	60	100
Course Category	PROGRAMMECORE COURSE	Syllabus Revision						
Pre-requisite	Basic electronics, Boolean algebra and Number systems.							

1. The course should enable the students –
2. To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions.
3. To introduce the methods for simplifying Boolean expressions.
4. To outline the formal procedures for the analysis and design of combinational circuits and Sequential circuits.
5. To introduce the concept of memories and programmable logic devices.
6. To illustrate the concept of synchronous and asynchronous sequential circuits.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Explain the basic theorems and properties of Boolean algebra.	K3
CO2	Utilize K- Map for gate level minimization of the given Boolean function	K5
CO3	Construct combinational logic circuits for the given requirement and determine their performance.	K5
CO4	Design synchronous and asynchronous sequential circuits using VERILOG.	K6
CO5	Illustrate the Classifications of memories and programmable logic devices.	K6

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O2	PSO3
CO1	S	M	M	M	-	-	-	-	-	-	S	S	S	S	M
CO2	S	S	S	S	-	-	-	-	-	-	M	L	M	S	M
CO3	-	S	S	M	-	M	-	-	-	-	M	M	S	S	M
CO4	S	S	S	S	M	-	-	-	-	-	S	M	M	S	L
CO5	S	S	S	S	S	-	-	-	-	-	M	M	S	S	M

UNIT-I	MINIMIZATION TECHNIQUES AND LOGIC GATES	9Hours
Minimization Techniques: Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm -Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions –Quine-McCluskey method of minimization. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NORImplementationsofLogic Functionsusing gates,NAND –NOR implementations – Multilevelgate implementations-Multioutputgateimplementations.TTLandCMOSLogicandtheir Characteristics–Tristate gates.		

UNIT-II	COMBINATIONAL CIRCUITS	9Hours
Designprocedure–Halfadder–FullAdder–Halfsubtractor–Fullsubtractor– Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer-decoder-encoder–paritychecker–paritygenerators–codeconverters-MagnitudeComparator.		

UNIT-III	SEQUENTIAL CIRCUITS	9Hours
Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation – Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment -Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.		

UNIT-IV	MEMORY DEVICES	9Hours
Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM – EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timingwave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell–ProgrammableLogicDevices– Programmable Logic Array (PLA)-Programmable Array Logic (PAL) – FieldProgrammableGateArrays(FPGA)-Implementationofcombinationallogiccircuitsusing ROM,PLA,PAL		

UNIT-V	SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS	9Hours
Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VERILOG		
	Total Hours	45Hours

Text Book(s)	
1.	M.Morris Mano,"Digital Design",4e,PrenticeHall of India Pvt.Ltd.,2008/ Pearson Education (Singapore) Pvt.Ltd. NewDelhi, 2003.
Reference Book(s)	
1.	JohnF.Wakerly, "Digital Design", Fourth Edition, Pearson / PHI,2008.
2.	JohnYarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
3.	CharlesH.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4.	DonaldP.Leachand Albert Paul Malvino,"Digital Principles and Applications",6th Edition, TMH, 2006.
5.	ThomasL.Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc,2011.
6.	DonaldD.Givone, "Digital Principles and Design", TMH, 2003.
7.	A.AnandaKumar,Fundamentals of digital circuits,second edition,PHI learning private Limited, 2009.

Course Code		L	T	P	C	IA	EA	TM
Course Name	SIGNALS AND SYSTEMS	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite	Mathematics–I&II							

Course Objectives:

The course should enable the students-

1. To understand the properties and representation of discrete and continuous signals.
2. To analyze continuous time signals and system in the Fourier and Laplace domain.
3. To analyze discrete time signals and system in the Fourier and Z transform domain.
4. To development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Outcomes:

On completion of the course,the student will be able to

Course outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand and classify systems based on the impulse response behavior of both continuous-time and discrete-time systems.	K2
CO2	Analyze and Evaluate the mathematical modeling of various signals and systems..	K4
CO3	Analyze the Continuous time signals using Fourier series and Fourier Transforms.	K3
CO4	Examine the Continuous time LTI systems using Fourier series and Fourier Transforms.	K5
CO5	Analyze sampling process and sampling of discrete time signals.	K3

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	-	M		-	-	-	-	-	-	L	M	-	S
CO2	S	S	M	S	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	M	M	-	-	-	-	-	-	-	L	L	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	L	-	S
CO5	S	S	M	M	-	-	-	-	-	-	-	L	M	M	S

UNIT-I	CLASSIFICATION OF SIGNALS AND SYSTEMS	9Hours
Continuous Time Signals (CT signals), Discrete time signals (DT signals) step, ramp, pulse, impulse, exponential, Classification of CT and DT signals-periodic, aperiodic, random signals-CT systems And DT systems, Basic properties of systems- Linear Time invariant systems and properties.		
UNIT-II	ANALYSIS OF CONTINUOUS TIME SIGNALS	9Hours
Fourier Series Analysis- Representation of periodic signals in trigonometric and exponential form, Spectrum of CT signals-Fourier Transform and Laplace Transform in signal analysis.		
UNIT-III	LINEAR TIME INVARIANT–CONTINUOUS TIME SYSTEMS	9Hours
Differential Equation - Block diagram Representation, Impulse response, Convolution IntegralFrequency response, Fourier and Laplace Transforms in analysis, State variable equations and Matrix representation of systems.		
UNIT-IV	ANALYSIS OF DISCRETE TIME SYSTEMS	9Hours
Sampling of CT signals and aliasing, DTFT and properties, Z-transform and properties of Z transform		
UNIT-V	LINEAR TIME INVARIANT– DISCRETE TIME SYSTEMS	9Hours
Difference equations, Block Diagram representation, Impulse response, Convolution sum, LTI systems analysis using DTFT and Z-transforms, State variable equations and matrix representation of systems.		
	Total Hours	45Hours

Text Book(s)

1.	P.RameshBabu & R.Anandanatarajan, signals and systems,4th edition, Scitech Publication Private limited, 2009.
2.	AllamV.Oppenheim, S.WilskyandS.H.Nawab, Signals and systems, Pearson Education, 2007.

Reference Book(s)

1.	Robert A.Gabeland RichardA.Roberts, Signals & LinearSystems, John Wiley& Sons2004.
2.	Simon Haykinsand Barry VanVeen, Signals and Systems, John Wiley& Sons, 2004.

Course Code		L	T	P	C	IA	EA	TM
Course Name	NETWORK THEORY	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students-

1. To introduce electric circuits and its analysis
2. To impart knowledge on solving circuits using network theorems
3. To introduce the phenomenon of resonance in coupled circuits.

Course Outcomes:

On completion of the course, the student will be able to

- Ability to analyze electric circuits
- Ability to apply circuit theorems
- Ability to analyze AC and DC Circuits

Course Outcomees	Description	Highest Bloom's Taxonomy
CO1	Concepts, Nodal, Mesh methods	K2
CO2	Sinusoidal Analysis, Resonance, three phase circuits	K3
CO3	Network Theorem and Application	K3
CO4	Circuit Response RLC, DC & AC Excitation	K2
CO5	Two Port Networks, synthesis Networks.	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	M	L	-	-	M	L	-	S			
CO2	S	S	S	S	M	-	-	-	M	L	-	M			
CO3	S	S	M	M	M	M	-	-	M	L	-	S			
CO4	S	M	S	M	M	M	-	-	L	L	-	M			
CO5	S	S	S	S	M	L	-	-	L	L	-	S			

UNIT-I	CIRCUIT CONCEPTS AND MESH & NODAL METHODS	9 Hours
Lumped circuits – Kirchhoff's Laws – Voltage - Current relationships of R, L and C – Independent sources Dependent sources –Simple resistive circuits – Network reduction – Voltage division – Current division –Source transformation. Formation of matrixequations and analysis of AC and DC circuits using mesh-current and nodal-voltage. Methods – Mutual inductance – Coefficient of coupling – Ideal transformer.		
UNIT-II	SINUSOIDAL STEADY STATE ANALYSIS	9 Hours
Phasor – Sinusoidal steady state response – concepts of impedance and admittance- analysis of simple circuits – Power and Powerfactor – series resonance and parallel resonance – Bandwidth and Q factor Solution of three-phase balanced and unbalancedcircuits.		
UNIT-III	NETWORK THEOREMS AND APPLICATIONS:	9 Hours
Superposition theorem – Reciprocity theorem – Compensation theorem – Substitution theorem – Maximum Power transfer theorem– Thevenin's theorem – Norton's theorem and Millman's theorem with applications.		
UNIT-IV	TRANSIENT ANALYSIS	9 Hours
Forced and free response of RL, RC and RLC circuits with D.C. and sinusoidal excitations.		
UNIT-V	TWO PORT NETWORKS AND SYNTHESIS	9 Hours
Characterization of two port networks in terms of Z,Y,H and T parameters – networks equivalents – relations between networkparameters – Analysis of T, Ladder ,Bridged – T and lattice networks – Characteristics Ideal filter - low pass and high pass filter.Reliability of one port network – Hurwitz polynomials and properties – P. R. functions and properties – synthesis of RL, RC and LCone port networks.		
	Total Hours	45 Hours

Text Books:

1. Hyatt W.H. and Kemmerly, "Engineering Circuits Analysis", McGraw- Hill International 8th Edition 2011.

2. Kuo F.F., "Network Analysis and Synthesis", Wiley International Edition, 2nd Edition 2006.

3. ParanjothiS.R.,"Electric Circuit Analysis", New Age International Ltd., Delhi, 2nd Edition. 2008.

References

1. Edminister J.A., "Theory and Problems of Electric Circuits", Schaum's outline series McGraw HillBook Company, 4th Edition 2003.

2. Sudhakar A and Shyam Mohan S.P., "Circuits and Network Analysis and Synthesis", Tata McGraw – Hill Publishing Ltd., New Delhi 5th Edition 2015.

3. Van Valkenburg M.E., "Network Analysis", Prentice – Hall of India Private Ltd., New Delhi, Third Edition,1974.

Online resources:

1. www.nptl.co.in
2. www.electrical4u.com

Course Code		L	T	P	C	IA	EA	TM
Course Name	ELECTRONIC DEVICES LABORATORY	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand various tools used for designing circuits.
2. To analyze the characteristics of Semiconductor devices.
3. To construct semiconductor devices for practical applications.
4. To design of amplifiers and analyze their characteristics.
5. To analyze the frequency response characteristics of small signal amplifier.
6. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Construct and evaluate the Performance characteristics of various semiconductor devices.	K2
CO2	Integrate the semiconductor devices for Practical Application.	K3
CO3	Design amplifier circuit and analyze the design of frequency response of the small Signal Amplifier.	K3
CO4	Design various circuits using software tools and integrate and compare the findings in hardware implementation.	K4
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	K4

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M
CO2	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M
CO3	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M

CO4	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M
CO5	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M

LIST OF EXPERIMENTS

1. Study of Labview/Multisim/PSPICE/ELVIS
2. CRO Operation and its Measurements.
3. P-N Junction Diode Characteristics (Forward bias & Reverse bias)
4. Zener Diode Characteristics
   - PartA: V-I Characteristics
   - PartB: Zener Diode act as a Voltage Regulator
5. BJT Characteristics (CE Configuration)
   - PartA: Input Characteristics
   - PartB: Output Characteristics
6. FET Characteristics (CS Configuration)
   - PartA: Drain (Output) Characteristics
   - PartB: Transfer Characteristics
7. LED and PHOTO DIODE Characteristics
8. SCR Characteristics
9. UJT Characteristics
10. Clipper and Clamper Circuits
11. Design and Simulate basic Common Source / Common Gate / Common Drain Amplifier
12. BJT- CE Amplifier
13. FET- CS Amplifier

Total Hours	**45 Hours**

Text Book(s)

1.	Donald .A. Neamen, Electronic Circuit Analysis and Design –2 nd Edition, Tata Mc Graw Hill, 2009.
2.	R.S.Sedha, “Text book of Applied Electronics”, Second edition, S Chand publishing, 2008.

Reference Book(s)

1.	R. A. Gayakwad, “Op-Amps And Linear Integrated Circuits”, PHI, 2010.
2.	Schilling & Belove, “Electronic Circuits, Discrete & Integrated”, TMH.2011.
3.	Boylestad & Neshelsky, “Electronic Devices & Circuits”, PHI.2012.

Course Code		L	T	P	C	IA	EA	TM
Course Name	DIGITAL SYSTEM DESIGN LABORATORY	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand, the logical behaviors of digital circuits.
2. To design combinational circuit.
3. To analyze the operation of logic gates and flip-flops.
4. To Design and Construct Hazard Free digital circuits.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Verify the truth table for logic gates and Flip-flops.	K2
CO2	Design and test of combinational Circuits	K3
CO3	Design and test of Sequential Circuits.	K3
CO4	Design of Hazard Free Switching Devices and integrate high configuration digital circuits.	K3
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	K4

Correlationbetween CourseOutcomes(COs)andProgram Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O2	PS O3
CO1	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M
CO2	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M
CO3	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M

CO4	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M
CO5	S	S	S	S	S	L	-	-	-	-	-	M	S	M	M

	LIST OF EXPERIMENTS	

1. Study of Multisim and LT spice.
2. Study of Gates & Flip-flops.
3. Half Adder and Full Adder.
4. Encoders and Decoders.
5. Multiplexer and De-multiplexer.
6. Magnitude Comparator (2-Bit) and Code Converter.
7. Synchronous Counters.
8. Ripple Counter and Mod–N Counter.
9. Shift Register–SISO/SIPO/PIPO/PISO
10. Design of Memory Devices
11. Design of Hazard Free Switching circuits.
12. Design of Mealy and Moore Circuits.

Total Hours	45 Hours

Text Book(s)

1	M.Morris Mano,"Digital Design",4th edition ,Prentice Hall of IndiaPvt.Ltd.,2008.
2	ThomasL.Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.

Reference Book(s)

1	JohnYarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
2	CharlesH.Roth."Fundamentals of Logic Design", 6thEdition, Thomson Learning, 2013.

SEMESTER - II

Course Code		L	T	P	C	IA	EA	TM
Course Name	ANALOG ELECTRONICS	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision					V.1.0	
Pre-requisite	Electronic Devices							

Course Objectives:

The course should enable the students

1. To develop fundamental knowledge about biasing and its various methods.
2. To analyze small signal equivalent circuits using BJT and JFET.
3. To understand methods of constructing feedback amplifiers, oscillators & tuned amplifiers.
4. To understand basic concepts of operational amplifier and its various applications.
5. To know about various analog switches, A/D and D/A convertors.

Course Outcomes:

On completion of the course,the student will beable to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Determine the configuration and apply the characteristics of diodes and transistors	K2
CO2	Design and construct various types of amplifier circuits.	K4
CO3	Design and construct sinusoidal and non-sinusoidal oscillators	K4
CO4	Characterize the functioning of OP-AMP and design application based circuits	K3
CO5	Design and construct ADC and DAC circuits	K4

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	M	-	-	-	-	-	-	-	-	L	S	-	M
CO2	S	S	S	M	-	-	-	-	-	-	-	M	S	-	S
CO3	S	S	M	L	-	-	-	-	-	-	-	L	M	-	S
CO4	S	M	S	-	-	-	-	-	-	-	-	M	S	L	S
CO5	S	M	S	L	-	-	-	-	-	-	-	L	M	-	S

UNIT-I	AMPLIFIER MODELS	9Hours

Voltage amplifier, Current amplifier, Trans-conductance amplifier and Trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, Bias stability, Various configurations (CE/CS, CB/CG, CC/CD) and their features, Small signal analysis, Estimation of voltage gain, input resistance, output resistance etc., Low frequency and High frequency transistor models, Design Procedure for particular specifications, Low frequency analysis of multistage amplifiers.

UNIT-II	POWER & FEEDBACK AMPLIFIERS	9Hours

Frequency response of single stage and multistage amplifiers, Cascode amplifier. Various classes of operation (Class A, B, AB, C), their power efficiency and linearity issues - Feedback Topologies: Voltage series, Current series, Voltage shunt, Current shunt, Effect of feedback on gain and bandwidth, Calculation with practical circuits, Concept of stability, gain margin and phase margin.

UNIT-III	OSCILLATORS & DIFFERENTIAL AMPLIFIERS	9Hours

Review of Basic Concept, Barkhausen criterion, RC oscillators (Phase shift, Wien Bridge), LC oscillators (Hartley, Colpitts, Clapp), Non- sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics, output resistance, minimum sustainable voltage and maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: Design of differential amplifier for a given specification, Designof gain and output stages, compensation.

UNIT-IV	OP-AMP APPLICATIONS	9Hours

Review of Inverting and Non-inverting amplifiers, Integrator and differentiator, Summing amplifier, Precision rectifier, Schmitt trigger and its applications- Active filters: Low pass, high pass, band pass and band stop, design guidelines.

UNIT-V	DAC & ADC	9Hours

Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, Resistor string. Analog todigital converters (ADC): Single slope, Dual slope, Successive approximation, Flash type - Switched capacitor circuits: Basic concept, practical configurations, Application in amplifier, integrator, ADC etc.

Total Hours	45Hours

Text Book(s)

1.	PaulR.GrayandRobertG.Meyer,"AnalysisandDesignofAnalogIntegratedCircuits", JohnWiley, 3rdEdition,1992.
2	J.V.Wait,L.P.HuelsmanandGAKorn,"IntroductiontoOperationalAmplifiertheoryand applications",McGrawHill,1992

Reference Book(s)

1	A.S.SedraandK.C.Smith,"MicroelectronicCircuits",OxfordUniversityPress,5thEdition, 2004.
2.	P.HorowitzandW.Hill,"TheArtofElectronics",CambridgeUniversityPress,2ndEdition, 1989.
3	J.MillmanandA.Grabel,"Microelectronics",McGrawHill,SecondEdition,1988.

Course Code		L	T	P	C	IA	EA	TM

Course Name	**ANALOG AND DIGITAL COMMUNICATION**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.2.0	
Pre-requisite	Electronic Devices, Digital System Design, Signals &Systems							

Course Objectives:

The course should enable the students:

1. To analyze and compare different analog modulation schemes.
2. To analyze the behavior of communication systems in the presence of noise.
3. To investigate pulse modulation systems and analyze their system performance.
4. To analyze different modulation schemes and compute bit error performance.
5. To study demodulation of digital signals.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Compare different analog modulation schemes for their efficiency and bandwidth.	K2
CO2	Analyze the behavior of communication systems in the presence of noise.	K4
CO3	Investigate pulse modulation systems and analyze their system performance	K4
CO4	Compute bit error performance of various modulation schemes.	K3
CO5	Gain knowledge on demodulation of digital signals.	K2

Correlation between Course Outcomes(COs) and Program Outcomes (POs):

COs	Program Outcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	S	M	M	-	-	-	-	-	-	L	S	S	M
CO2	S	S	S	M	M	-	-	-	-	-	-	L	S	S	M
CO3	S	S	S	M	M	-	-	-	-	-	-	L	S	S	M
CO4	S	S	S	L	M	-	-	-	-	-	-	L	S	S	M
CO5	S	S	M	L	L	-	-	-	-	-	-	L	S	S	M

UNIT-I	AMPLITUDE AND ANGLE MODULATION	9 Hours
Review of signals and systems-Frequency domain representation of signals - Amplitude modulation systems-DSB-SC, SSB and VSB modulation - Superhetrodyne Receiver - Angle modulationRepresentation of FM and PM signals-Relationship between FM and PM-Narrow band and widebandFM-Transmission bandwidth of FM wave- Generation and detection of FM wave.		
UNIT-II	**INFORMATION THEORYAND NOISE**	**9 Hours**
Entropy – Discrete memory less channels – Channel capacity – Hartley Shannon Law – Source Coding theorem – Huffman & Shannon- Fano codes - Noise in amplitude and frequency modulation systems- Pre-emphasis and De-emphasis-White noise – Narrowband noise -Threshold effect in angle modulation.		
UNIT-III	**PULSE MODULATION**	**9 Hours**
Sampling process -Pulse Amplitude Modulation (PAM)-Pulse Position Modulation (PPM)-Quantization Process-Pulse Code Modulation (PCM) - Delta Modulation - Differential Pulse Code Modulation-Line codes-Noise consideration in PCM-Time Division Multiplexing-Digital Multiplexers.		
UNIT-IV	**BASEBAND MODULATION TECHNIQUES**	**9 Hours**
Baseband transmission of digital data-Inter Symbol interference(ISI) problem - Nyquist channelBinary Amplitude shift keying(ASK)-Phase-Shift Keying(PSK) - Frequency Shift Keying(FSK)- Quadrature Amplitude Modulation(QAM)-Continuous phase modulation and Minimum shift keyingElements of detection theory-optimum detection of signals in noise-coherent communication with waveform-Probability of error calculation.		
UNIT-V	**DEMODULATION OF DIGITALSIGNALS**	**9 Hours**
Digital Modulation tradeoffs-optimum demodulation of digital signal over band limited channelsMaximum likelihood sequence detection (Viterbi receiver)-Equalization techniques-Synchronization and carrier recovery of digital modulation.		
	Total Hours	**45 Hours**

Text/Reference Book(s)

1.	Dr.SanjaySharma,"Analog and Digital Communication",SKKataria&Son's publication, SeventhEdition,2017.
2	Haykin.Sand Michel Moher,"Introduction to Analog and Digital ommunication",John Wiley, Second Edition , 2012.
3	Taub Hand Schilling D.L.,"Principles of Communication Systems",Tata Mc Graw Hill,4TH Edition 2017.
4	ProkisJ.G."Digital Communications",Tata McGraw Hill,Fourth Edition,2017.

Course Code		L	T	P	C	IA	EA	TM

Course Name	**MICROPROCESSOR AND MICROCONTROLLERS**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**						
Pre-requisite	Electronic Devices, Digital System Design							

Course Objectives:

The course should enable the students

1. To study architecture of 8085 Microprocessor and its instruction set.
2. To study architecture of 8086 Microprocessor and its instruction set.
3. To learn design aspects of I/O and Memory interfacing circuits.
4. To study architecture of 8051 microcontroller and its applications.
5. To know about RSIC processors and design ARM processor-based systems.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Execute programs using assembly language of 8085 Microprocessor.	K3
CO2	Execute programs using assembly language of 8086 Microprocessor.	K3
CO3	Design interfacing circuits using I/O and Memory devices.	K3
CO4	Develop systems using different microcontrollers.	K4
CO5	Design ARM microcontroller based systems.	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	S	M	-	-	-	-	-	-	-	L	M	M	-
CO2	S	S	S	M	-	-	-	-	-	-	-	L	M	M	-
CO3	S	S	S	M	-	-	-	-	-	-	-	L	M	L	S
CO4	S	S	S	M	M	-	-	-	-	-	-	L	M	S	S
CO5	S	S	S	M	M	-	-	-	-	-	-	L	-	M	M

UNIT - I	8085 MICROPROCESSOR	9Hours
Microprocessor architecture and its operation, memory, I/O devices, 8085 microprocessor – Core architecture - Various registers- Bus Timings, Multiplexing and De-multiplexing of Address Bus, Decoding and Execution, Instruction set – Classification, Instruction Format, Addressing Modes, 8085 Interrupt Process, Hardware and Software Interrupts.		
UNIT-II	8086 MICROPROCESSOR	9Hours
Core Architecture of the 8086 - Memory Segmentation, Minimum mode Operation and Maximum Mode Operation, Instruction Set of the 8086 processor- Classification - Instruction Format Addressing modes, Simple Assembly Language Programs - Arithmetic operations, Data transfer, String Manipulation, Searching and Sorting.		
UNIT-III	I/O INTERFACING	9Hours
Memory Interfacing and I/O interfacing - Parallel communication interface – Serial Communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: TrafficLight control, LED display , LCD display, Keyboard display interface and Alarm Controller.		
UNIT-IV	MICROCONTROLLER	9Hours
Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits – Instruction set- Addressing modes - Assembly language programming - Programming 8051Timers, Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.		
UNIT-V	ADVANCED MICROPROCESSOR & MICROCONTROLLER	9Hours
Advanced Microprocessor Architectures- 286, 486, Pentium - RISC Processors- RISC Vs CISC, RISC properties and evolution- ARM Processor – CPU: programming input and output supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPUperformance- CPU power consumption.		
	Total Hours	45Hours

Text Book(s)	
1	R.S.Gaonkar,“Microprocessor Architecture: Programming andApplications with the 8085/8080A”, Penram International Publishing, ThirdEdition, 1996.
2	DAPattersonandJ HHennessy,“Computer Organization and DesignThe hard ware and Software interface”Morgan Kaufman Publishers, Fourth Edition, 2011.
Reference Book(s)	
1	DouglasHall,“TheMicroprocessors and its Interfacing”,Tata McGrawHill,ThirdEdition, 2012.
2	KennethJ.Ayala,“The 8051 Microcontroller:Architecture Programming & Applications”, Penram International Publishing, Second Edition, 1996.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**MEASUREMENTS & INSTRUMENTATION**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.2.0		
Pre-requisite	Basic Knowledge of Electrical and Electronics Engineering							

Course Objectives:

The course should enable the students:

1. To introduce the basic functional elements of Instrumentation
2. To introduce the fundamentals of Electrical and Electronic Instruments.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Use various types of Electrical Instruments	K1
CO2	Use various types of Electrical Instruments	K2

Correlation between Course Outcomes(COs) and Program Outcomes (POs):

COs	Program Outcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	S	M	-	-	-	-	-	-	-	L	S	-	-
CO2	S	S	S	M	-	-	-	-	-	-	-	L	M	-	S

UNIT-I	BASIC MEASUREMENTS CONCEPTS AND ERRORS	9 Hours
Measurements Systems – Static and dynamic Characteristics – Units and standards of MeasurementsSystems - Types of Errors, Accuracy, Precision, Reproducibility, Repeatability and Noise, Analog Instruments – Galvano Meter, D'Arsonaval Galvanometer, Moving Coil Instruments, PMMC - Ammeter, Voltmeter& Ohm Meter, Moving Iron Instruments, Electrodynamometer.		
UNIT-II	DATA DISPLAY AND RECORDING SYSTEMS	9 Hours
Oscilloscope: CRO – CRT, Deflection System, Specifications, Controls, Storage Oscilloscope, DigitalStorage, Sampling Oscilloscope. Graphic Recording Instruments: Strip Chart Recorders, X_Y Recorder, Plotters.		
UNIT-III	DIGITAL INSTRUMENTS AND SIGNAL GENERATORS	9 Hours
Digital Voltmeter system, Digital Multi meter, Digital Frequency Meter System- SIGNAL GENERATORS: LF Signal Generators, Function Generators, Pulse Generators, RF Signal Generators, Sweep Signal Generators, Sweep Frequency Generators, Frequency Synthesizers		
UNIT-IV	WAVEFORM ANALYSERS AND RADIO RECEIVERS	9 Hours
Distortion Meter, Spectrum Analyzer, Digital Spectrum Analyzer - Radio Receiver Measurement: Receiver Basics and Parameters, Measuring Sensitivity, Selectivity and Image Response		
UNIT-V	TRANSDUCERS	9 Hours
Classification of Transducers- Resistance – Potentiometer, Strain gauges, Resistance Thermometers, Thermistor. Inductive Transducers: LVDT, RVDT. Capacitive Transducers: Piezoelectric, Photoelectric transducers, Digital Transducers – Encoder, Shaft Encoder, Optical Encoder.		
	Total Hours	45 Hours

Text/Reference Book(s)

1.	A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", 18thEdition, Dhanpat Rai Publications, 2001.
2	. David A Bell, "Electronic Instrumentation and Measurements", Second Edition, PHI, 2003
3	Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, Third Edition, PearsonEducation, 2003
4	Albert D. Helfrick and William D.Cooper "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.
5	James W. Dally, William F. Riley, Kenneth G. McConnell, "Instrumentation f o r Engineering Measurements", 2nd Edition, John Wiley, 2003.
6	Doeblin: "Measurement Systems - Application and Design", IV Edition, McGraw-Hill, 1990.

Course Code		L	T	P	C	IA	EA	TM
Course Name	ELECTRO MAGNETIC FIELDS AND WAVEGUIDES	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite	Physics and Mathematics							

Course Objectives:

The course should enable the students

1. Tostudythebasics ofElectromagnetic.
2. Tounderstandthepropagationandpolarizationof Electromagnetic waves.
3. ToanalyzewavepropagationinTransmissionLinesanditsapplications.
4. Toanalyzewavepropagationinmetallicwaveguides.
5. To knowthe radiationcharacteristicsofanantenna.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Gain knowledge on basics of Electro- magnetic.	K1
CO2	Understand the propagation of Electromagnetic Waves.	K2
CO3	Determine the characteristics and wave propagation on transmission lines.	K3
CO4	Analyze wave propagation on metallic wave guides.	K4
CO5	Determine the radiation and radiation characteristics of an antenna.	K2

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	S	S	S	-	-	-	-	-	-	-	-	L	S	-	-
CO2	S	S	S	-	-	-	-	-	-	-	-	L	-	-	S
CO3	S	S	S	-	-	-	-	-	-	-	-	L	M	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	M	S	S
CO5	S	S	S	-	-	-	-	-	-	-	-	L	M	S	-

UNIT-I	BASICS OF ELECTRO MAGNETICS	9Hours

Vector algebra-Coordinate Systems-Vector differential operator-Gradient-Divergence-Curl-Divergence Theorem-Stokes theorem-Coulombs law-Electric field intensity-Electric flux density- Gauss lawand its applications-Biot Savart Law-Ampere's law-Faradays law- Maxwell's Equations In Integral and differential form-Electric and magnetic boundary conditions at the mediainterface.

UNIT-II	ELECTRO MAGNETIC WAVES	9Hours
Uniform Plane Waves-Uniform plane wave propagation-Wave propagation in conducting medium-Wave Polarization-Reflection by perfect conductor (normal and oblique incidence)- Reflection by perfect insulator(normal and oblique incidence)-plane waves in arbitrary direction-Brewster angles-Total internal reflection-poynting vector and power flow-Power loss inplane conductor.		
UNIT-III	**TRANSMISSION LINES**	**9Hours**
Equations of Voltage and Current on TX line- Propagation constant-characteristic impedance-reflection phenomenon-standing waves-Input impedance of dissipation less transmission line-open andshortcircuitedline-powerandimpedancemeasurementonTXline-λ/8,λ/4&λ/2line-λ/4 Impedance transformer-Smithchart and its applications-single and double stub matching.		
UNIT-IV	**GUIDED WAVES AND WAVE GUIDES**	**9Hours**
Waves between parallel planes-TEwaves-TMwaves-Characteristic of TE andTM waves-TEM waves-Velocities of propagation-Attenuation in parallel plane Guides-Rectangular wave guide-TE and TM wave sin rectangular wave guide-Impossibility of TEM wave in rectangular wave guide.		
UNIT-V	**RADIATION**	**9Hours**
Solution for potential functions-Radiation from oscillating dipole-Power radiated by oscillating dipole-antenna parameters-Gain-directivity-Effective aperture-Radiation Resistance-Band width-Beam width-Input impedance-Matching Baluns-Mono pole and dipole antenna.		
	Total Hours	**45Hours**

Text Book(s) and Reference Books

1	SadikuMH,"Principles of Electromagnetics",Oxford University PressInc,New Delhi,2009. Second Edition, Prentice Hall of India, 1968.
2	E.C.Jordan & K.G.Balmain,"Electromagnetic Waves & Radiating Systems",
3	John DRyder,"Network lines and fields", Prentice Hall of India, NewDelhi, 2005.
4	DavidK.Cheng,"Fieldand Wave Electro magnetics",Second Edition,PrenticeHall of India, 1989.
5	SandeepWali,"Electromagnetic theory", first edition, Macmillan Publishers Private limited, 2011.

Course Code		L	T	P	C	IA	EA	TM
Course Name	ANALOG ELECTRONICS LABORATORY	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand the basics of linear integrated circuits and available ICs
2. To understand characteristics of operational amplifier.
3. To apply operational amplifiers in linear and nonlinear applications.
4. To analyze the frequency response characteristics of Amplifiers.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	HighestBloom's Taxonomy
CO1	Design oscillators and amplifiers using operational amplifiers.	K2
CO2	Design filters using Op-amp and perform experiment on frequency response.	K2
CO3	Analyze the working of PLL and use PLL as frequency multiplier	K3
CO4	Analyze the performance of oscillators and Multi-vibrators.	K3
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	K4

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												ProgramSpecific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	L	-	-	-	-	-	-	-	L	L	-	M
CO2	S	S	S	M	-	-	-	-	-	-	-	M	S	-	S
CO3	S	S	S	S	-	-	-	-	-	-	-	L	M	-	S
CO4	S	M	S	M	-	-	-	-	-	-	-	M	S	-	L
CO5	S	M	S	S	-	-	-	-	-	-	-	L	M	-	S

	LISTOF EXPERIMENTS	

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1. Characteristics of Opamp–IC741.
2. Inverting and Non-inverting amplifier using IC741.
3. Measurement of op-amp characteristics.
4. Instrumentation amplifier and Differential Amplifier using IC741.
5. Integrator and Differentiator using IC741.
6. Schmitt Trigger using IC741.
7. ADC/DAC using IC741.
8. Astable & Monostable Multi-vibrator using IC555.
9. RC Phase shift oscillator and Wien bridge oscillator using BJT.
10. Hartley & Colpitts oscillator using BJT.
11. Frequency Response of Class B Push Pull Amplifier using BJT.
12. Frequency Response of Voltage Series Feedback Amplifier using BJT.
13. Phase Locked Loop (PLL)

Total Hours	**45 Hours**

Text Book(s)

1. J.V. Wait, L.P. Huelsman & GA Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill, 1992
2. J. Millman and A. Grabel, “Microelectronics”, 2nd edition, McGraw Hill, 1988
3. P. Horowitz and W. Hill, “The Art of Electronics”, 2nd edition, Cambridge University Press, 1989.

Reference Book(s)

1. A.S. Sedra and K.C. Smith, “Microelectronic Circuits”, Oxford University Press, V Edition, 2004.
2. Paul R. Gray and Robert G.Meyer, “Analysis and Design of Analog Integrated Circuits”, John Wiley, 3rd Edition, 1992.

Course Code		L	T	P	C	IA	EA	TM
Course Name	ANALOG AND DIGITAL COMMUNICATION LABORATORY	0	0	3	2	40	60	100
Course Category	PROGRAMMECORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To construct basic circuits of Analog communication system.
2. To construct basic circuits of Digital communication system.
3. To Design and construct experiments for performing modulation and sampling.
4. To analyze the Performance characteristics of analog and Digital Communication Systems.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Apply the practical knowledge to construct Analog communication circuits.	K3
CO2	Apply the practical knowledge to construct Digital communication circuits	K3
CO3	Evaluate Analog and Digital modulated wave form in time /frequency domain .	K3
CO4	Analyze and evaluate the performance of Analog and Digital communication systems.	K5
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	K4

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	-	-	-	M	-	-	-	S	S	-
CO2	S	S	S	S	S	-	-	-	M	-	-	-	S	S	-
CO3	S	S	S	S	S	-	-	-	M	-	-	-	S	S	-
CO4	S	S	S	S	S	-	-	-	M	-	-	-	S	S	-
CO5	S	S	S	S	S	-	-	-	M	-	-	-	S	S	-

LISTOF EXPERIMENTS
1. Study of Multisim, VisSim and MATLAB.
2. AM modulator and Demodulator.
3. DSB-SC modulator and Demodulator.
4. SSB modulator and Demodulator.
5. FM modulator and Demodulator.
6. PAM modulator and Demodulator.
7. PPM & PWM Modulator.
8. Pre-emphasis and De-emphasis in FM.
9. Signal Sampling and Reconstruction (Sampling Theorem).
10. Pulse Code Modulation and Demodulation.
11. Delta modulation and Adaptive Delta modulation.
12. Amplitude Shift Keying (ASK) and Frequency Shift Keying (FSK) modulator and Demodulator.
13. Phase Shift keying (PSK) and Binary Phase Shift Keying (BPSK) Modulator and Demodulator

Total Hours	45Hours

Text Book(s)	
1.	Haykin.S and Michel Moher," Introduction to Analog and Digital communication", Second edition, John Wiley and sons Inc, 2012.
2.	Prokis J.G.," Digital communications", 4th edition, Tata McGraw Hill, 2000.

Reference Book(s)	
1.	Taub H and Schilling D.L., "Principles of Communication systems", Tata McGraw Hill, 2001
2.	Dr.Sanjay Sharma, "Analog and Digital communication", seventh edition, K KATARIA & amp; SON'S publication, 2017.

Course Code		L	T	P	C	IA	EA	TM
Course Name	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To study architecture of 8086 microprocessor and perform various arithmetic &logical operations.
2. To learn the design aspects of I/O and Memory Interfacing circuits.
3. To analyze the communication between Peripherals and bus interfacing.
4. To Execute Programs using 8051 Microcontroller.
5. To enable to students to working a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Design and implement programs on 8086Microprocessor.	K3
CO2	Design I/O circuits and analyze the performance.	K3
CO3	Design Memory Interfacing circuits.	K3
CO4	Integrate Microprocessor and Microcontroller and Peripherals for Various Applications.	K5
CO5	Demonstrate capability to working a team and to build circuits for various applications.	K4

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	M			M			L	S	S	L
CO2	S	S	S	S	S	M			M			L	S	S	L
CO3	S	S	S	S	S	M			M			L	S	S	S
CO4	S	S	S	S	S	M			M			L	S	S	S
CO5	S	S	S	S	S	M			M			L	S	S	S

LISTOF EXPERIMENTS

8086 Microprocessor Experiments

1. Basic Arithmetic and Logical operations using 8086.
2. Code conversion, decimal arithmetic and Matrix operations.
3. Floating-point operations, string manipulations, sorting and searching.
4. Counters and Time delay.
5. Password Checking, Print RAM size and System Date.

8086 Microprocessor-Peripherals and Interfacing Experiments

6. Traffic Light Control and Stepper Motor Control.
7. Digital Clock.
8. Keyboard and Display.
9. Serial and Parallel Interface.
10. A/D and D/A Interface and Waveform Generation.

8051 Microcontroller Experiments - Hardware / Simulation

11. Basic Arithmetic and Logical Operations.
12. Square program, Cube program and Finding 2's complement of a number.
13. Unpacked BCD to ASCII.
14. A/D and D/A Interface and Waveform Generation.
15. Interfacing LCD to 8051

Total Hours	**45Hours**

Text Book(s)

1.	R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085/8080A", Penram International Publishing, Third Edition, 1996.
2.	D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface" Morgan Kaufman Publishers, Fourth Edition, 2011.

Reference Book(s)

1.	Douglas Hall, "The Microprocessors and its Interfacing", Tata McGraw Hill, Third Edition, 2012.
2.	Kenneth J. Ayala, "The 8051 Microcontroller: Architecture Programming & Applications", Penram International Publishing, Second Edition, 1996.

Part Time- B.E. (Electronics and Communication Engineering)
Curriculum (2025-26) onwards

SEMESTER - III

Course Code		L	T	P	C	IA	EA	TM
Course Name	MICROWAVE ENGINEERING	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite	Electromagnetic Fields and Waveguides, Network Theory							

Course Objectives:

The course should enable the students

1. To inculcate the basics and representation of RF and microwave networks.
2. To instill knowledge on the properties of various microwave components.
3. To deal with the principles of microwave system design
4. To deal with the microwave measurement techniques
5. To introduce the application areas of microwave Systems

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	At the end of the course, students will demonstrate the ability to:	K2
CO2	Illustrate the concepts of propagation and analysis in RF and Microwave networks	K2
CO3	Understand various microwave system components and their properties.	K3
CO4	Analyze / synthesis the microwave systems	K3
CO5	Appreciate that during measurements of microwave systems, the different mathematicaltreatment is required compared to general circuit analysis	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	L	L	-	L	-	-	-	-	L	L	S	M	L
CO2	S	M	-	L	-	L	-	-	-	-	L	L	S	M	L
CO3	S	S	M	L	-	-	-	-	-	-	L	L	S	M	L
CO4	L	L	M	M	-	L	-	-	-	-	L	L	S	M	L
CO5	L	L	S	L	-	-	-	-	-	-	L	L	S	M	L

UNIT-I	INTRODUCTION TO MICROWAVES	9Hours

History of microwaves, Microwave frequency bands; Applications of microwaves: Civil and Military,Medical, EMI/ EMC. Mathematical model of microwave transmission-Concept of mode, Features ofTEM, TE and TM modes, Losses associated with microwave transmission, Concept of impedance inmicrowave transmission. Analysis of RF and microwave transmission lines- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line, Microwave network analysis- Equivalentvoltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering parameters, Properties of S parameters

UNIT-II	PASSIVE AND ACTIVE MICROWAVE DEVICES	9Hours

Microwave passive components: Terminations- Variable short circuit, Attenuator, Phase shifters, Directional coupler, Magic Tee, Power divider, Resonator. Microwave active components and circuits: Diodes, Transistors, Oscillators, Mixers. Microwave semiconductor devices: Gunn diodes, IMPATT diodes, Schottky barrier diodes, PIN diodes. Microwave tubes: Klystron, TWT, Magnetron.

UNIT-III	MICROWAVE DESIGN PRINCIPLES	9Hours

Impedance transformation, Impedance matching, Microwave filter design, RF and Microwave amplifier design, Microwave power amplifier design, Low noise amplifier design, Microwave mixer design, Microwave oscillator design. Microwave antennas- Antenna parameters, Antenna for groundbased systems, Antennas for airborne and satellite borne systems, Planar antennas.

UNIT-IV	MICROWAVE MEASUREMENTS	9Hours

Power, frequency and impedance measurement at microwave frequency, Network analyzer and measurement of scattering parameters, Spectrum analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of microwave antenna parameters

UNIT-V	MICROWAVE SYSTEMS	9Hours

Radar, Terrestrial and Satellite communication, Radio aids to navigation, RFID, GPS. Modern trendsin microwaves engineering- Effect of microwaves on human body, Medical and Civil applications ofmicrowaves, Electromagnetic interference and Electromagnetic compatibility (EMI & EMC), Monolithic microwave ICs, RFMEMS for microwave components, Microwave imaging

	Total Hours	45Hours

Text Book(s)

1.	R.E. Collins, "Foundations for microwave engineering", Second edition, Wiley-IEEE press,2001 (Units I, II and III)
2.	Annapurna Das and Sisir K Das, “Microwave engineering”, Tata McGraw-Hill Pub.Co. Ltd.,2017. (Units III, IV and V)

Reference Book(s)

1.	David M. Pozar, “Microwave engineering,” John Wiley and sons, Fourth edition, 2011.
2.	Gupta K.C. and Bahl I.J., “Microwave circuits,” Artech house
3.	Samuel. Y. Liao, “Microwave circuit analysis and amplifier design”, Third edition, Pearson,2003.
4.	. Gentili C., “Microwave amplifiers and oscillators”, North oxford academic, 1986.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**DIGITAL SIGNAL PROCESSING**	2	1	0	3	40	60	100
Course Category	PROGRAMMECORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite	Signal & Systems, Digital System Design							

Course Objectives:

The course should enable the students

1. To learn discrete Fourier transforms, properties of DFT and its application to linear filtering.
2. To understand the characteristics of digital filters, design digital FIR filters and apply these filters to filter undesirable signals in various frequency bands.
3. To design digital IIR filters and apply these filters to filter undesirable signals in various frequency bands.
4. To understand the effects of finite precision representation on digital filters.
5. To understand the fundamental concepts of multi-rate signal processing and its applications.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Apply DFT and FFT algorithms for the analysis of digital signals and systems.	**K3**
CO2	Design FIR filters for various applications.	**K3**
CO3	Design IIR filters for various applications.	**K3**
CO4	Characterize the effects of finite precision representation on digital filters.	**K3**
CO5	Design multi-rate filters.	**K3**

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	M	L	L	S	-	-	-	L	-	-	L	S	S	L
CO2	S	M	M	S	M	M	-	-	L	-	-	M	S	S	L
CO3	S	S	M	M	M	-	-	-	L	-	-	M	S	S	L
CO4	S	S	M	M	M	M	-	-	-	-	-	M	S	S	L
CO5	S	S	M	M	M	-	-	-	L	-	-	L	S	S	L

UNIT-I	DISCRETE FOURIER TRANSFORM	9Hours
Review of discrete-time signals and systems – Discrete Fourier Transform (DFT) and its properties, Circular convolution, Linear filtering using DFT, Filtering long data sequences - overlap-savemethods - Overlap-add, Fast Fourier Transform (FFT) algorithms – Fast computation of DFT –Radix-2 decimation in time FFT - Decimation in frequency FFT – Linear filtering using FFT.		
UNIT-II	DESIGN OF FINITE IMPULSE RESPONSE FILTERS	9Hours
Structures for FIR systems – Transversal and Linear phase structures, Design of FIR filters – Symmetric and Antisymmetric FIR filters, Design of linear phase FIR filters using Windows(Rectangular, Hamming and Hanning windows) and Frequency sampling methods		
UNIT-III	DESIGN OF INFINITE IMPULSE RESPONSE FILTERS	9Hours
Structures for IIR systems – direct, cascade, parallel forms, Comparison of FIR and IIR, Analog filters – Butterworth filters - Chebyshev type – I filters (upto 3rd order), Analog transformation of prototypeLPF to BPF/BSF/HPF, Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z-transform method.		
UNIT-IV	FINITE WORD LENGTH EFFECTS	9Hours
Representation of fixed and floating point numbers, ADC quantization -truncation and rounding - quantization noise, Coefficient quantization Error – Product quantization error – Overflow error - Round-off noise power, Limit cycle oscillation due to product round-off error- Limit cycle oscillationdue to overflow in digital filters – Principle of scaling		
UNIT-V	MULTI-RATE SIGNAL PROCESSING	9Hours
Introduction to multi-rate signal processing – Decimation – Interpolation- Sampling rate conversion by a rational factor - Polyphase decomposition of FIR filter – Multistage implementation of samplingrate conversion – Design of narrow band filters–Applications of multi-rate signal processing		
	Total Hours	45Hours

Text Book(s)

1.	John G.Proakis and Dimitris G. Manolakis, “Digital signal processing - Principles, algorithmsand applications”, Pearson education / Prentice hall, Fourth edition, 2007.

Reference Book(s)

1.	Sanjay K.Mithra, “Digital signal processing - A Computer based approach”, Tata McGraw-Hill, 2007
2.	M.H.Hayes, “Digital signal processing”, Schum’s outlines, Tata McGraw Hill, 2007.
3.	A.V.Oppenheim, R. W. Schafer and J. R. Buck, “Discrete-time signal processing”, Pearson, 2004.
4.	I.C.Ifeachor and B.W.Jervis, “Digital signal processing – A practical approach”, Pearson 2002
5.	L.R. Rabiner and B. Gold, “Theory and application of digital signal processing”, Prentice Hall, 1992.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**COMPUTER AIDED SYSTEM DESIGN**	2	1	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Network Theory, Electronic Devices, Analog Electronics and Digital System Design							

Course Objectives:

The course should enable the students

1. To learn electronic design automation techniques for designing analog circuits at circuit levelusing PSPICE.
2. To understand the concept of Analog and digital modelling in time and frequency domain inPSPICE.
3. To introduce electronic design automation (EDA) techniques for designing digital circuits at gatelevel using VHDL.
4. To study EDA techniques for designing digital circuits at gate level using Verilog HDL.
5. To learn EDA techniques for designing digital circuits at switch level using Verilog HDL andsynthesis concepts

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the concepts of the simulation components and analysis for electronic devices andcomponents in PSPICE.	**K3**
CO2	Develop the analog and digital modelling concepts in frequency and time domains inPSPICE.	**K3**
CO3	Develop programs for combinational and sequential logic circuits by identifying the differentabstraction and delay models for digital circuits in VHDL	**K3**
CO4	Develop programs for combinational and sequential logic circuits by applying the differentabstraction and delay models for digital circuits in Verilog HDL.	**K3**
CO5	Develop programs for combinational and sequential logic circuits at switch level in VerilogHDL and understand Verilog synthesis flow.	**K3**

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M
CO2	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M
CO3	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M
CO4	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M
CO5	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M

UNIT-I	OVERVIEW OF EDA AND PSPICE	9Hours
Evolution of EDA tools, typical design flow of VLSI IC circuits (ASIC Flow), Design capture and design verification tools, Analog Circuit Techniques: Overview of PSPICE, Types of simulation - DC, AC, Transient, Monte Carlo, Parametric and others, Simulation devices- Laplace devices, Energysources, Passive components, Semi-conductors, ICs, Special devices – voltage markers, Initialconditions, etc.		
UNIT-II	MODELING FOR SIMULATION IN PSPICE	9Hours
Modelling of digital circuits in SPICE, Analog modelling in the frequency domain and time domain, Models for RLC, Diode, BJT, JFET and MOSFET.		
UNIT-III	VHDL	9Hours
Introduction to VHDL – Entities and architectures, Behavioural modelling – Concurrent and sequential processing – if, case, loops, next, exit, wait, and assert statements, Structural modelling – Port map, components and generics. Delay models –Inertial, transport and delta delays. Data types- Variables,signals, constants, arrays, VHDL operators, Functions, Procedures, Packages, Libraries andConfigurations, Simple programming examples of combinational and sequential circuits		
UNIT-IV	VERILOG HDL	9Hours
Introduction to Verilog - Modules and module instances, design blocks and stimulus blocks, Data types and operators, Modelling – Gate level (Structural) modelling, Dataflow modelling- continuousassignments, Behavioural modelling- initial, always, blocking and non-blocking statements. System tasks -display, monitor, time and stop. Tasks and functions, Simple programming examples of combinational and sequential circuits		
UNIT-V	ADVANCED TOPICS IN VERILOG HDL AND SYNTHESIS	9Hours
Delay modelling- distributed, lumped, and pin-to-pin, rise / fall / turn-off, min / typical / max delays.Switch level modelling – PMOS, NMOS and CMOS. Simple programming examples of switch levelmodelling- CMOS Inverter, CMOS Nand, CMOS Nor gates, CMOS Multiplexers and CMOS latches.Introduction to Verilog synthesis flow: Definition of terms – Technology mapping, Library cells, and Technology libraries.		
	Total Hours	45Hours

Text Book(s)

1.	Muhammad Rashid, “Introduction to PSPICE using Orcad for circuits and electronics”, Thirdedition, Pearson education, 2003.
	Douglas L. Perry, “VHDL –Programming by Example”, Fourth edition, TMH, 2002
	Samir Palnitkar, “Verilog HDL –A guide to Digital Design and Synthesis”, Second edition,Pearson Education, 2004

Reference Book(s)

1.	Neil Weste and Kamran Eshraghian, “Principles of CMOS VLSI Design”, Second edition,Addison Wesley, 1998.
2.	Charles H Roth, Jr., “Digital Systems Design using VHDL”, Second edition, ThomsonLearning, 2008.
3.	Joseph Cavanagh, “Verilog HDL-Digital design and modelling”, CRC press, 2007

Course Code		L	T	P	C	IA	EA	TM
Course Name	**ELECTROMAGNETIC FIELDS & MICROWAVE LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMMECORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand the principle of Electric field and Magnetic field on variousconductors.
2. To understand the working Principle of various type of Microwave Oscillators.
3. To know the behavior of microwave components and parameters.
4. To practice microwave measurement procedures

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the working principle of microwave components	**K2**
CO2	Know about the behaviour of microwave components	**K2**
CO3	Learn about the characteristics and measurements of E and H Fields..	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LISTOF EXPERIMENTS
1. Determination of Electric Field Pattern Between Two Circular Electrodes
2. Determination of Electric Field between Parallel Conductors
3. Measurement of Electric Field and Potential Inside the Parallel Plate Capacitor
4. Measurement of Capacitance and Inductance of Transmission Lines
5. Determination of Magnetic Field Outside A Straight Conductor
6. Determination of Magnetic Field of Coils
7. Verification of Faraday's law of Magnetic Induction.
8. Determination of Velocity of electromagnetic waves for the given Co-axial Cable.
9. Reflex klystron or Gunn diode characteristics and basic microwave parameter measurementsuch as VSWR, frequency, wavelength.
10. Directional Coupler Characteristics.
11. Radiation Pattern of Horn Antenna.
12. S-parameter Measurement of the following microwave components (Isolator, Circulator, EPlane Tee, H Plane Tee, Magic Tee)
13. Attenuation and Power Measurement

Course Code		L	T	P	C	IA	EA	TM
Course Name	**DIGITAL SIGNAL PROCESSING LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To implement Linear and Circular Convolution.
2. To implement FIR and IIR filters.
3. To study the architecture of DSP processor
4. To demonstrate Finite word length effect

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Students will be able to carry out simulation of DSP systems	**K3**
CO2	Students will be able to analyze Finite word length effect on DSP systems	**K3**
CO3	Students will be able to demonstrate the applications of FFT to DSP	**K3**
CO4	Students will be able to implement adaptive filters for various applications of DSP	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LISTOF EXPERIMENTS

MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of sequences (functional & random) & correlation.
2. Linear and Circular Convolutions.
3. Spectrum Analysis using DFT.
4. FIR filters design.
5. IIR filters design.
6. Multi-rate Filters.
7. Equalization Techniques.

DSP PROCESSOR BASED IMPLEMENTATION

8. Study of architecture of Digital Signal Processor.
9. MAC operation using various addressing modes.
10. Linear Convolution.
11. Circular Convolution.
12. FFT Implementation.
13. Waveform generation.
14. IIR and FIR Implementation.
15. Finite Word Length Effect.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**COMPUTER AIDED SYSTEM DESIGN LABORATOTY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To Construct RC circuits, OPAMPS, Combinational and Sequential circuitsUsing PSICE
2. To Simulate and Implement sequential and combinational digital circuits using HDL

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Construct Analog and Digital circuits and study their characteristics using PSPICE.	K3
CO2	Implement digital circuits using HDL	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LISTOF EXPERIMENTS

PSPICE:

(Modelling, Design, Simulation and Analysis using Schematic / Circuit file / both)

1. Study of PSPICE
2. RC circuits – Transient and AC analysis
3. MOS Device Characterization and CMOS Inverter Characteristics – DC analysis
4. Diode based circuits (like, Rectifiers, Clampers, etc.,) – Transient, Worst-case, MC,Sensitivity, etc. analysis
5. Amplifiers and Current mirrors using BJT/MOSFET
6. Op-Amp based Wein Bridge Oscillator and DAC using sub-circuit and Analog behaviouralmodelling
7. Digital Circuits – Logic switches / Multiplexer / Counter

HDL: (Logic Design and Simulation of Digital Circuits using VHDL / Verilog HDL /Both)

8. Study of VHDL and Verilog
9. Full Adder and Multiplexer using different Modelling / Descriptions and Concurrent and

SEQUENTIAL EXECUTION IN VHDL:

10. 8-bit Adder / Multiplier (min 4-bit) – Port Map, Generics, Technology Mapping in VHDL
11. 8-bit Counter – Bottom up approach design and Test vector generation in Verilog HDL
12. NAND / NOR / Transmission gates using Switch level modelling in Verilog HDL
13. Design of simple sequential and combinational circuits
14. Design of ALU
15. Design of FSM and Control Unit
16. FPGA real time programming and I/O Interfacing– Waveform generation / Traffic lightcontroller

SEMESTER - IV

Course Code		L	T	P	C	IA	EA	TM
Course Name	CONTROL SYSTEMS	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite	Basic knowledge of Circuit Theory							

Course Objectives:

The course should enable the students-

1. To introduce the elements of control system and various representations.
2. To provide knowledge on the time response and stability of systems
3. To introduce the various frequencies response plots and analyzes the stability of systems.
4. To introduce state variable representation of physical systems and study the effect of statefeedback.
5. To design various types of compensators.

Course Outcomes:

On completion of the course,the studentwill be able to

Course outcomes	Description	HighestBloom's Taxonomy
CO1	Represent a control system and thereby to obtain the mathematical model	K3
CO2	Perform time domain analysis of control systems	K4
CO3	Perform frequency domain analysis of control systems.	K3
CO4	Design compensators that can be used to design control systems with required specifications	K4
CO5	Understand the state variable analysis of systems	K5

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												ProgramSpecific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	M	-	L	L	L	L	L	L	L	S	L	M
CO2	S	S	S	M	-	M	L	L	L	M	L	M	S	L	M
CO3	S	S	S	M	-	M	L	L	L	L	L	M	M	L	M
CO4	S	S	S	M	-	M	M	L	L	L	L	M	S	L	M
CO5	S	S	S	M	-	M	L	L	L	M	L	M	S	L	M

UNIT-I	CONTROL SYSTEM MODELING & SYSTEM REPRESENTATION	9Hours
Basic Elements of Control System – Open loop and Closed loop systems - Differential equation - Transfer function, Modeling of Electric systems, and Translational and Rotational mechanical systems – Transfer function – AC & DC Servomotor and Synchros -Block diagram reduction Techniques - Signal flow graph.		
UNIT-II	**TIME RESPONSE AND STABILITY ANALYSIS**	**9Hours**
Time response analysis - First Order Systems - Impulse and Step Response analysis of Second order systems - Steady state errors- Concepts of Stability-Routh-Hurwitz Criterion-Root Locus Technique-Application of Root Locus Diagram- Relative Stability.		
UNIT-III	**FREQUENCY RESPONSE AND STABILITY ANALYSIS**	**9Hours**
Frequency response – Frequency domain specifications - Correlation between frequency domain andtime domain specifications – Stability analysis - Bode plot – Polar plot - Nyquist Stability criterion		
UNIT-IV	**STATE VARIABLE ANALYSIS**	**9Hours**
State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations - Concepts of Controllability and Observability		
UNIT-V	**COMPENSATOR DESIGN**	**9Hours**
Compensators - Effect of adding poles and zeros - Lag, lead and lag-lead compensators design using Bode Plot - Design of State feedback controller - P, PI, PD and PID Controller.		
	Total Hours	**45Hours**

Text Book(s)

1.	Nagarath I.J. and Gopal M., “Control Systems Engineering”, New Age International Publishers,2017
2.	Norman S Nise, “Control Systems Engineering”, 7th Edition, Wiley, 2015
3.	Benjamin C. Kuo, “Automatic Control systems”, Wiley, 2014

Reference Book(s)

1.	M. Gopal, “Control Systems, Principles and Design”, 4th Edition, Tata McGraw Hill, New Delhi,2012.
2.	S.K.Bhattacharya, “Control System Engineering”, 3rd Edition, Pearson, 2013
3.	Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Prentice Hall, 2012.
4.	K. Ogata, “Modern Control Engineering”, 5th edition, PHI, 2012

Course Code		L	T	P	C	IA	EA	TM
Course Name	COMPUTER NETWORKS	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite	Basic knowledge of Digital System Design, Signals & Systems and DigitalCommunication							

Course Objectives:

The course should enable the students-

1. Understand the concepts of network architecture and transmission medium
2. Perform and understand methods for error detection and correction of data
3. Be exposed to various addressing schemes and routing protocols.
4. Learn the flow control and congestion control algorithms
5. Be familiar with real time applications of networks

Course Outcomes:

On completion of the course,the studentwill be able to

Course outcomes	Description	HighestBloom's Taxonomy
CO1	Choose the required functionality at each layer for given application	K3
CO2	Detect and Correct the error in the frame	K4
CO3	Apply the knowledge of addressing scheme and various routing protocols in datacommunication to select optimal path.	K4
CO4	Trace the flow of information from one node to another node in the network	K3
CO5	Develop real time applications of networks	K5

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												ProgramSpecific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	M	L	-	M	M	-	M	S	S	S	S	L	M
CO2	S	S	M	M	-	M	M	L	S	S	S	S	S	M	M
CO3	S	S	S	M	-	L	M	-	S	S	S	S	S	L	M
CO4	S	M	S	M	-	M	M	L	L	M	L	M	S	M	M
CO5	S	M	S	S	-	M	S	L	S	S	S	S	S	L	M

UNIT-I	FUNDAMENTALS & SIGNAL TRANSMISSION	9Hours
Fundamentals : Building a network – Requirements - Layering and protocols - OSI Model - Internet Architecture – Performance - Network Topology ; Physical Layer: Data and Signals - Digital Transmission - Analog Transmission - Multiplexing and Spread Spectrum - Transmission Media..		
UNIT-II	**MEDIA ACCESS & LOGICAL LINK CONTROL**	**9Hours**
Framing - Error Detection and Correction - Media access control - Ethernet (802.3) - Wireless LANs – 802.11 – Bluetooth - Switching and bridging - Flow control.		
UNIT-III	**ROUTING & ADDRESSING SCHEMES**	**9Hours**
Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP) - Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM)		
UNIT-IV	**END TO END COMMUNICATION**	**9Hours**
Overview of Transport layer - UDP - Reliable byte stream (TCP) - Connection management – Flow control - Retransmission – Queueing Disciplines - TCP Congestion control - Congestion avoidance (DECbit, RED)		
UNIT-V	**APPLICATION LAYER PROTOCOLS**	**9Hours**
Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS - SNMP - Multimediaapplications		
	Total Hours	**45Hours**

Text Book(s)

1.	Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, FifthEdition, Morgan Kaufmann Publishers, 2011.
2.	. Behrouz A. Forouzan, “Data Communications and Networking”, Fourth Edition,McGrawHill, 2011.

Reference Book(s)

1.	James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuringthe Internet”, Fifth Edition, Pearson Education, 2009
2.	Nader. F. Mir, “Computer and Communication Networks”, Pearson/Prentice Hall Publishers,2010
3.	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks – An Open SourceApproach, First Edition, McGraw Hill, 2011.

Course Code		L	T	P	C	IA	EA	TM
Course Name	EMBEDDED SYSTEMS	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite	Basic knowledge of Microprocessors, Microcontrollers &Digital System Design							

Course Objectives:

The course should enable the students-

1. Learn the architecture and programming of ARM processor.
2. Be familiar with the embedded computing platform design and analysis.
3. Be exposed to the basic concepts and overview of real time Operating system.
4. Learn the system design techniques and networks for embedded systems to industrialapplications.

Course Outcomes:

On completion of the course,the studentwill be able to

Course outcomes	Description	Highest Bloom's Taxonomy
CO1	Describe the architecture and programming of ARM processor.	K2
CO2	Outline the concepts of embedded systems	K3
CO3	Use the system design techniques to develop software for embedded systems.	K3
CO4	Differentiate between the general purpose and real time operating system	K3
CO5	Model real-time consumer/industrial applications using embedded-system concepts.	K5

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	M	S	-	S	-	-	M	S	S	M	S	L	M
CO2	S	M	M	M	-	M	-	-	M	S	M	M	S	M	M
CO3	S	L	M	M	-	L	-	-	M	S	M	M	S	M	M
CO4	S	M	M	S	-	L	-	-	M	M	S	M	S	L	M
CO5	S	S	S	S	-	M	-	-	M	M	M	S	S	L	M

UNIT-I	INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS	9Hours

Complex systems and microprocessors– Embedded system design process – Overview on formalismsfor system design –Design example: Model train controller– Instruction sets preliminaries – ARM Processor – CPU: programming input and output– supervisor mode, exceptions and traps – Co– processors– Memory system mechanisms – CPU performance– CPU power consumption– Introduction to Embedded Industrial CPUs for rugged environment.

UNIT-II	EMBEDDED COMPUTING PLATFORM DESIGN	9Hours

The CPU Bus–Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform–level performance analysis – Components for embedded programs– Models of programs– Assembly, linking and loading – compilation Programming techniques– Program level performance analysis – Software performance optimization –Program validation and testing.

UNIT-III	PROCESSES AND OPERATING SYSTEMS	9Hours

Introduction – Kernel, Threads –Multiple tasks and multiple processes – Multirate systems– Pre- emptive real–time operating systems– Priority based scheduling– Interposes communication mechanisms – Evaluating operating system performance– power optimization strategies for processes GPOS versus RTOS- Classification of RTOSExample Real time operating systems– POSIX– Windows CE.

UNIT-IV	SYSTEM DESIGN TECHNIQUES AND NETWORKS	9Hours

Design methodologies– Design flows – Requirement Analysis – Specifications–System analysis and architecture design – Quality Assurance techniques– Distributed embedded systems – Multiprocessors–CPUs, accelerators, MPSoCs– Overview on Internet of (robotic) Things– Ubiquitousoptimization

UNIT-V	CASE STUDY	9Hours

Data compressor – Alarm Clock – Audio player – Software modem–Digital still camera – Telephoneanswering machine–Engine control unit – Video accelerator–Challenges and trends in embedded systems in industrial applications

	Total Hours	45Hours

Text Book(s)

1.	Marilyn Wolf, “Computers as Components - Principles of Embedded Computing SystemDesign”, Third Edition “Morgan Kaufmann Publisher, 2012

ReferenceBook(s)

1.	Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, ThirdEdition, Cengage Learning, 2012.
2.	. David. E. Simon, “An Embedded Software Primer”, 1st Edition, Addison WesleyProfessional, 2007
3.	Raymond J.A. Buhr, Donald L.Bailey, “An Introduction to Real-Time Systems- From Designto Networking with C/C++”, Prentice Hall, 1999

Course Code		L	T	P	C	IA	EA	TM
Course Name	PRINCIPLES OF MANAGEMENT & PROFESSIONAL ETHICS	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

1. The course should enable the students-
2. To develop knowledge on the principles of management essential for all kinds ofpeople in all kinds of organizations.
3. To have a clear understanding of the managerial functions like planning, organizing, leading andcontrolling.
4. To understand global business and diversity.
5. To gain some basic knowledge on international aspect of management
6. To understand the concepts of computer ethics in work environment.

Course Outcomes:

On completion of the course,the studentwill be able to

Course outcomes	Description	Highest Bloom's Taxonomy
CO1	Examine situations and to internalize the need for applying ethics principles, values to tackle withvarious situations.	K2
CO2	Develop a responsible attitude towards the use of computer as well as the technology	K2
CO3	Able to envision the societal impact on the products / projects they develop in their career.	K2
CO4	Understanding the code of ethics and standards of computer professionals	K2
CO5	Analyze professional responsibility and empowering access to information in the work place.	K3

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	P O6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO3
CO1	-	-	-	-	-	-	-	M	S	M	M	L	L	-	L
CO2	-	-	-	-	-	L	-	M	S	M	M	L	L	-	M
CO3	-	-	-	-	-	-	-	M	S	M	S	M	L	L	L
CO4	-	-	-	-	-	-	-	S	S	M	M	S	L	-	M
CO5	-	-	-	-	-	M	-	S	M	M	M	S	L	-	M

UNIT-I	INTRODUCTION TO MANAGEMENT	9Hours
Definition of Management, process of Management, Planning, Organizing, leading, Controlling Classical Approach-Contribution and Limitation, Management Science Approach, Skills, Roles and Performance: Types of managers Managerial Skills,- Technical Skill, Analytical Skill Decision Making skill, Human Relation skill, Communication skill. Managerial Roles – Interpersonal Role, Informational Role, Decisional Role		
UNIT-II	PLANNING FUNCTION	9Hours
Elements of Planning-Objectives, Action, Resource, Implementation, Managerial Decision Making: Types of Decision, Process of Decision Making, Decision Making-Certainty Condition, Uncertainty Condition, Selecting Alternative. Managing Information System; Need for Decision Support System,MIS and DSS Strategic Planning – Organizational Strategy, Business Portfolio Matrix.		
UNIT-III	ORGANIZING FUNCTION	9Hours
Organizational Structure- Job Design, Departmentation, Span of Control, Delegation of Authority, Decentralized authority, Chain of Command and Authority, Line and Staff concept Matrix organizational Design		
UNIT-IV	ENGINEERING ETHICS	9Hours
Senses of 'engineering ethics' – variety of moral issues – types of inquiry – moral dilemmas – moralautonomy – kohlberg's theory – Gilligan's theory – consensus and controversy – professions and professionalism – professional ideas and virtues – theories about right action – self-interest – customsand religion – uses of ethical theories		
UNIT-V	ENGINEER'S RESPONSIBILITY FOR SAFETY	9Hours
Safety and risk – Assessment of safety and risk – Risk benefit analysis – Reducing risk – The Three Mile Island and Chernobyl- case studies		
	Total Hours	45Hours

Text Book(s)

1.	Mike Martin & Roland schinzinger "Ethics in engineering" McGraw Hill, 2009
2.	Govindarajan M, Natarajan. S.Senthilkumar V.S, "Engineering Ethics", PHI, 2004.
3.	Dr. T. Ramaswamy, Principles of Management, Himalaya Publishing House, 2014.

Reference Book(s)

1.	Charles D.Fleddermamm, "Engineering Ethics", Pearson Hall, 2004.
2.	Charles E.Haris, Michael S.Protchard & Michael J.Rabins, "Engineering Ethics- concepts andcases", Wadsworth Thompson Learning, 2009.
3.	JhonR.Boartright, "Ethics and conduct of Business", Pearson Education, 2003

Course Code		L	T	P	C	IA	EA	TM
Course Name	COMPUTER NETWORKS LABORATORY	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand the function of various protocol
2. To perform real time experiments using existing infrastructure
3. To gain knowledge to construct LAN and WAN in real time environment

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Ability to design MAC and routing protocols in Wired and Wireless Environment using NS2 /QUALNET / NS3 / OMNET / CISCO	**K4**
CO2	Acquire the technical competence to meet out the industry expectation on the state – of the artwired / wireless technologies.	**K3**
CO3	Acquire the ability to design WLAN/ LAN systems meeting out real time requirements	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LISTOF EXPERIMENTS

1. (a) Study of different types of Network cables and implement cross-wired cable and straightthrough cable using clamping tool

   b) Study of Network devices c) Study of Network IP

2. Configuration of Local Area Network (LAN) and VPN

3. Wireless LAN protocols

4. To create scenario and study the performance of network with CSMA / CA protocol andcompare with CSMA/CD protocols.

5. Implementation and study of stop and wait protocol

6. Implementation and study of Go back-N and selective repeat protocols

7. Implementation of client server using TCP protocol

8. Implementation of Remote Procedure Call

9. Implementation of distance vector routing algorithm

10. Configure a network using address resolution protocol (ARP) and routing information protocol(RIP) and analyze the performance of the network.

11. Configuration of internet protocol (IP)

12. Configuration of network using Ad hoc On demand distance vector (AODV) routing

13. Configuration of network using Dynamic Source Routing (DSR) routing

Course Code		L	T	P	C	IA	EA	TM
Course Name	EMBEDDED SYSTEM DESIGN LABORATORY	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To learn the working of ARM processor
2. To understand the Building Blocks of Embedded Systems
3. To learn the concept of memory map and memory interface
4. To know the characteristics of Real Time Systems
5. To write programs to interface memory, I/O's with processor
6. To study the interrupt performance

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Write programs in ARM for a specific Application	K3
CO2	Interface memory and Write programs related to memory operations	K3
CO3	Interface A/D and D/A convertors with ARM system	K3
CO4	Analyse the performance of interrupt	K4
CO5	Write programmes for interfacing keyboard, display, motor and sensor	K4
CO6	Formulate a mini project using embedded system	K4

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO6	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LISTOF EXPERIMENTS
1. Study of ARM evaluation system 2. Study of Keil C Compiler 3. Interfacing ADC and DAC 4. Interfacing LED and PWM 5. Interfacing real time clock and serial port 6. Interfacing keyboard and LCD 7. Interfacing EPROM and interrupt 8. Mailbox 9. Interrupt performance characteristics of ARM and FPGA 10. Flashing of LEDS 11. Interfacing stepper motor and temperature sensor 12. Implementing Zigbee protocol with ARM.

Course Code		L	T	P	C	IA	EA	TM
Course Name	VLSI DESIGN LABORATORY	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To learn Hardware Descriptive Language (Verilog/VHDL)
2. To learn the fundamental principles of VLSI circuit design in digitaland analog domain
3. To familiarize fusing of logical modules on FPGAs
4. To provide hands on design experience with professional design (EDA) platforms.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Write HDL code for basic as well as advanced digital integrated circuits	**K3**
CO2	Import the logic modules into FPGA Boards and carry out a series of validations of thedesign.	**K4**
CO3	Synthesize, Place and Route the digital IPs	**K4**
CO4	Design, Simulate and Extract the layouts of Analog IC Blocks using EDA tools.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LISTOF EXPERIMENTS

1. (a) Study of IC design flow using EDA tools of different vendors (b) Introduction to JTAG

FPGA Based Experiments:

2. HDL based design entry, Test bench creation and simulation of BCD counters PRBSgenerators, Comparators (min 4-bit) / Bothe multiplier / Carry select adder.
3. Synthesis, Placement and Routing (P&R) and post P&R simulation of the componentssimulated in (Expt. No. 2) above
4. Critical paths and static timing analysis results to be identified. Identify and verify possibleconditions under which the blocks will fail to work correctly.
5. Hardware fusing and testing of each of the blocks simulated in (Expt. 2). Use of either chipscope feature (Xilinx) or the signal tap feature (Altera) is a must.
6. Invoke the PLL and demonstrate the use of the PLL module for clock generation in FPGAs.

IC Design Experiments:

7. Design and PSPICE simulation of (a) Simple 5 transistor differential amplifier. Measure gain, BW, output impedance, ICMR, andCMRR. (b) Ring Oscillator
8. Layout generation, DRC and LVS Checking, Parasitic Extraction and Resimulation of CMOSInverter.
9. Synthesis and Standard cell-based design of a circuit simulated in (Expt. 7-b) above - Synthesis principles, Logical Effort, Interpreting Scripts, Constraints and Library preparationand generation, Boolean Optimization, Optimization for Area, Power.
10. For Expt. 7-b above, Floor Planning, Placement and Routing (P&R), Power and Clock Routing, and post P&R simulation
11. Static Timing analyses procedures and constraints. Critical path considerations.
12. DFT - Scan chain insertion / Clock Tree Synthesis / Stick diagrams.

SEMESTER - V

Course Code		L	T	P	C	IA	EA	TM
Course Name	COMPUTER ARCHITECTURE	2	1	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision					V.1.0	
Pre-requisite	Digital System Design, Microprocessors & Microcontrollers							

Course Objectives:

The course should enable the students

1. To familiarize with implementation of fixed point and floating-point arithmetic operations.
2. To study the design of data path unit and control unit for processor.
3. To understand the concept of various memories and I/O systems and interfacing.
4. To introduce the parallel processing technique and multi-core processors.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the basics structure of computers and instructions.	K3
CO2	Illustrate the fixed point and floating-point arithmetic for ALU operation.	K3
CO3	Discuss about implementation schemes of data-path and control units and pipelineperformance	K4
CO4	Explain the concept, interfacing and organization of of various memories and I/O systems.	K3
CO5	Discuss parallel processing technique and unconventional architectures.	K4

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

UNIT-I	STRUCTURE OF COMPUTERS AND INSTRUCTIONS	9Hours
Classification of computers and their characteristics –Functional units- Eight ideas — Performance, Instructions: Operations - Operands – Instruction representation – Logical operations – Decision making operations – Procedures: Stacks, Ques and Subroutines - Program translation.		
UNIT-II	**ARITHMETIC FOR COMPUTERS**	**9Hours**
Addition and Subtraction – Multiplication – Division – Floating Point arithmetic Operations – IEEE 754 floating point formats - Sub-word Parallelism		
UNIT-III	**PROCESSOR DATAPATH AND CONTROL UNITS**	**9Hours**
Fundamental concepts–Instruction execution –-Multiple bus organization – Data path–Hardwired control-Microprogrammed control, Pipelining – Pipelined data path and control, Data Hazards - Control Hazards – Exception handling		
UNIT-IV	**MEMORY AND I/O SYSTEMS**	**9Hours**
Memory Hierarchy – Review of memory technologies – Cache memory – Measuring and improving cache performance – Virtual memory - TLB's. Accessing I/O Devices – Interrupts – Direct Memory Access, Bus structure – Bus operation – Arbitration – Interface circuits - Standard I/O Interfaces – PCI, SCSI and USB.		
UNIT-V	**PARALLELISM**	**9Hours**
Parallel processing challenges, Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures, Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors. Introduction to Multiprocessor Network Topologies		
	Total Hours	**45Hours**

Text Book(s)

1.	David A. Patterson and John L. Hennessy, "Computer Organization and Design:The Hardware/Software interface", Fifth Edition, Morgan Kauffman / Elsevier, 2014.
2.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organizationand Embedded Systems", Sixth Edition, McGraw Hill, 2012.

Reference Book(s)

1.	Miles J. Murdocca and Vincent P. Heuring, —Computer Architecture and Organization: AnIntegrated approach‖, Second edition, Wiley India Pvt Ltd, 2015.
2.	William Stallings, "Computer Organization and Architecture – Designing for Performance",Eighth Edition, Pearson Education, 2010.
3.	John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill,2012.

Course Code		L	T	P	C	IA	EA	TM
Course Name	OPTICAL COMMUNICATION	2	1	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision				V.1.0		
Pre-requisite	Digital System Design, Microprocessors & Microcontrollers							

Course Objectives:

The course should enable the students

1. To learn the basic elements of optical fiber transmission link, fiber modes configurationsand structures.
2. To understand the different kind of losses, signal distortion, SM fibers.
3. To learn the various optical sources, materials and fiber splicing
4. To learn the fiber optical receivers and noise performance in photo detector.
5. To explore link budget, WDM, solitons and SONET/SDH network

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Demonstrate an understanding of optical fiber communication link, structure, propagation andtransmission properties of an optical fiber.	K5
CO2	Estimate the losses and analyze the propagation characteristics of an optical signal in differenttypes of fibers	K5
CO3	Describe the principles of optical sources and power launching-coupling methods.	K3
CO4	Compare the characteristics of fiber optic receivers.	K5

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	M	L	-	-	-	-	-	-	-	M	L	M	-	S
CO2	M	S	L	-	-	-	L	-	-	-	L	S	M	-	M
CO3	S	L	M	-	-	-	M	-	-	-	S	M	M	L	S
CO4	L	S	S	-	-	-	-	-	-	-	M	L	M	-	M

UNIT-I	INTRODUCTION TO OPTICAL FIBERS	9Hours
Evolution of fiber optic system- Element of an Optical Fiber Transmission link-- Total internal reflectionAcceptance angle –Numerical aperture – Skew rays Ray Optics-Optical Fiber Modes and Configurations -Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes -Single Mode Fibers-Graded Index fiber structure		
UNIT-II	SIGNAL DEGRADATION OPTICAL FIBERS	9Hours
Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, SignalDistortion in Optical Waveguides-Information Capacity determination -Group Delay- Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling -Design Optimization of SM fibers-RI profile and cut-off wavelength.		
UNIT-III	FIBER OPTICAL SOURCES AND COUPLING	9Hours
Direct and indirect Band gap Materials -LED structures -Light source materials -Quantum efficiencyand LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition – Rate equations-External Quantum efficiency -Resonant frequencies -Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers- Power Launching and coupling, Lencing schemes, Fiber -to- Fiber joints, Fiber splicing-Signal to Noise ratio , Detector response time.		
UNIT-IV	FIBER OPTIC RECEIVER AND MEASUREMENTS	9Hours
Fundamental receiver operation, Pre-amplifiers, Error sources – Receiver Configuration– Probabilityof Error – Quantum limit, Fiber Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber NumericalAperture Measurements – Fiber diameter measurements		
UNIT-V	OPTICAL NETWORKS AND SYSTEM TRANSMISSION	9Hours
Basic Networks – SONET / SDH – Broadcast – and –select WDM Networks –Wavelength Routed Networks – Non linear effects on Network performance –-Link Power budget -Rise time budget- Noise Effects on System Performance-Operational Principles of WDM Performance of WDM + EDFA system – Solutions – Optical CDMA – Solitons in Optical Fiber -Ultra High Capacity Networks.		
	Total Hours	45Hours

Text Book(s)

1. Gerd Keiser, “Optical Fiber Communication " Mc Graw-Hill International, 4th Edition.2010.
2. John M. Senior, “Optical Fiber Communication”, Second Edition, Pearson Education, 2007.

Reference Book(s)

1. Ramaswami, Sivarajan and Sasaki “Optical Networks”, Morgan Kaufmann, 2009
2. J.Senior, " Optical Communication, Principles and Practice ", Prentice Hall ofIndia, 3 rd Edition, 2008.
3. J.Gower, " Optical Communication System ", Prentice Hall of India, 2001.

Course Code		L	T	P	C	IA	EA	TM
Course Name	OPTICAL COMMUNICATION LABORATORY	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision						
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand the working principle of optical sources, detector, fibersand optical components
2. To develop understanding of simple optical communication link.
3. To learn about the characteristics and measurements in optical fibre
4. To understand the Various losses involved in OFC

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the working principle of optical sources, detector, fibers and microwavecomponents	K2
CO2	Develop understanding of simple optical communication link	K2
CO3	Learn about the characteristics and measurements in optical fibre	K2
CO4	Analyse the losses in Optical Fibre Communication	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LISTOF EXPERIMENTS

1. DC Characteristics of Light Emitting Diode
2. DC Characteristics of PIN Photo diode
3. Mode Characteristics of Fibers
4. Measurement of connector and bending losses
5. Analysis of Fiber optic Analog - frequency response (analog)
6. Analysis of Fiber optic Digital Link - eye diagram (digital)
7. Numerical Aperture determination for Optical Glass Fibers
8. Numerical Aperture determination of Plastic Fiber
9. Attenuation Measurement in Fibers
10. Bit error rate Measurement
11. Design of basic Optical Communication system using computational too
12. Study experiment – Optical Wavelength Multiple Access
13. Study of computational tools of Optical Communication

SEMESTER - VI

Course Code		L	T	P	C	IA	EA	TM
Course Name	INDUSTRIAL IOT	2	1	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	Syllabus Revision				V.1.0		
Pre-requisite	Computer Networks and Internet							

Course Objectives:

The course should enable the students

1. To focus on basics of Industrial Internet
2. To modify the various existing industrial systems
3. To get an idea about IIoT Architectures
4. To acquire the knowledge about various Network Protocols
5. To extract the backend Middleware Protocols

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Enhance the company's performance using IoT	
CO2	Demonstrate the different styles of technical and business innovators	
CO3	Examine various IIoT Architectures related to data management system	
CO4	Organize the design of Industrial Internet Systems	
CO5	Select various Software design patterns using API	
CO6	Construct a Middleware software system related to proximity edge networks.	

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	-	-	-	S	-	-	-	-	-	-	-	L	M
CO2	L	M	-	S	-	-	S	-	-	-	M	-	-	-	M
CO3	L	-	-	-	-	-	-	S	-	L	-	M	-	L	M
CO4	-	-	-	-	-	-	-	-	S	-	-	-	-	L	M
CO5	-	-	-	-	-	-	-	-	S	-	-	-	-	L	M
CO6	-	-	-	-	-	-	-	-	S	-	-	-	-	L	M

UNIT-I	INTRODUCTION TO INDUSTRIAL INTERNET	9Hours
Innovation and IIoT – Intelligent Devices – Industrial Internet – Health care –Oil and Gas Industry – Smart Office – Logistics – IoT Innovations in Retail.		
UNIT-II	**TECHNICAL AND BUSINESS INNOVATORS OF INDUSTRIAL INTERNET**	**9Hours**
Miniaturization – Cyber Physical Systems – Wireless technology – IP Mobility – Network Functionality Virtualization – Cloud and Fog - Big Data and Analytics – M2M Learning and Artificial Intelligence.		
UNIT-III	IIOT REFERENCE ARCHITECTURE	9Hours
Industrial Internet Architecture Framework – Functional Viewpoint – Operational Domain, Information Domain, Application Domain, Business Domain – Implementation View point – Architectural Topology – Three Tier Topology – Data Management.		
UNIT-IV	INDUSTRIAL INTERNET SYSTEMS	9Hours
Introduction-Proximity Network Protocols – WSN Edge Node – Legacy Industrial Protocols – RS232 Serial Communications, 40-20ma Current Loop, Field Bus Technologies – Modern Communication Protocols – Industrial Ethernet – Industrial Gateways.		
UNIT-V	MIIDDLEWARE TRANSPORT PROTOCOL	9Hours
TCP/IP, UDP, RTP, CoAP –Middleware Software patterns –Software Design patterns – Application Programming Interface (API) – CAN Protocol-Web Services – Middleware IIoT – Securing the IIoT- Identity Access Management.		
	Total Hours	45Hours

Text Book(s)

1.	S. Misra, A. Mukherjee, and A. Roy, Introduction to IoT. Cambridge University Press, 2020
2.	S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.2020

Reference Book(s)

1.	Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights, 2014
2.	Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015

Professional Elective Courses

Course Code		L	T	P	C	IA	EA	TM
Course Name	ANTENNAS AND PROPAGATION	3	0	0	3	40	60	100
Course Category	PROFESSIONA LELECTIVE COURSE -I	Syllabus Revision				V.1.0		
Pre-requisite	BasicknowledgeofElectromagneticFieldsandWaveguides							

Course Objectives:

1. The course should enable the students:
2. To give insigh to fradiation phenomena and antenna parameters.
3. To give thorough understanding of the radiation characteristics of different types of antenna arrays.
4. To understand the concept of different types of aperture antennas.
5. To create awareness about different types of Special antennas and measurement of antennas.
6. To understand the concept of antennas propagation.

Course Outcomes:

Oncompletionofthe course,thestudentwill beable to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	AntennasParameters.	**K4**
CO2	Differenttypesofantennaarrays.	**K3**
CO3	Analyzetheapertureantennasandtheir types.	**K4**
CO4	DescribetheconceptsofSpecialAntennas.	**K2**
CO5	Describethedifferenttypesofpropagationinantennas.	**K4**

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												ProgramSpecific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	S	-	S	-	-	L	-	-	L	-	L	S	L	-
CO2	M	M	-	-	-	-	L	-	M	M	-	-	L	M	M
CO3	S	L	-	L	-	-	M	-	-		-	-	-	-	L
CO4	M	L	-	-	M	-	S	-	-	L	-	L	-	L	L
CO5	L	L	-	-	-	-	S	-	-	S	-	L	L	L	S

UNIT-I	FUNDAMENTALSOFRADIATION	9Hours
Definition of antenna parameters – Gain, Directivity, Effectiveaperture,RadiationResistance, Band width, Beam width, Input Impedance, MatchingBaluns,Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, Half wave dipole. Folded dipole.		
UNIT-II	**ANTENNAARRAYS**	**9Hours**
Nelementlineararray,Patternmultiplication,BroadsideandEndfirearray–ConceptofPhased arrays,Adaptivearray, BasicprincipleofantennaSynthesis-Binomialarray,YagiArrays.		
UNIT-III	**APERTUREANDSLOTANTENNAS**	**9Hours**
Radiationfromrectangularapertures,UniformandTaperedaperture,Hornantenna,Reflector antenna,Apertureblockage,Feedingstructures,Slotantennas,Microstripantennas–Radiation mechanism–Application,Numericaltoolforantennaanalysis.		
UNIT-IV	**SPECIALANTENNAS**	**9Hours**
Principle of frequency, independent antennas –Spiral antenna, helical antenna,Logperiodic, Modernantennas- Reconfigurableantenna, Active antenna, Dielectricantennas, Electronic band gapstructureandapplications,AntennaMeasurements-TestRanges,MeasurementofGain, Radiationpattern,Polarization,VSWR.		
UNIT-V	**PROPAGATIONOFRADIOWAVES**	**9Hours**
Modes of propagation , Structure of atmosphere , Ground wave propagation, Tropospheric propagation , Duct propagation, Troposcatter propagation , Flatearth andCurvedearthconcept Sky wave propagation – Virtual height, critical frequency , Maximum usable frequency – Skip distance, Fading , Multi hop propagation.		
	Total Hours	**45Hours**

Text Book(s)

1.	JohnDKraus,"AntennasforallApplications",4th Edition,McGrawHill,2010.

Reference Book(s)

1.	Edward C. Jordan and Keith G. Balmain" Electromagnetic Waves and Radiating Systems"Prentice Hall of India, 2nd Edition 2011.
2.	RajeswariChatterjee,"AntennaTheoryandPractice"RevisedSecondEditionNewAge International Publishers, 2006.
3.	Constantine.A.Balanis"AntennaTheoryAnalysisandDesign",WileyStudentEdition, 4th Edition, 2016.
4.	H.Sizun"RadioWavePropagationforTelecommunicationApplications",FirstIndianReprint, Springer Publications, 2007.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**INFORMATION THEORY AND CODING**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -I	**Syllabus Revision**				V.1.0		
Pre-requisite	BasicKnowledgeofAnalogandDigitalCommunication							

Course Objectives:

The course shouldenablethestudents:

1. To provide an insight into the concept of information in the context of communication theory and its significance in the design of communication receivers.
2. To explore in detail, the calculations of channel capacity to support error-free transmission and also, the most commonly used source coding and channel coding algorithms.
3. To encourage and train to design coding schemes for data compression and error correction,
4. They will also get an overall perspective of how this impacts the design of an optimum communication receiver.

Course Outcomes:

Oncompletionofthe course,thestudentwill beable to:

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Overview of Probability Theory, significance of "Information" with respect to Information Theory.	**K2**
CO2	Derive equations for entropy, mutual information and channel capacity for all kinds of channels.	**K3**
CO3	Implement the various types of source coding algorithms and analyze their performance.	**K4**
CO4	Explain various methods of generating and detecting different types of error correcting codes.	**K3**
CO5	Understand the fundamentals of Field Theory and polynomial arithmetic.	**K2**
CO6	Design linear block codes and cyclic codes (encoding and decoding)	**K3**

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes(PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	M	-	-	-	-	-	-	-	-	-	-	S	L	-
CO2	S	S	L	-	-	-	-	-	-	-	-	-	S	L	-
CO3	S	S	-	M	S	-	-	-	-	-	-	-	S	L	-

CO4	S	S	-	L	-	-	-	-	-	-	-	-	S	L	-
CO5	S	L	-	-	-	-	-	-	-	-	-	-	S	L	-
CO6	S	M	-	-	L	-	-	-	-	-	-	-	S	M	-

UNIT-I	**SOURCE CODIN GANDENTROPY**	**9Hours**
Definition and Examples- Uniquely Decodable Codes-Instantaneous Codes-Constructing Instantaneous Codes- Kraft's Inequality - McMillan Inequality- Information and Entropy-propertiesoftheEntropyfunction-EntropyandAverageWord-Length-Shannon-Fanocoding-EntropyofExtensionsandproducts-Shannon'sFirstTheorem.		

UNIT-II	**INFORMATION CHANNEL**	**9Hours**
Information Channel- Definitions- Binary Symmetric channel-System Entropies-systementropies fortheBinary Symmetric Channel Extension to Shannon's First Theoremto information channels- MutualIn formation-Mutual information for the Binary Symmetric channel-Channel Capacity.		

UNIT-III	**CHANNELS AND OPTIMAL CODES**	**9Hours**
Decision rules- Improved Reliability- hamming Distance- Statement and proof of Shannon's Theorem- Converse of Shannon's Theorem- Optimality-Binary Huffman Codes-Average Word- lengthofHuffmancodes-OptimallyofBinaryHuffmancodes-r-aryHuffmancodes-Extensions of source.		

UNIT-IV	**CYCLIC CODES**	**10Hours**
Description of cyclic codes- Generator and parity check matrices of Cyclic codes- Encoding of cycliccodes- Cyclic hamming codes- Syndrome Computation and error Detection- Decoding of cyclic codes- Cyclic Hamming Codes- Error- Trapping Decoding- Improved error-Trapping Decoding-The(23,12)Golaycode-shortenedCycliccodes-CyclicProductcodes-Quasi-Cyclic codes.		

UNIT-V	**CONVOLUTION ALARITHMETIC CODES**	**8Hours**
Encoding of Convolutional codes-Structural properties of Convolutional codes-Distance Properties of Convolutional codes.		
	Total Hours	**45Hours**

Text Book(s)

1. N.Abramson,"Information and Coding",McGrawHill,1963.
2. M.Mansurpur,"Introduction to InformationTheory",McGrawHill,1987.

Reference Book(s)

1. R.B.Ash,"InformationTheory",PrenticeHall,1970.
2. ShuLinand D.J.CostelloJr.,Error Control Coding,PrenticeHall,1983.
3. G.A.JonesandJ.MaryJones,"InformationandCodingTheory",SpringerSUMS.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**INTRODUCTION TO MEMS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -I	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic Knowledge of Integrated Circuits, Measurement & Instrumentation							

Course Objectives:

The course should enable the students

1. To introduce the concepts of micro and nano electromechanical devices.
2. To know the fabrication process of Microsystems.
3. To know the design concepts of micro sensors and micro actuators.
4. To understand application of MEMS in different industries & provides real-world case studies.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the historical background of MEMS development and the impact of MEMS on technology advancement.	**K2**
CO2	Recognize the use of materials in micro fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.	**K2**
CO3	Analyze the key performance aspects of electromechanical transducers including sensors and actuators.	**K3**
CO4	Analysis of micromachining technique for a specific MEMS fabrication process.	**K4**
CO5	Analysis of MEMS applications in different industries.	**K4**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes(PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	L	-	L	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	-	M	-	-	-	-	-	-	-	-	S	-	-
CO4	S	M	L	M	-	-	-	-	-	-	-	-	-	M	-
CO5	S	S	M	M	M	-	-	-	-	-	-	-	S	M	L

UNIT-I	**INTRODUCTION**	**9Hours**
IntroductionandHistoricalBackgroundofMEMSdevelopment,intrinsiccharacteristicsof MEMS,OverviewofMicrofabrication,MicroelectronicsFabricationProcessflow,Process selectionand Design.		
UNIT-II	**SENSORS AND ACTUATORS**	**9Hours**
Introduction to electrostatic sensors and actuators – parallel plate capacitors and applications – Inertia sensor, pressure sensor, flow sensor, tactile sensor, parallel-plate actuators, Thermal Sensors and actuators. Piezo resistive sensors – piezo resistive sensor materials, stress analysis of mechanical elements and applications. Piezoelectric sensing and actuators – Quartz, PZT, PVDF, ZnO.		
UNIT-III	**LITHOGRAPHY (LIGA) AND ETCHING TECHNIQUE**	**9Hours**
Lithography's origin, Overview of photolithography, Lithography sensitivity and intrinsic resist sensitivity, resolution in photolithography and its enhancement technique, Dry Etching: Definitions and Jargon, Physicaletching, plasma etching, Deepreactive Ion etching,Comparing WetandDryetching.		
UNIT-IV	**SURFACE MICRO MACHINING**	**9Hours**
Introduction,MechanicalpropertiesofThinfilms,SurfaceMicromachiningprocesses,Poly-Si surfaceMicromachiningmodifications,comparisonofbulkmicromachiningandsurface micromachining. Top-Down and Bottom-Up micromachining technique.		
UNIT-V	**APPLICATIONS AND CASE-STUDIES**	**9Hours**
MEMSinAutomotivemarket,MEMSinMedicalandBiomedicalMarket,Environmental Monitoring,Industrial/Automation,IT/Peripheral,Telecommunication.CASE-STUDIES:Blood Pressure (BP) Sensor, Microphone, Acceleration sensor, Gyros.		
	Total Hours	**45Hours**

Text Book(s)

1.	"Foundation of MEMS" Chang Liu, Second Edition, Parson, 2012.
2.	"Fundamentals of Micro fabrication – The Science of Miniaturization" Marc J.Madou, Second Edition, CRC Press, 2011.

Reference Book(s)

1.	"Micro and Smart Systems" – Anantha suresh & Gopal Krishnan - Wiley India
2.	"Microsystem Design" - S.D.Senturia, Kluwer Academic Publishers.
3.	"MEMS and Microsystems Design and Manufacture", Tai Ran Hsu,TataMcraw Hill, 2002.
4.	"MEMS and NEMS: Systems, Devices, and Structures" Sergey Edward Lyshevski, CRC Press,2002.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**VLSI DESIGN**	3	0	0	3	40	60	100
Course Category	PROFESSIONA LELECTIVE COURSE -II	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Electronic Circuits and Digital System Design							

Course Objectives:

The course should enable the students:

1. To understand the principles of CMOS-VLSI technology and the design issues involvedat circuit, logic, layout, system level and to learn programmable logics.

Course Outcomes:

On completion of the course,the student will beable to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	❖ Learn the evolution of IC Technologies	K4
CO2	❖ Learn and analyze front end and back end of CMOS Circuits	K3
CO3	❖ Analyze circuit performance and logic circuits of CMOS	K4
CO4	❖ Understand design and testability for VLSI circuits	K2

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	S	-	S	-	-	L	-	-	L	-	L	S	L	-
CO2	M	M	-	-	-	-	L	-	M	M	-	-	L	M	M
CO3	S	L	-	L	-	-	M	-	-		-	-	-	-	L
CO4	M	L	-	-	M	-	S	-	-	L	-	L	-	L	L

UNIT-I	INTRODUCTION TO VLSI AND MOS TRANSISTOR THEORY	9Hours

Evolution of IC Technologies: SS1, MSI, LSI, VLSI, ULSI, and GLSI. The Moore's Law, MOS THEORY: TheMOS as switch - nMOS and pMOS. CMOS logic and its features, The nMOS Enhancement Transistor – Workingand Characteristics. Threshold voltage and Body effect of MOS. MOS device design equations (First order effects).

MOS INVERTERS: The CMOS inverter Transfer characteristics, Noise margin. The nMOS and pseudo-nMOSinverter, Tile BiCMOS Inverter, Tile CMOS Transmission gate

UNIT-II	CMOS PROCESSING TECHNOLOGY AND LAYOUTS	9Hours

Silicon Semiconductor fabrication technology, Fabrication forms and CMOS (Basic n-WELL process)

LAYOUTS AND DESIGN RULES: Layout based rules, Simple CMOS Stick Layout diagrams - Inverter, NAND, NOR gatesand Multiplexer. Scaling: Constant Field, and Constant voltage

UNIT-III	MOS CIRCUIT PERFORMANCE AND CMOS LOGIC CIRCUITS	9Hours

Sheet Resistance definition, MOS device capacitances – model, Distributed RC effects, switching characteristics - Rise time, fall time and Delay time. Stage ratio, Simple examples of Combinational and Sequential circuits usingCMOS: NANDI NOR gates, and Compound gates, Latches, and Registers.

UNIT-IV	SUB SYSTEM DESIGN AND TESTING	9Hours

General System Design-Design of ALU subsystems, Adder and Multipliers Memories - Static RAM, Control LogicImplementation using PLA's. Testing of VLSI circuits - Need for Testing, Fault models, and ATPG. Design forTestability (DFT) - Scan Based and Self-test approaches.

UNIT-V	PROGRAMMABLE LOGICS	9Hours

Basic ROM structures, PLAs, PALs, PLDs, Implementation of Traffic Light controller using PLD, FPGAs andCPLDs: XILINX and ALTERA series.

	Total Hours	45Hours

Text Book(s)

1. Neil Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design"-AddisonWesley,1998.
2. H Roth, Jr."Digital Systems Design using VHDL"-Thomson Learning, 2001.

Reference Book(s)

1. VLSI Design Principles- John P. Uyemura, John Wiley,2002.
2. E. Fabricious, Introduction to VLSI design, McGraw-Hill1990.
3. Wayne Wolf, Modern VLSI Design, Pearson Education, 2003.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MULTIMEDIA COMPRESSION TECHNIQUES**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -II	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Coding Theory and CommunicationSystems							

Course Objectives:

1.The course should enable the students
2. To have acomplete understanding of error–control coding.
3. To understand encoding and decoding of digital data streams.
4. To introduce methods for the generation of the secodes and their decoding techniques.
5. To have a detailed knowledge of compression and decompression techniques.
6. To introduce the concepts of multimedia communication.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Describe various multimedia components.	**K4**
CO2	Describe compression and decompressiont echniques.	**K4**
CO3	Apply the compression concepts in multimedia communication.	**K3**
CO4	Understand The VOIP Technology.	**K2**
CO5	Describe Multimedia Networking.	**K4**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S		-	-	S	-	-	-	-	-	-	-	M	-	-
CO2	S	M	-		S	-	-	-	-	-	-	L	M	L	S
CO3	S	L	-	-	M	-	-	-	-	-	-	L	L	M	S
CO4	S	S	S	-	M	-	-	-	-	-	-	M	L	M	L
CO5	S	S	-	-	M	-	-	-	-	-	-	M	M	M	M

UNIT-I	MULTIMEDIACOMPONENTS	9Hours
Introduction-Multimedia skills-Multimedia components and their characteristics-Text,sound, images, graphics,animation,video,hardware.		
UNIT-II	**AUDIOANDVIDEOCOMPRESSION**	**9Hours**
Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding- codeexcitedLPC-perpetual codingVideo compression–principles-H.261-H.263-MPEG1,2,and 4.		
UNIT-III	**TEXTANDIMAGECOMPRESSION**	**9Hours**
Compression principles-source encoders and destination encoders-lossless and lossy Compression-entropyencoding–source encoding-text compression–static Huffman coding dynamic coding–arithmetic coding– Lempel ziv-welsh Compression-image compression.		
UNIT-IV	**VOIPTECHNOLOGY**	**9Hours**
Basics of IP transport,VoIP challenges,H.323/SIP–Network Architecture,Protocols,Call establishment and release,VoIPandSS7,Quality of Service-CODECMethods-VOIP applicability.		
UNIT-V	**MULTIMEDIANETWORKING**	**9Hours**
Multimedia networking-Applications-streamed stored andaudio-making the best Effort service-protocols for real time interactive Applications-distributing multimedia eyond best effort service- Secluding and policing Mechanisms-integrated services-differentiated Services-RSVP.		
	Total Hours	**45Hours**

Text Book(s)

1.	FredHalshall“Multimedia communication-Applications,Networks,Protocols and Standards”, Pearson Education, 2007.

ReferenceBook(s)

1.	TayVaughan,“Multimedia:Makingitwork”,SeventhEdition,TMH,2008.
2.	Kurose and W.Ross “Computer Networking- a Top Down Approach”, Pearson Education, 2005.
3.	MarcusGoncalves“VoiceoverIPNetworks”,McGrawHill,1999
4.	KR.Rao, ZSBojkovic, DAMilovanovic,“Multimedia Communication Systems: Techniques, Standards, and Networks”, Pearson Education, 2007.
5.	R.Steimnetz,K.Nahrstedt,“Multimedia Computing,Communications and Applications”, Pearson Education,1995.

Course Code		L	T	P	C	IA	EA	TM
Course Name	NANO ELECTRONICS	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -II	Syllabus Revision				V.1.0		
Pre-requisite	Basic knowledge of Material Science and Electronics							

Course Objectives:

1. To learn and understand basic concepts of Nano electronics.
2. To know the techniques of fabrication and measurement.
3. To gain knowledge about Nanostructure devices and logic devices

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand various aspects of Nano-technology and the processes involved in making nanocomponents and material.	K2
CO2	Leverage advantages of the Nano-materials and appropriate use in solving practical problems.	K2

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	M	-	M	L	-	-	-	-	-	-	L	S	-	-
CO2	S	M	-	M	L	-	-	-	-	-	-	L	S	M	-

UNIT-I	INTRODUCTION TO NANO TECHNOLOGY	9Hours

Introduction to nano technology, meso structures, Basics of Quantum Mechanics: Schrodingerequation, Density ofStates. Particle in a box Concepts, Degeneracy, Band Theory of Solids, Kronig-Penny Model, Brillouin Zones

UNIT-II	CMOS SCALING AND ITS LIMITS	9Hours

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs,limits to scaling, system integration limits (interconnect issues etc.), Nano Materials - Measurement and Fabricationof Nano materials.

UNIT-III	FUNDAMENTALS OF NANOELECTRONICS	9Hours

Fundamentals of logic devices:- physical limits to computations; concepts of logic devices:- classifications – twoterminal devices – field effect devices – coulomb blockade devices – spintronics– quantum cellular automata – quantum computing – DNA computer; Ultimate computation: - powerdissipation limit – dissipation in reversible computation.

UNIT-IV	NANO STRUCTURE DEVICES	9Hours

Resonant Tunnelling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotubeelectronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices,Graphene, atomistic simulation.

UNIT-V	LOGIC DEVICES AND APPLICATIONS	9Hours

Logic Devices-Silicon MOSFETs-Ferroelectric Field Effect Transistors-Quantum Transport DevicesBased onResonant Tunnelling-Single-Electron Devices for Logic Applications-Superconductor Digital Electronics-QuantumComputing Using Superconductors-Carbon Nanotubes for Data Processing- Molecular Electronics. MEMS/NEMS,

Future applications and Trends

	Total Hours	45Hours

Text Book(s)

1.	G.W. Hanson, Fundamentals of Nano electronics, Pearson, 2009

Reference Book(s)

1.	W. Ranier, Nano electronics and Information Technology, Wiley-VCH, 2003.
2.	K.E. Drexler, Nano systems, Wiley, 1992.
3.	J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press,1998.
4.	C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	DIGITAL IMAGE & VIDEO PROCESSING	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -III	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Signals & Systems, Digital Signal Processing andDigital System Design							

Course Objectives:

1. To learn digital image fundamentals.
2. To be exposed to simple image processing techniques.
3. To be familiar with image compression and segmentation techniques
4. To represent image and video in form of features

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the image enhancement techniques	**K2**
CO2	Understand wavelets and image compression	**K3**
CO3	Understand the fundamentals of video processing	**K3**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	L	L	M	M	L	-	L	-	-	L	-	S	M	M	-
CO2	M	M	M	L	-	M	L	-	-	L	-	S	M	M	-
CO3	S	M	M	L	-	M	M	-	-	L	-	S	S	M	-

UNIT-I	DIGITAL IMAGE FUNDAMENTALS	9Hours
Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – ImageSensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - color models. –Neighborhood, adjacency, connectivity, distance measures.		
UNIT-II	**IMAGE ENHANCEMENT**	**9Hours**
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing andSharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform–Smoothing and Sharpeningfrequency domain filters – Ideal, Butterworth and Gaussian filters. ColorImage Processing-Color models–RGB,YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Colorimage smoothing and sharpening; ColorSegmentation.		
UNIT-III	**IMAGE RESTORATION AND SEGMENTATION**	**9Hours**
Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – NotchFilters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering Segmentation: Detection ofDiscontinuities–Edge Linking and Boundary detection – Region based segmentation- Morphological processingerosion and dilation.		
UNIT-IV	**WAVELETS AND IMAGE COMPRESSION**	**9Hours**
Wavelets and Multi-resolution image processing, wavelets and Sub band filter banks, wavelet packets, ImageCompression-Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossycompression- predictive and transform coding; Discrete Cosine Transform; Still imagecompression standards –JPEG and JPEG-2000		
UNIT-V	**VIDEO PROCESSING**	**9Hours**
Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full search,fast searchstrategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy –Group of pictures, frames, slices, macro-blocks and blocks; Elements of avideo encoder and decoder; Video codingstandards – MPEG and H.26X. Video Segmentation- Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation – motion-based; Video object detection and tracking		
	Total Hours	**45Hours**

Text Book(s)

1.	R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education,2008

Reference Book(s)

1.	Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 2nd edition,2004
2.	Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2011.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	WIRELESS SENSOR NETWORKS	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -III	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Data Communication Network							

Course Objectives:

1. To understand the basics of Wireless sensor Networks
2. To learn the Architecture of WSN
3. To understand the concept of Networking and Networking in WSN

Course Outcomes:

On completion of the course,the student will be able to

Course Outcome s	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand challenges and technologies for wireless networks	**K2**
CO2	Understand architecture and sensors	**K3**
CO3	Establishing infrastructure and simulations	**K4**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	M	L	-	-	-	-	-	-	-	-	-	-	L	-	-
CO2	S	M	-	-	-	-	-	-	-	-	-	-	M	-	-
CO3	S	M	L	-	L	-	-	-	-	-	-	-	-	-	-

UNIT-I	OVERVIEW OF WIRELESS SENSOR NETWORKS	**9Hours**

Single-Node Architecture - Hardware Components- Network Characteristics- unique constraints andchallenges,Enabling Technologies for Wireless Sensor Networks- Types of wireless sensor networks.

UNIT-II	ARCHITECTURES	**9Hours**

Network Architecture- Sensor Networks-Scenarios- Design Principle, Physical Layer and Transceiver DesignConsiderations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and ExecutionEnvironments- introduction to Tiny OS and nesC- Internet to WSN Communication

UNIT-III	NETWORKING SENSORS	**9Hours**

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, -BMAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts,Address and Name Management, Assignment of MAC Addresses, RoutingProtocols Energy-Efficient Routing,Geographic Routing.

UNIT-IV	INFRASTRUCTURE ESTABLISHMENT	**9Hours**

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT-V	SENSOR NETWORK PLATFORMS AND TOOLS	**9Hours**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms,Node levelSimulators, State-centric programming.

Total Hours	**45Hours**

Text Book(s)

1.	Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless SensorNetworks", John Wiley,2005.
	Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks – An InformationProcessing Approach", Elsevier,2007.
	Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks -Theory And Practice”,By John Wiley & Sons Publications, 201

Reference Book(s)

1.	KazemSohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks-Technology,Protocols, AndApplications”, John Wiley, 2007.
2.	Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**ASIC DESIGN**	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -III	Syllabus Revision					V.1.0	
Pre-requisite	Basic knowledge of Digital System Design and VLSI							

Course Objectives:

1. To understand the programmable logic devices.
2. To understand the logic of chip design.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the chip design	K2
CO2	Understand the concept of IC floor planning, Placement and routing.	K5

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	M	M	L	-	L	-	-	-	-	M	-	S	M	S
CO2	S	M	M	-	-	L	-	-	-	-	M	-	S	M	S

UNIT-I	INTRODUCTION TO ASICS, CMOS LOGIC & ASIC LIBRARY DESIGN	9Hours

Types of ASICs - Design flow - CMOS transistors CMOS Design rules - Combinational LogicCell – Sequentiallogic cell - Data path logic cell - Transistors as Resistors – Transistor Parasitic Capacitance- Logical effort –Librarycell design - Library architecture.

UNIT-II	PROGRAMMABLE ASICS, ASIC LOGIC CELLS AND ASIC I/O CELLS	**9Hours**
Anti-fuse - static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT- Xilinx LCA – AlteraFLEX-Altera MAX DC & AC inputs and outputs-Clock & Power inputs- Xilinx I/O blocks.		
UNIT-III	PROGRAMMABLE ASIC INTERCONNECT, ASIC DESIGN SOFTWARE AND LOW-LEVELDESIGN ENTRY	**9Hours**
Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 – Altera FLEX –Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation.		
UNIT-IV	LOGIC SYNTHESIS, SIMULATION AND TESTING	**9Hours**
Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test- fault simulation - automatic test pattern generation		
UNIT-V	ASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT & ROUTING	**9Hours**
System partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow–global routing-detailed routing-special routing-circuit extraction -DRC.		
	Total Hours	**45Hours**

Text Book(s)

1.	M.J.S .Smith, "Application Specific Integrated Circuits, Addison -Wesley Longman Inc.,1997.

Reference Book(s)

1.	Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach,Prentice Hall PTR,2003.
2.	Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.
3.	R. Rajsuman, System-on-a-Chip Design and Test. Santa Clara, CA: Artech HousePublishers,2000.
4.	F.Nekoogar. Timing Verification of Application-Specific Integrated Circuits (ASICs). Prentice Hall PTR,1999.

Course Code		L	T	P	C	IA	EA	TM
Course Name	ADVANCED MICRO CONTROLLERS	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -III	Syllabus Revision				V.1.0		
Pre-requisite	Basic knowledge of Microprocessors and Microcontrollers							

Course Objectives:

1. To study the properties and evolution of RISC and CISC processors.
2. To study the architecture addressing modes and instruction set of R8C microcontroller.
3. To impart knowledge on embedded software development.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcmoes	Description	Highest Bloom's Taxonomy
CO1	Explain RISC and CISC properties	K3
CO2	Interfacing using CAN bus	K3
CO3	System design based on microcontroller	K3

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	S	-	-	-	-	-	-	-	-	L	S	-	-
CO2	S	S	S	-	-	-	-	-	-	-	-	L	S	-	-
CO3	S	S	S	-	-	-	-	-	-	-	-	L	S	-	-

UNIT-I	RISC PROCESSORS	9Hours
RISC Vs CISC, RISC properties and evolution, Advanced RISC microcontrollers, PIC 8-bit Microcontrollers		
UNIT-II	**R8C 16-BIT MICROCONTROLLER**	**9Hours**
The R8C Architecture, CPU Registers, Instruction Set, On-Chip Peripherals, R8C Tiny Development Tools, ADC,PWM, UART, Timer Interrupts, System design using R8C Microcontroller.		
UNIT-III	**MSP430 16 - BIT MICROCONTROLLER**	**9Hours**
The MSP430 Architecture, CPU Registers, Instruction Set, On-Chip Peripherals, MSP430 Development Tools,ADC, PWM, UART, Timer Interrupts, System design using MSP430 Microcontroller.		
UNIT-IV	**EMBEDDED SOFTWARE DEVELOPMENT**	**9Hours**
Cross development tools, Debugging techniques, Real-time Operating System, Memory Management, schedulingtechniques.		
UNIT-V	**VSYSTEM DEVELOPMENT**	**9Hours**
Microcontroller based System Design, Peripheral Interfacing, Inter-Integrated Circuit Protocol for RTC,EEPROM, ADC/DAC, CAN BUS interfacing, Application in Automobiles, Robotic and consumer Electronics		
	Total Hours	**45Hours**

Text Book(s)

1.	Julio Sanchez Maria P.Canton, Microcontroller Programming: Themicrochip PIC, CRCPress, Taylor & FrancisGroup,2007.

Reference Book(s)

1.	D. E. Simon, An Embedded Software Primer¦, Addison-Wesley, 1999.
2.	Wayne Wolf, Computers as Components: Principles of Embedded Computing SystemDesign, Morgan KaufmanPublishers, 2006.
3.	John H.Davis, MSP 430 Micro controller basics¦ Elsevier, 2008.

Course Code		L	T	P	C	IA	EA	TM
Course Name	MOBILE COMMUNICATION AND NETWORKS	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -IV	Syllabus Revision				V.1.0		
Pre-requisite	Basic knowledge of Digital Communication and Antennas							

Course Objectives:

1. To understand the issues involved in mobile communication system design and analysis.
2. To understand the concept of frequency reuse.
3. To understand the characteristics of wireless channels.
4. To know the fundamental limits on the capacity of wireless channels.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcoes	Description	Highest Bloom's Taxonomy
CO1	Understand the working principles of the mobile communication systems.	K4
CO2	Understand the relation between the user features and underlying technology.	K3
CO3	Analyze mobile communication systems for improved performance.	K3

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	M	M	L	-	-	-	-	M	S	-	L	S	M	S
CO2	S	M	S	M	-	-	-	-	M	L	-	M	S	M	M
CO3	M	L	S	L	-	-	-	-	L	M	-	M	S	L	M

UNIT-I	CELLULAR CONCEPTS	9Hours
Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity,power control; Wireless Standards: Overview of 2G and 3G cellular standards.		
UNIT-II	**THE WIRELESS CHANNEL**	**9Hours**
Signal Propagation-Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signalpropagation and lognormal shadowing. Fading channels -Multipath and small scale fading- Doppler shift, statisticalmultipath channel models, narrowband and wideband fading models,power delay profile, average and rms delayspread, coherence bandwidth and coherence time, flat andfrequency selective fading, slow and fast fading, averagefade duration and level crossing rate.		
UNIT-III	**ANTENNAS FOR MOBILE TERMINALS**	**9Hours**
Capacity of flat and frequency selective channels, Antennas- Antennas for mobile terminal monopoleantennas,PIFA, base station antennas and arrays		
UNIT-IV	**MULTI-ANTENNA COMMUNICATION**	**9Hours**
Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE andadaptive, DFE. Transmit Diversity-Altamonte scheme.		
UNIT-V	**MIMO AND MULTIPLEXING**	**9Hours**
MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff. Performancemeasures- Outage, average SNR, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.		
	Total Hours	**45Hours**

TextBook(s)

1.	WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.

ReferenceBook(s)

1.	WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
2.	Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
3.	AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
4.	VK Garg&JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	CMOS IC DESIGN	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -IV	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of VLSI Design							

Course Objectives:

1. To understand MOS Devices and CMOS IC's, Design of a CMOS Amplifier, CMOSoscillator circuits and comparators.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcmoes	**Description**	**Highest Bloom's Taxonomy**
CO1	Design different CMOS circuits using various logic families along with their circuit layout.	**K4**
CO2	Understand the concepts of MOS Design.	**K2**
CO3	Design and analysis of Combinational and Sequential MOS Circuits.	**K4**
CO4	Extend the Digital IC Design to Different Applications.	**K3**
CO5	Understand the Concepts of Semiconductor Memories, Flash Memory, RAM array organization.	**K3**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	M	M	L	-	L	-	-	-	-	-	-	S	M	M
CO2	S	M	M	-	-	L	L	-	M	-	L	-	S	M	M
CO3	S	M	M	L	-	M	-	-	M	-	M	-	S	L	M
CO4	S	M	M	L	-	M	-	-	M	-	M	-	S	L	M
CO5	S	M	M	-	-	M	-	-	-	-	L	-	S	M	M

UNIT-I	INTRODUCTION, DESIGN ISSUES AND MANUFACTURING PROCESS	**9Hours**

A Historical Perspective, Issues in Digital Integrated Circuit Design, Quality Metrics of a Digital Design,Introduction to Manufacturing Process, Manufacturing CMOS Integrated Circuits, IntegratedCircuit Layout: DesignRules, Parasitics.

UNIT-II	INTERCONNECT AND DELAY MODELS	**9Hours**

Interconnect Modelling: Capacitive Parasitics, Resistive Parasitics, Inductive Parasitics, Advanced InterconnectTechniques.

Delay Model & Robustness: Introduction, RC Delay model, Linear Delay model, logical path effortsof paths.Robustness: Variability- Reliability- Scaling-Variation Tolerant design.

UNIT-III	COMBINATIONAL CIRCUIT DESIGN	**9Hours**

Review of Circuit Families, Circuit pitfalls and Fallacies- the CMOS Inverters and CMOS Logic Gates – StaticView:Introduction to CMOS Inverter, The Static CMOS Inverter – An Intuitive Perspective, Evaluating theRobustness of the CMOS Inverter, Introduction to Static CMOS Design, Complementary CMOS, Ratioed Logic,Pass-Transistor Logic. CMOS Inverter: Dynamic View: Performance of CMOS Inverter: The Dynamic Behaviour,Power, Energy, and Energy-Delay, Perspective: Technology Scaling and its Impact on the Inverter Metrics

UNIT-IV	SEQUENTIAL CIRCUIT DESIGN	**9Hours**

Static and Dynamic Sequential Circuits -Static Latches and Registers, Dynamic Latches and Registers, AlternativeRegister Styles: Pulse Registers and Sense-Amplifier Based Registers, Pipelining: An Approach to OptimizeSequential Circuits – Latch Vs Register-Based Pipelines – A Logic Style for Pipelined Structures, Non bistableSequential Circuits

UNIT-V	DESIGN OF ABB AND MEMORY STRUCTURES	**9Hours**

Arithmetic Building Blocks: Introduction, Data paths in Digital Processor Architecture, The Adder,The Multiplier,The Shifter, Other Arithmetic Operators, Power and Speed Trade-off's in Data path Structures, Perspective: Designas a Trade-offMemory and Array Structures: Introduction, The Memory Core, Memory Peripheral Circuitry, MemoryReliability and Yield, Power Dissipation in Memories, Case Studies in Memory Design: ThePLA, A 4-Mbit SRAM and A 1-Gbit NAND Flash memory, Perspective: Semiconductor Memory Trends and Evolution.

	Total Hours	**45Hours**

Text Book(s)

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits – ADesign Perspective,2nd edn., Pearson Education, 2003.
2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan,Borivoje Nikolic, 2nd Ed., PHI.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**

Course Name	SPEECH AND AUDIO PROCESSING	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -IV	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge Signal & Systems and Digital Signal Processing							

Course Objectives:

1. To introduce speech production and related parameters of speech.
2. To learn the computation and use of techniques in the analysis of speech.
3. To understand different speech modelling procedures and their implementation issues.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcoes	Description	Highest Bloom's Taxonomy
CO1	Mathematically model the speech signal	**K2**
CO2	Analyze the quality and properties of speech signal.	**K3**
CO3	Modify and enhance the speech and audio signals.	**K4**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	L	-	L	-	-	-	-	-	-	-	-	S	S	L
CO2	S	M	-	L	-	-	-	-	-	-	-	-	S	M	-
CO3	S	M	L	M	M	-	-	-	-	-	-	-	M	S	L

UNIT-I	INTRODUCTION TO SPEECH PRODUCTION AND MODELING	9Hours
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. SpeechSignal 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**	**9Hours**
Basic concepts of linear prediction; Linear Prediction Analysis of nonstationary signals –prediction gain, examples;Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.		
UNIT-III	**SPEECH QUANTIZATION**	**9Hours**
Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer,differentialquantizers; Vector quantization – distortion measures, codebook design, codebook types		
UNIT-IV	**SCALAR QUANTIZATION OF LPC**	**9Hours**
Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Linespectral frequency – LPC to LSF conversions, quantization based on LSF Linear Prediction Coding- LPC model ofspeech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model.		
UNIT-V	**CODE EXCITED LINEAR PREDICTION**	**9Hours**
CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders;Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebooksearch; Low Delay CELP and algebraic CELP. Speech Coding Standards-An overview of ITU-T G.726, G.728 andG.729 standards		
	Total Hours	**45Hours**

Text Book(s)

1. "Digital Speech" by A.M.Kondoz, Second Edition, Wiley, 2004.
2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu,Wiley Inter science, 2003.

Reference Book(s)

1. Ben Gold And Nelson Morgan, "Speech And Audio Signal Processing, Processing AndPerception Of Speech
And Music", Wiley- India Edition, 2006.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	HIGH SPEED ELECTRONICS	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -IV	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic Knowledge in Electronic Circuits and Transmission Lines							

Course Objectives:

1. To understand the importance of high-speed electronics circuits in various applications.
2. To learn the characteristics of various components used in high speed electronics
3. To implement the design of High-speed electronic system using those components.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcmoes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand significance and the areas of application of high-speed electronics circuits.	**K2**
CO2	Understand the properties of various components used in high speed electronics	**K2**
CO3	Design High-speed electronic system using appropriate components.	**K2**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	L	S	M	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	L			-	-	-	-	-	-	-	L	L	-	-
CO3	S	L	S	-	-	-	-	-	-	-	-	L	M	L	

UNIT-I	TRANSMISSION LINE THEORY CROSSTALK AND NONIDEAL	**9Hours**

	EFFECTS	
Signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency powerdelivery, methodologies for design of high speed buses; radiated emissions and minimizing system noise;		
UNIT-II	**DEVICES**	**9Hours**
Passive and active, Lumped passive devices (models), Active (models, low vs. high frequency		
UNIT-III	**RF AMPLIFIER**	**9Hours**
Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers,Class A, B,AB andC, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages Mixers –Upconversion Down conversion, Conversion gain and spurious response. Oscillators		
UNIT-IV	**PRINCIPLES**	**9Hours**
PLL Transceiver architectures Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication,Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control andDesign challenges		
UNIT-V	**NOISE ANALYSIS**	**9Hours**
Sources, Noise Figure, Gain compression, Harmonic distortion, Inter-modulation, Cross-modulation,Dynamicrange.		
	Total Hours	**45Hours**

TextBook(s)

1. Stephen H. Hall, Garrett W. Hall, James A. McCall “High-Speed Digital System Design: AHandbook ofInterconnect Theory and Design Practices”, August 2000, Wiley-IEEE Press.
2. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, CambridgeUniversity Press, 2004.
3. Behzad Razavi, “RF Microelectronics”, Prentice-Hall 1998

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**

Course Name	BIO-MEDICAL ELECTRONICS	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -V	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic Knowledge in Electronic Devices and Circuits							

Course Objectives:

1. To learn the electrical and non-electrical physiological measurements
2. To understand the function of bio amplifiers.
3. To know the configuration of various electrodes

Course Outcomes:

On completion of the course,the student will be able to

Course Outcoes	Description	Highest Bloom's Taxonomy
CO1	Perform electrical and non-electrical physiological measurements	**K2**
CO2	Explain the function of bio amplifiers.	**K2**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	L	-	-	S	L	-	M	-	S	M	M	L	S
CO2	S	L	M	-	-	S		-	M	-	M	M	M	L	S

UNIT-I	BIO POTENTIAL ELECTRODES	9Hours

Origin of bio potential and its propagation, Electrode-electrolyte interface, electrode–skin interface, half cellpotential, impedance, polarization effects of electrode – non polarizable electrodes. Types ofelectrodes - surface,needle and micro electrodes and their equivalent circuits, Recording problems - measurement with two electrodes

UNIT-II	ELECTRODE CONFIGURATIONS	9Hours

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12lead system.EEG – 10-20 electrode system, unipolar, bipolar and average mode, EMG– unipolar andbipolar mode

UNIT-III	BIO AMPLIFIER	9Hours

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECGamplifier. Bandpass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrieramplifier. Chopper amplifier, Power line interference

UNIT-IV	MEASUREMENT OF NON-ELECTRICAL PARAMETERS	9Hours

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method,oscillometric method, direct methods: electronic manometer, Pressure amplifiers- systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermaldilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT-V	BIO-CHEMICAL MEASUREMENT	9Hours

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), immunologically sensitiveFET(IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer,blood cell counter, auto analyzer (simplified schematic description).

	Total Hours	45Hours

TextBook(s)

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons,2004.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 2003.

ReferenceBook(s)

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", PHI, 2007.
2. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGrawHill,2003.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	ADAPTIVE SIGNAL PROCESSING	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -V	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic Knowledge in Signals & Systems and Digital Signal Processing							

Course Objectives:

1. To learn the significance of real time changing control parameters.
2. To understand the representation of 'adaptability requirement'.
3. To understand the mathematical modelling of various signalprocessing systems.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcmoes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the non-linear control and the need and significance of changing the controlparameters w.r.t. real-time situation.	**K3**
CO2	Mathematically represent the 'adaptability requirement'.	**K2**
CO3	Understand the mathematical treatment for the modelling and design of the signal processingsystems.	**K3**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	M	L	L	L	L	-	-	-	-	-	-	M	-	-
CO2	S	M	L	M	L	L	-	-	-	-	-	-	M	-	-
CO3	S	L	M	S	L	L	-	-	-	-	-	-	S	-	-

UNIT-I	INTRODUCTION TO ASP	9Hours
General concept of adaptive filtering and estimation, applications and motivation, Review of probability, randomvariables and stationary random processes, Correlation structures, properties of correlation matrices.		
UNIT-II	**LMS AND FILTERS**	**9Hours**
Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued The LMS algorithm (real,complex), convergence analysis, weight error correlation matrix, excess mean squareerror and MIS-adjustment		
UNIT-III	**LMS ALGORITHM**	**9Hours**
Variants of the LMS algorithm the sign LMS family, normalized LMS algorithm, block LMS and FFT basedrealization, frequency domain adaptive filters, Sub-band adaptive filtering. Signal space concepts - introduction tofinite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner productspace, orthogonality, Gram Schmidt orthogonalization, concepts of orthogonal projection, orthogonaldecomposition of vector spaces.		
UNIT-IV	**RANDOM VARIABLES**	**9Hours**
Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic latticefilters, recursive updating of forward and backward prediction errors, relationship with AR modelling, joint processestimator, gradient adaptive lattice.		
UNIT-V	**INTRODUCTION TO RECURSIVE LEAST SQUARES**	**9Hours**
Vector space formulation of RLS estimation, pseudo inverse of a matrix, time updating of inner products,development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affineprojection and subspacebased adaptive filters, partial update algorithms, QR decomposition and systolic array.		
	Total Hours	**45Hours**

TextBook(s)

1.	S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2.	C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.
3.	Adaptive Signal Processing, Bernie Widrow and Stearns, Prentice Hall
4.	Fundamentals of Adaptive Filtering, Ali Sayed, Wiley, 2003

Course Code		L	T	P	C	IA	EA	TM
Course Name	RF DESIGN	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -V	Syllabus Revision				V.1.0		
Pre-requisite	Basic knowledge of Electronic Circuits and Microwave Engineering							

Course Objectives:

1. To understand the characteristics of active/passive RF devices and components.
2. To learn the characteristics of RF filters.
3. To learn the design of RF amplifiers and Oscillators.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcoes	Description	Highest Bloom's Taxonomy
CO1	Use the active/ passive RF devices and components for various applications.	K2
CO2	Analyze the RF filter and Oscillator design.	K2

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	M	M	M	-	L	-	-	-	L	-	M	M	M	L
CO2	M	M	M	M	-	L	-	-	-	L	-	M	S	M	L

UNIT-I	**RF ISSUES**	**9Hours**
Importance of RF design, Electromagnetic Spectrum, RF behaviour of passive components, Chip components andCircuit Board considerations, Scattering Parameters, Smith Chart and applications		
UNIT-II	**RF FILTER DESIGN**	**9Hours**
Overview, Basic resonator and filter configuration, Special filter realizations, Filter implementations, Coupled filter.		
UNIT-III	**ACTIVE RF COMPONENTS & APPLICATIONS**	**9Hours**
RF diodes, BJT, RF FETs, High electron mobility transistors; Matching and Biasing Networks – Impedancematching using discrete components, Micro-strip line matching networks, Amplifier classes of operation andbiasing networks		
UNIT-IV	**RF AMPLIFIER DESIGNS**	**9Hours**
Characteristics, Amplifier power relations, Stability considerations, Constant gain circles, Constant VSWR circles,Low Noise circuits, Broadband, high power and multistage amplifiers.		
UNIT-V	**OSCILLATORS, MIXERS & APPLICATIONS**	**9Hours**
Basic Oscillator model, High frequency oscillator configuration, Basic characteristics of Mixers; Phase LockedLoops; RF directional couplers and hybrid couplers; Detector and demodulator circuits.		
	Total Hours	**45Hours**

Text Book(s)

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications,Pearson Education Asia, First Edition, 2001.
2. Pozar, Microwave Engineering, John Wiley, Third Edition, 2004.

Reference Book(s)

1. Joseph. J. Carr, Secrets of RF Circuit Design, McGrawHill, Third Edition, 2000.
2. .Mathew M . Radmanesh, Radio Frequency & Microwave Electronics, Pearson, 2001..

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	NEURAL NETWORKS & FUZZYLOGIC	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -VI	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Mathematics, Data Communication and Networks							

Course Objectives:

1. To learn the various architectures of building an ANN and its applications
2. To learn advanced methods of representing information in ANN like self-organizingnetworks, associative andcompetitive learning
3. To learn the fundamentals of Crisp sets, Fuzzy sets and Fuzzy Relations

Course Outcomes:

On completion of the course,the student will be able to

Course Outcmoes	**Description**	**Highest Bloom's Taxonomy**
CO1	Learn the various architectures of building an ANN and its applications	**K2**
CO2	Learn the Fundamentals of Crisp sets, Fuzzy sets and Fuzzy Relations	**K2**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	**S**	**M**	**S**	**M**	**S**	**L**	**-**	**-**	**-**	**-**	**-**	**L**	**L**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**S**	**L**

UNIT-I	INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS	**9Hours**
Neuro-physiology - General Processing Element - ADALINE - LMS learning rule – MADALINE – XOR Problem– MLP - Back Propagation Network - updation of output andhidden layer weights - application of BPN.		
UNIT-II	ASSOCIATIVE MEMORY & CPN	**9Hours**
Associative memory - Bi-directional Associative Memory – Hopfield memory - travelling sales man problemAnnealing, Boltzmann machine-learning–application-Counter Propagation network–architecture–trainingApplications		
UNIT-III	SELF ORGANIZING MAP & ART	**9Hours**
Self-organizing map - learning algorithm - feature map classifier – applications - architecture of AdaptiveResonance Theory - pattern matching in ART network		
UNIT-IV	CRISP SETS AND FUZZY SETS	**9Hours**
Introduction – crisp sets an overview – the notion of fuzzy sets –Basic concepts of fuzzy sets – classical logic andoverview – Fuzzy logic- Operations on fuzzy sets - fuzzy complement – fuzzy union – fuzzy intersectioncombinations of operations – general aggregation operations		
UNIT-V	FUZZY RELATIONS	**9Hours**
Crisp and fuzzy relations – binary relations – binary relations on a single set– equivalence and similarity relations–Compatibility or tolerance relations– orderings – morphisms-fuzzy relation equations.		
	Total Hours	**45Hours**

Text Book(s)

1.	Freeman J.A. and Skapura B.M., "Neural Networks, Algorithms Applications andProgrammingTechniques", Addison-Wesley, 1990.
2.	George J Klir and Tina A Folger," Fuzzy sets, uncertainty and information", PHI, 1988.
3.	Laurene Fausett, "Fundamentals of Neural Networks: Architecture, Algorithms andApplications", Pearson Education, 1994.
4.	H.J. Zimmerman, "Fuzzy set theory and its Applications", Allied Publishers Ltd, 1996.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**4G LTE CELLULAR SYSTEMS**	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -VI	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Cellular Mobile Communication							

Course Objectives:

1. To categorize the current wireless cellular standards of LTE and LTE advanced.
2. To analyze the effective utilization of spectrum and RF requirements for LTE.
3. To discriminate the LTE Air Interface, OFDMA, MIMO, SDR and CoMP technology.
4. To describe the relay deployment and overview of WiMAX.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcoes	Description	Highest Bloom's Taxonomy
CO1	Describe the different standards of LTE and LTE –advanced such as SAE, EPC	K1
CO2	Discriminate 4G Technology.	K3
CO3	Differentiate relay schemes and compare LTE with WiMAX.	K3

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	L	S	-	S	-	-	-	-	-	L	-	L	S	-	L
CO2	M	M	-	-	-	-	-	-	M	M	-	-	L	-	M
CO3	S	L	-	S	-	-	M	-	-		-	L	M	-	L

UNIT-I	STANDARDIZATION OF LTE	9Hours
3rd Generation Partnership Project (3GPP); The 3G Evolution to 4G; Long Term Evolution (LTE) and SystemArchitecture Evolution (SAE), LTE and LTE-Advanced; LTE-Advanced E- UTRAN architecture; Protocol stack:NAS (Non- Access Stratum), RRC (Radio Resource Control), PDCP (Packet Data Convergence Protocol), RLC(Radio Link Control), MAC (Medium Access Control); Evolved Packet Stratum: Mobility Management Entity(MME), Serving Gateway (S- GW), Packet Data Network Gateway (PDN-GW).		
UNIT-II	**SPECTRUM AND RF CHARACTERISTICS**	**9Hours**
Carrier aggregation: LTE and LTE-Advanced carrier aggregation scenario; Control channels; Multiple accessscheme; Transceiver architecture; Spectrum sharing; Research challenges: Transceiver design; Increased FFT size,Resource management; Retransmission control; Overview of RF Requirements for LTE		
UNIT-III	**KEY 4G TECHNOLOGIES**	**9Hours**
OFDMA; SOFTWARE DEFINED RADIO, Enhanced MIMO, HANDOVER AND MOBILITY, Enhanced MIMO: Single-User MIMO (SU- MIMO): MIMO adaptive switching scheme. LTE- Advanced mainMIMO modes; Multi-User MIMO (MU-MIMO); Cooperative MIMO; Single- site MIMO: Advanced precodingconcept. Downlink MIMO transmission; Uplink MIMO transmission		
UNIT-IV	**COMP TRANSMISSION & RECEPTION**	**9Hours**
CoMP architecture: Centralized architecture, Distributed architecture, Mixed architectures: The CoMP schemes: Downlink, Uplink, Relays: Relay basic scheme, Relay deployment scenarios; Types; Duplexing schemes: Integration into RAN, Add-ons; BACKHAUL DESIGN FOR INBAND RELAYING.		
UNIT-V	**LTE VS WIMAX**	**9Hours**
WiMAX Overview: WiMAX Standards Evolution, WiMAX Deployment; Technology Comparison between LTEand WiMAX.		
	Total Hours	**45Hours**

Text Book(s)

1.	Erik Dahlman, Stefan Parkvall, John Skold, "4G: LTE Advanced for Mobile Broadband,Second Edition,2011.
2.	Erik Dahlman, Stefan Parkvall, John Skold, "4G, LTE Advanced Pro and The Road to5G", 3rd Edition.

Reference Book(s)

1.	Christopher Cox, Wiley, "An introduction to LTE: LTE Advanced, SAE and 4G MobileCommunication, 2012.

Course Code		L	T	P	C	IA	EA	TM
Course Name	ERROR CORRECTING CODES	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -VI	Syllabus Revision					V.1.0	
Pre-requisite	Basic Knowledge of Analog and Digital Communication							

Course Objectives:

1. To understand about the concepts of various types of error sources
2. To learn the error control coding techniques applied in the field of Digital Communication.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcmoes	Description	Highest Bloom's Taxonomy
CO1	Understand the error sources	K2
CO2	Understand error control coding applied in Digital Communication.	K2

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	M	S	M	-	-	-	-	-	-	L	L	S	M	L
CO2	S	M	S	M	-	-	-	-	-	-	L	L	S	M	L

UNIT-I	LINEAR BLOCK CODES	9Hours

Introduction- Mathematics of Binary Codes- Parity Checks- Systematic codes- Minimum HammingDistance of alinear block code- How to Encode - Generator Matrix-Encoding with parity check matrix- Decoding with paritycheck matrix- Decoding by Standard Array- Codec Design for linear Block Codes- Modifications to Block CodesDorsch Algorithm Decoding, Syndrome decoding on symmetric channels- Hamming codes- Weight enumeratorand the McWilliams identities; Perfect codes, Introduction to finite fields and finite rings- factorization of (Xn-1)over a finite field.

UNIT-II	CYCLIC CODES	**9Hours**

Introduction- Definition of a cyclic code- Example of a cyclic code- Polynomial Representation- Encoding byconvolution- Establishing the cyclic property -Deducing the properties of a cyclic code-PrimitivePolynomialsSystematic Encoding of cyclic codes- Syndrome of a cyclic code- Implementation of Encoding- Decoding-Decoderoperation - Multiple Error Correction-Example of Multiple Error Correction-Shortened Cyclic codes- ExpurgatedCyclic codes-Cyclic codes for Burst -Error correction- Spectral properties of cyclic codes.

UNIT-III	BCH CODES	**9Hours**

Introduction- Specifying Cyclic codes by roots-Definition of BCH codes-Construction of BCH codes-roots andparity check matrices- Algebraic Decoding- BCH Decoding and the BCH Bound- Decodingin the frequencydomainDecoding examples for binary BCH codes- Polynomial form of the key equation- Euclid's methodBerlekampMassey Algorithm- Massey's minimum shift register synthesistechnique and its relation to Berlekamp's algorithm- A fast Berlekamp - Massey algorithm.

UNIT-IV	REED SOLOMON CODES	**9Hours**

Introduction- Generator Polynomial for a Reed Solomon Code-Time domain encoding for Reed Solomon CodeDecoding Reed Solomon Codes- Reed Solomon Code Decoding Example-Frequency Domain Encoded ReedSolomon Code-Erasure Decoding- Generalized Minimum Distance Decoding-Welch-Berlekamp Algorithm- SinglyExtended Reed Solomon Codes-Doubly Extended Reed Solomon Codes- Justeen codes, MDS codes, Alterant,Goppa codes

UNIT-V	CONVOLUTION CODES	**9Hours**

Introduction- General properties of Convolutional codes- Generator Polynomials – Terminology- Encoder StateDiagram- Distance Structure of Convolutional codes-Evaluating Distance and weight Structures-MaximumLikelihood Decoding- Viterbi Algorithm- General properties –Example of viterbi decoding- issues arising- Practicalimplementations of viterbi decoding-Performance of Convolutional codes- Good Convolutional codes- puncturedConvolutional codes- Applications of Convolutional codes- codes for multilevel modulations-Wozencraft'ssequential decoding algorithm,Fann's algorithm.

Total Hours	**45Hours**

Text Book(s)

1.	F.J. McWilliams and N.J.A. Slone, "The theory of error correcting codes", 1977.
2.	.R.E. Balahut, "Theory and practice of error control codes", Addison Wesley, 1983
3.	Peter Sweeney, "Error Control Coding from theory to practice", John Wiley & Sons ltd, 2002.
4.	Shu Lin and D.J. Costello Jr., "Error Control Coding", Prentice Hall, 1983.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**VLSI TESTING**	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -VI	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Electronic Circuits and Microwave Engineering							

Course Objectives:

1. To understand the basics of testing and the testing equipments in VLSI
2. To understand the different testing methods in VLSI

Course Outcomes:

On completion of the course,the student will be able to

Course Outcoes	**Description**	**Highest Bloom's Taxonomy**
CO1	Explain different testing equipments.	**K2**
CO2	Design the different testing schemes for a circuit.	**K2**
CO3	Discuss the need for test process	**K3**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	S	-	-	L	-	-	-	-	-	-	L	L	-	S
CO2	S	S	L	M	M	-	-	-	-	-	-	L	M	M	S
CO3	S	S	L	M	M	-	-	-	-	-	-	L	M	M	S

UNIT-I	INTRODUCTION	**9Hours**
Test process and automatic test equipment, test economics and product quality, fault modelling		
UNIT-II	DIGITAL TESTING	**9Hours**
Logic and fault simulation, testability measures, combinational and sequential circuit test generation.		
UNIT-III	ANALOG TESTING	**9Hours**
Memory Test, DSP Based Analog and Mixed Signal Test, Model based analog and mixed signal test, delay test,IIDQ test.		
UNIT-IV	DESIGN FOR TESTABILITY	**9Hours**
Built-in self-test, Scan chain design, Random Logic BIST, Memory BIST, Boundary scan test standard, Analog testbus, Functional Microprocessor Test, Fault Dictionary, Diagnostic Tree, Testable System Design, Core BasedDesign and Test Wrapper Design, Test design for SOCs.		
UNIT-V	LOADED BOARD TESTING	**9Hours**
Unpowered short circuit tests, unpowered analog tests, Powered in-circuit analog, digital and mixed signal tests,optical and X-ray inspection procedures, functional block level design of in-circuit test equipment		
	Total Hours	**45Hours**

Text Book(s)

1.	Michael L. Bushnell and Vishwani D. Agarwal, “Essentials of Electronic Testing for Digital, Memory &Mixed-Signal VLSI Circuits”, Springer, 2006.

Reference Book(s)

1.	Dimitris Gizopouilos, “Advances in Electronic Testing”, Springer, 2006

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	SATELLITE COMMUNICATION	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -VII	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Antennas and Digital Communication							

Course Objectives:

1. To understand the basics of satellite orbits.
2. To understand the satellite segment and earth segment.
3. To analyze the various methods of satellite access.
4. To understand the applications of satellites

Course Outcomes:

On completion of the course,the student will be able to

Course Outcmoes	**Description**	**Highest Bloom's Taxonomy**
CO1	Analyze the satellite orbits.	**K2**
CO2	Analyze the earth segment and space segment.	**K2**
CO3	Design various satellite applications.	**K2**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	M	M	-	-	-	-	-	-	-	-	-	M	L	-
CO2	M	S	M	-	M	-	-	-	-	-	-	L	M	M	L
CO3	S	S	S	L	L	-	-	-	-	-	-	-	L	L	L

UNIT-I	SATELLITE ORBITS	9Hours
Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and nonGeo-stationary orbits – Look Angle Determination- Limits of visibility –eclipse- Sub satellite point –Sun transitoutage-Launching Procedures - launch vehicles and propulsion.		
UNIT-II	**SPACE SEGMENT AND SATELLITE LINK DESIGN**	**9Hours**
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion,Communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite Uplink andDownlink Analysis and Design, Link Power Budget, C/N calculation, G/T ratio-Performance Impairments-Systemnoise, Inter-modulation Noise, Noise Temperature, Propagation Factors, Rain and Ice effects, Polarization.		
UNIT-III	**EARTH SEGMENT**	**9Hours**
Introduction – Receive – Only home TV systems (TVRO) – Outdoor UNIT – Indoor UNIT for analog(FM) TV – Master antenna TV system (MATV) – Community Antenna TV system (CATV) – Transmit – Receive earthstations, Antennas, Terrestrial Interface, Equipment Measurements on G/T,C/N, EIRP, Antenna Gain.		
UNIT-IV	**SATELLITE ACCESS**	**9Hours**
Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast,multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression –encryption.		
UNIT-V	**SATELLITE APPLICATIONS**	**9Hours**
INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, SatelliteNavigational System. Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast(DAB)- World space services, Business TV (BTV), GRAMSAT, Specialized services – E –mail, Videoconferencing, Internet.		
	Total Hours	**45Hours**

Text Book(s)

1.	Dennis Roddy, "Satellite Communication", Fourth Edition, McGraw Hill, 2006.
2.	Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite CommunicationSystemsEngineering", Prentice Hall, 2007.
3.	N. Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
4.	M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan, 2003.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	RADAR AND NAVIGATIONAL AIDS	3	0	0	3	40	60	100
Course Categoy	PROFESSIONAL ELECTIVE COURSE -VII	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Antenna Propagation and Digital communication							

Course Objectives:

1. To understand Doppler principle for target detection in Radars
2. To understand Principles of antennas and propagation related to radars along with studyof transmitters andreceivers.
3. To understand principles of navigation, in addition to approach and landing aids relatedto navigation

Course Outcomes:

On completion of the course,the student will be able to

Course Outcoes	**Description**	**Highest Bloom's Taxonomy**
CO1	Explain the principles of navigation	**K2**
CO2	Derive and discuss the range equation and nature of detection	**K2**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	**S**	**M**	**M**	**M**	**L**	**L**	**-**	**-**	**-**	**-**	**-**	**L**	**L**	**S**	**M**
CO2	**S**	**S**	**S**	**S**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**L**	**L**	**S**	**M**

UNIT-I	INTRODUCTION TO RADAR EQUATION	**9Hours**

Introduction- Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies– Applications of Radar – The Origins of Radar - Detection of Signals in Noise- Receiver Noise and the SignaltNoise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of RadarPulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse RepetitionFrequency- Antenna Parameters- System losses – Other Radar Equation Considerations.

UNIT-II	**MTI AND PULSE DOPPLER RADAR**	**9Hours**

Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies – DopplerFilter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI froma Moving Platform (AMIT) – Pulse Doppler Radar – Other Doppler Radar Topics- Tracking with Radar – Monopulse Tracking –Conical Scan and Sequential Lobing – Limitations to Tracking Accuracy - Low-AngleTracking - Tracking in Range - Other Tracking Radar Topics - Comparison of Trackers - Automatic Trackingwith Surveillance Radars(ADT).

UNIT-III	**DETECTION OF SIGNALS IN NOISE**	**9Hours**

Matched –Filter Receiver –Detection Criteria – Detectors –-Automatic Detector - Integrators - Constant-FalseAlarm Rate Receivers - The Radar operator - Signal Management - Propagation Radar Waves – AtmosphericRefraction -Standard propagation - Nonstandard Propagation - The Radar Antenna - Reflector Antennas -Electronically Steered Phased Array Antennas – Phase Shifters- Frequency-Scan Arrays Radar Transmitters andReceivers - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron – CrossedField Amplifiers -Other RF Power Sources – Other aspects of Radar Transmitter.- The Radar Receiver -Receivernoise Figure – Super heterodyne Receiver - Duplexers and Receiver Protectors- Radar Displays.

UNIT-IV	**RADIO DIRECTION AND RANGES**	**9Hours**

Introduction - Four methods of Navigation.- The Loop Antenna - Loop Input Circuits - An Aural Null DirectionFinder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at VeryHigh Frequencies - Automatic Direction Finders – The Commutated Aerial Direction Finder - Range and Accuracyof Direction Finders - The LF/MF Four course Radio Range - VHF Omni Directional Range (VOR) – VORReceiving Equipment - Range and Accuracy of VOR – Recent Developments. Hyperbolic Systems of Navigation(Loran and Decca) - Loran-A - Loran-A Equipment - Range and precision of Standard Loran - Loran-C - The DeccaNavigation System -Decca Receivers - Range and Accuracy of Decca - The Omega System

UNIT-V	**SATELLITE NAVIGATION SYSTEM**	**9Hours**

Distance Measuring Equipment - Operation of DME - TACAN - TACAN Equipment – Instrument LandingSystem - Ground Controlled Approach System - Microwave Landing System (MLS) The Doppler Effect – BeamConfigurations -Doppler Frequency Equations – Track Stabilization - Doppler Spectrum - Components of theDoppler Navigation System - Doppler range Equation - Accuracy of Doppler Navigation Systems. InertialNavigation - Principles of Operation - Navigation over the Earth – Components of an Inertial Navigation System -Earth Coordinate Mechanization - Strapped- Down Systems - Accuracy of Inertial Navigation Systems-The Transit
System - Navistar Global Positioning System (GPS).

Total Hours	**45Hours**

Text Book(s)

1. Merrill I. Skolnik," Introduction to Radar Systems", 3rd Edition, McGraw-Hill, 2003.
2. N.S. Nagaraja, "Elements of Electronic Navigation Systems", 2nd Edition, TMH, 2000.

Reference Book(s)

1. J.C Toomay, "Principles of Radar", 2nd Edition, PHI, 2004.

Course Code		L	T	P	C	IA	EA	TM
Course Name	WAVELET AND ITS APPLICATIONS	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -VII	Syllabus Revision						
Pre-requisite	Basic knowledge of Signals & Systems and Digital Signal Processing							

Course Objectives:

The course should enable the students

1. To understand the fundamentals of Wavelet Transform
2. To learn the multi-resolution analysis technique with respect to WT
3. To know the characteristics of types of wavelet transforms and their applications

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the fundamentals of Wavelet Transform	K2
CO2	Implement the multiresolution analysis technique with respect to WT	K3
CO3	Understand the characteristics of Wavelet Transforms and their applications	K3

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	M	L	S	-	-	-	-	-	-	S	S	S	L
CO2	S	S	M	L	S	-	-	-	-	-	-	S	S	M	L
CO3	S	S	M	L	S	-	-	-	-	-	-	S	M	L	-

UNIT-I	FUNDAMENTALS OF WAVELET TRANSFORMS	9Hours

Vector Spaces – Properties– Dot Product – Basis – Dimension, Orthogonality and Orthonormality – RelationshipBetween Vectors and Signals – Signal Spaces – Concept of Convergence – Hilbert Spaces for Energy SignalsFourier Theory: Fourier series expansion, Fourier transform, Short time Fourier transform, Time-frequency analysis.

UNIT-II	MULTI RESOLUTION ANALYSIS	9Hours

Definition of Multi Resolution Analysis (MRA) – Haar Basis – Construction of General OrthonormalMRA – Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT – Discrete Time MRA – BasisFunctions for the DTWT – PRQMF Filter Banks.

UNIT-III	CONTINUOUS WAVELET TRANSFORMS	9Hours

Wavelet Transform – Definition and Properties – Concept of Scale and its Relation with Frequency – ContinuousWavelet Transform (CWT) – Scaling Function and Wavelet Functions (Daubechies Coiflet, Mexican Hat, Sinc,Gaussian, Bi Orthogonal) – Tiling of Time – Scale Plane for CWT.

UNIT-IV	DISCRETE WAVELET TRANSFORM	9Hours

Filter Bank and Sub Band Coding Principles – Wavelet Filters – Inverse DWT Computation by FilterBanks – BasicProperties of Filter Coefficients – Choice of Wavelet Function Coefficients – Derivations of Daubechies Wavelets– Mallat's Algorithm for DWT – Multi Band Wavelet Transforms Lifting Scheme- Wavelet Transform UsingPolyphase Matrix Factorization – GeometricalFoundations of Lifting Scheme – Lifting Scheme in Z – Domain.

UNIT-V	APPLICATIONS	9Hours

Wavelet methods for signal processing- Image Compression Techniques: EZW–SPHIT Coding – Image DenoisingTechniques: Noise Estimation – Shrinkage Rules – Shrinkage Functions – Edge Detection and Object Isolation,Image Fusion, and Object Detection.

Total Hours	45Hours

Text Book(s)

1. R. Rao R M and A S Bopardikar, “Wavelet Transforms Introduction to theory andApplications”, PearsonEducation, Asia, 2000.
2. L.Prasad&S.S.Iyengar, “Wavelet Analysis with Applications to Image Processing”, CRCPress, 1997.

Reference Book(s)

1. Stephen G. Mallat, “A wavelet tour of signal processing" 2 nd Edition Academic Press, 2000
2. Stephen G. Mallat, “A wavelet tour of signal processing" 2 nd Edition Academic Press, 2000.

Course Code		L	T	P	C	IA	EA	TM
Course Name	SOFTWARE DEFINED RADIO	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE-VII	Syllabus Revision				V.1.0		
Pre-requisite	Analog & Digital Communication							

Course Objectives:

Thecourseshould enablethestudents

1. To understand Software Defined radio Architectures and design principles.
2. To learn radio frequency implementation components, functions and capabilities.
3. To discussmultirate signal processing and digital generation of signals.
4. To acquire knowledge on Data converter sand Smart Antennas in SDR.
5. Tol earn the digital Hardware and Software methods for SDR

Course Outcomes:

On completion of the course,the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Demonstrate the understanding of software defined radio architecture And design principles.	K2
CO2	Design and demonstrate on Radio frequency implementation issues.	K3
CO3	Implement smart antennas in SDR.	K3
CO4	Analyze complex problem scritically in the domain of SDR using Smart Antenna techniques.	K3
CO5	Analyze complex problems critically in the domain of SDR using Smart Antenna techniques.	K3

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	S	M	M	-	-	-	L	L	M	M	S	M	L
CO2	S	S	S	M	M	-	-	-	L	L	M	M	S	M	L
CO3	S	S	S	M	M	-	-	-	L	L	M	M	S	M	L
CO4	S	S	S	M	L	-	-	-	L	L	M	M	S	M	L
CO5	S	S	S	M	S	-	-	-	L	M	M	M	S	M	L

UNIT-I	**INTRODUCTIONTOS OF TWARE RADIO CONCEPTS**	**9Hours**
Evolution, Need, Goals, Characteristics, benefits, definitions and architectures of Software Defined		
Radio;Design Principles; Relations with other radios, issues, enabling technologies, radio frequency Spectrum and regulations.		
UNIT-II	**RADIO FREQUENCY IMPLEMENTATION**	**9Hours**
The purpose of the RF FrontEnd, Dynamic Range, RF receivers frontend Topologies, Importance of the components to Overall performance,Transmitter Architecture,Noise and Distortion in the RF Chain, ADC and DAC Distortion, Flexible RF systems using MEMS.		
UNIT-III	**MULTIRATE SIGNAL PROCESSING AND DIGITAL GENERATION OF SIGNALS**	**9Hours**
Sample rate conversion principles.Digital filter Banks.Timing recovery in Digital Receivers using Multirate Digital filters .Approach esto Direct Digital Synthesis .Analysis of spurious signal Bandpass Signal generation,Generation of Random sequences.		
UNIT-IV	**DATA CONVERTERS AND SMART ANTENNAS**	**9Hours**
Parameters of Ideal and practical Data Converters, Techniques to Improve Data Converter performance, Common ADC and DAC Architectures. Smart Antennas-Hardware implementation of Smart Antennas.		
UNIT-V	**DIGITAL HARDWARE AND SOFTWARE CHOICES**	**9Hours**
DSP Processors, FPGA, ASICs. Trade offs, Object oriented programming, Object Brokers,GNU Radio-USRP.		
	Total Hours	**45Hours**

Text Book(s)

1.	JeffreyH.Reed,"Software Radio:Amodern Approach to Radio Engineering, Prentice Hall, 2002.
2.	Joseph Mitola,"Software RadioArchitecture:Object Oriented Approaches to Wireless System Engineering",Wiley-Interscience;IEdition2000.

Reference Book(s)

1.	TonyJRouphael,“RFandDSPforSDR,”ElsevierNewnesPress,2008.
2.	S.Shanmugavel,M.A.Bhagyaveni,R.Kalidoss,“Cognitive Radio-An Enabler for Internet of things”,River Publishers,2017,Modems”,JohnWiley&Sons,2000.
3.	Paul Burns, “Software Defined Radio for 3G,”ArtechHouse, 2002.
4.	P.Kenington, “RF and Baseb and Techniques for Software Defined Radio,”ArtechHouse, 2005.

LIST OF OPEN ELECTIVE

COURSES (OEC)

Course Code		L	T	P	C	IA	EA	TM
Course Name	DISASTER MANAGEMENT	3	0	0	3	40	60	100
Course Categoy	OPEN ELECTIVE COURSE-I	Syllabus Revision				V.1.0		
Pre-requisite	Basic Knowledge of Environmental Science							

Course Objectives:

1. To provide students an exposure to disasters, their significance and types.
2. To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
3. To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
4. To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

Course Outcomes:

On completion of the course,the student will be able to

Course Outcmoes	Description	Highest Bloom's Taxonomy
CO1	Differentiate the types of disasters, causes and their impact on environment and society	K2
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.	K2
CO3	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disasterdamage assessment	K3

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	-	-	-	-	M	S	-	M	-	-	-	-	M	-	L
CO2	L	-	-	-	-	-	-	M	S	S	S	-	L	-	M
CO3	L	-	-	-	-	M	-	-	-	S	-	-	M	-	L

UNIT-I	INTRODUCTION TO DISASTERS	9Hours

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake,Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political,environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location,disability – Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos andDon'ts during various types of Disasters.

UNIT-II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9Hours

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR,Structural- non structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/UrbanLocal Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at Stateand Central Level- State Disaster Management Authority (SDMA) – Early Warning System – Advisories fromAppropriate Agencies.

UNIT-III	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	9Hours

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams,embankments,changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India -Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-IV	DISASTER RISK MANAGEMENT IN INDIA	9Hours

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health,Waste Management, Institutional arrangements (Mitigation, Response andPreparedness, Disaster Management Actand Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information TechnologyComponents in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster DamageAssessment.

UNIT-V	DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELDWORKS	9Hours

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Madedisasters: Case Studies, Space Based Inputs forDisaster Mitigation and Management and field worksrelated to disaster management.

	Total Hours	45Hours

Text Book(s)

1.	Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427.
2.	Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India EducationPvt. Ltd., 2012.

Course Code		L	T	P	C	IA	EA	TM
Course Name	CRYPTOGRAPHY & NETWORK SECURITY	3	0	0	3	40	60	100
Course Categoy	OPEN ELECTIVE COURSE-I	Syllabus Revision				V.1.0		
Pre-requisite	Basic knowledge of Digital Communication							

Course Objectives:

1. To understand OSI security architecture and classical encryption techniques.
2. To acquire fundamental knowledge on the concepts of finite fields and number theory.
3. To understand various block cipher and stream cipher models.
4. To describe the principles of public key cryptosystems, hash functions and digital signature.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcoes	Description	Highest Bloom's Taxonomy
CO1	Design firewalls and intrusion detection system	K2
CO2	Design security services for E-mail	K3

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	M	L	-	-	-	-	-	-	-	-	L	M	-	-
CO2	S	S	L	-	-	-	-	-	-	-	-	L	M	-	-

UNIT-I	INTRODUCTION & NUMBER THEORY	9Hours

Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryptiontechniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography). FINITEFIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic- Euclid's algorithm-Finite fieldsPolynomial Arithmetic –Prime numbers-Fermat's and Euler's theorem- Testing for primality -The Chineseremainder theorem- Discrete logarithms.

UNIT-II	BLOCK CIPHERS & PUBLIC KEY CRYPTOGRAPHY	9Hours

Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard(AES)-Triple DES-Blowfish-RC5 algorithm. Public key cryptography:Principles of public key cryptosystems-TheRSA algorithm-Key management - Diffie Hellman Key exchange- Elliptic curve arithmetic-Elliptic curvecryptography.

UNIT-III	HASH FUNCTIONS AND DIGITAL SIGNATURES	9Hours

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC– MD5 - SHA - HMAC – CMAC - Digital signature and authentication protocols – DSS – EI Gamal – Schnorr.

UNIT-IV	SECURITY PRACTICE & SYSTEM SECURITY	9Hours

Authentication applications – Kerberos – X.509 Authentication services - Internet Firewalls for Trusted System:Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-CommerceTransactions. Intruder – Intrusion detection system – Virus and related threats – Countermeasures – Firewalls designprinciples – Trusted systems – Practicalimplementation of cryptography and security.

UNIT-V	E-MAIL, IP & WEB SECURITY	9Hours

E-mail Security: Security Services for E-mail-attacks possible through E-mail - establishing keys privacyauthenticationof the source-Message Integrity-Non-repudiation - Pretty Good Privacy- S/MIME. IP Security: Overview of IP sec-IP and IP v6 -Authentication Header-Encapsulation Security Payload (ESP)-Internet KeyExchange (Phases of IKE, ISAKMP/IKE Encoding). Web Security: SSL/TLS Basic Protocol computing the keysclient authentication-PKI as deployed by SSL Attacks fixed in v3- Exportability-Encoding-Secure ElectronicTransaction (SET).

	Total Hours	45Hours

Text Book(s)

1. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education,March 2013.
2. Charlie Kaufman, Radia Perlman and Mike Speciner,"Network Security", Prentice Hall ofIndia, 2002.

Reference Book(s)

1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill, 2007.
2. Charles Pfleeger, "Security in Computing", 4th Edition, Prentice Hall of India, 2006.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	NANO SCIENCE	3	0	0	3	40	60	100
Course Categoy	OPEN ELECTIVE COURSE-I	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Material Science & Electronics							

Course Objectives:

1. To Understand carbon nano structures
2. To Understand carbon nano tubes for data processing
3. To Understand mass storage device
4. To Understand data transmission interfaces and displays

Course Outcomes:

On completion of the course,the student will be able to

Course Outcmoes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the basic structure and functioning of carbon nano tube	**K2**
CO2	Super conductors in digital electronics	**K2**
CO3	Materials and material processing for DRAMs,	**K2**
CO4	Technique for mass storage devices	**K2**
CO5	Data transmission interfaces and displays	**K2**

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	**ProgramOutcomes(POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	S	-	-	S	-	-	-	-	-	-	L	M	-	S
CO2	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	M	M	-	-	-	-	-	-	-	L	L	L	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	L	L	S
CO5	S	S	-	M	-	-	-	-	-	-	-	L	M	M	S

UNIT-I	TECHNOLOGY AND ANALYSIS	**9Hours**

Film Deposition Methods, Lithography, Material Removing Technologies, Etching and Chemical, MechanicalProcessing, Scanning Probe Techniques, Carbon Nano Structures: Carbon Clusters, Carbon Nano tubes,Fabrication, Electrical, Mechanical and Vibrational Properties, Applications of Carbon Nano Tubes.

UNIT-II	LOGIC DEVICES	**9Hours**

Silicon MOSFETS, Novel Materials and Alternative Concepts, Ferro Electric Filed Effect Transistors, SuperConductor Digital Electronics, Carbon Nano Tubes for Data Processing.

UNIT-III	RANDOM ACCESS MEMORIES	**9Hours**

High Permittivity Materials for DRAMs, Ferro Electric Random-Access Memories, Magneto- Resistive RAM.

UNIT-IV	MASS STORAGE DEVICES	**9Hours**

Hard Disk Drives, Magneto Optical Disks, Rewriteable DVDs based on Phase Change Materials,HolographicData Storage.

UNIT-V	DATA TRANSIMISSION, INTERFACES AND DISPLAYS	**9Hours**

Photonic Networks, Microwave Communication Systems, Liquid Crystal Displays, Organic LightEmittingDiodes.

Total Hours	**45Hours**

TextBook(s)

1.	Rainer Waser, “Nano Electronics and Information Technology”, Wiley VCH, April 2003.
2.	Charles Poole, “Introduction to Nano Technology”, Wiley Interscience, May 2003.

Course Code		L	T	P	C	IA	EA	TM
Course Name	PLC AND DATA ACQUISITION SYSTEMS	3	0	0	3	40	60	100
Course Categoy	OPEN ELECTIVE COURSE-I	Syllabus Revision					V.1.0	
Pre-requisite	Analog and Digital Electronics							

Course Objectives:

1. To understand the need of computer control in automation.
2. To study the data acquisition systems.
3. To study the evolution and advantages of PLC.
4. To understand the various PLC instructions.
5. To study the use of PLC for some specific applications.

Course Outcomes:

On completion of the course,the student will be able to

Course Outcoes	Description	Highest Bloom's Taxonomy
CO1	Able to understand the need of computer in Automation.	K2
CO2	Understand the basics of data conversion and data acquisition.	K4
CO3	Understand the fundamental of PLC.	K3
CO4	Program a PLC with different logical languages.	K2
CO5	Various industrial Applications of PLCs are studied.	K2

Correlation between Course Out comes(COs) and Program Outcomes(POs):

COs	ProgramOutcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	-	L	-	M	-	M	-	-	-	-	-	L	-	M
CO2	L	-	M	-	L	L	L	-	-	-	-	-	M	-	L
CO3	S	L	-	-	-	M	M	-	-	-	-	-	L	-	M

CO4	M	M	S	L	-	-	S	-	-	-	M	L	M	-	L
CO5	L	S	L	-	S	-	S	-	-	-	L	M	L	-	M

UNIT-I	COMPUTER CONTROL-INTRODUCTION	**9Hours**

Need of computer in a control system-Functional block diagram of a computer control system-Data loggersSupervisory computercontrol- Direct digital control-Digital control interfacing-SCADA.

UNIT-II	DATA ACQUISITION SYSTEMS	**9Hours**

Sampling theorem – Sampling and digitizing – Aliasing – Sample and hold circuit – Practical implementation ofsampling and digitizing – Definition, design and need for data acquisition systems – Interfacing ADC and DACwith Microprocessor / Multiplexer - Multiplexed channel operation – Microprocessor/PC based acquisition systems.

UNIT-III	BASICS OF PLC	**9Hours**

Definition and History of PLC-PLC advantage and disadvantages- Over all PLC systems-CPU andProgrammer/Monitors-PLC input and output models – Architecture- PLC Programming language – Relay logic –Ladder logic – Programming of Gates – Flow charting as a programming method – connecting PLC to computer -PLC Troubleshooting and Maintenance.

UNIT-IV	PLC PROGRAMMING	**9Hours**

Programming of Timers – Introduction - ON delay, OFF delay, Retentive Timers – PLC Timer functions – Examplesof timer function Industrial application, Programming Counters – up/down counter – Combining counter – Examplesofcounter function Industrial application. PLC Arithmetic Functions – PLC number Comparison function.

UNIT-V	PLC DATA HANDALING FUNCTIONS	**9Hours**

PLC Program Control Instructions: Master Control Reset - Skip – Jump and Move Instruction. Sequencerinstructions - Types of PLC Analog modules and systems, PLC analog signal processing –BCD or multi bit dataprocessing – Case study of Tank level control system, bottle filling system andSequential switching of motors.

	Total Hours	**45Hours**

Text Book(s)

1. Petrezeulla, “Programmable Logic Controllers”, McGraw Hill, 1989.
2. Curtis D. Johnson,” Process Control Instrumentation Technology”, 8th edition PHI, 2005

ReferenceBook(s)	
1.	Hughes .T, “Programmable Logic Controllers”, ISA Press, 1989.
2.	G.B.Clayton,” Data Converters”, The Mac Millian Press Ltd., 1982.
3.	John w.Webb& Ronald A.Reis., “Programmable logic controllers- principles andapplications”, 5th Edition,PHI, 2010

Course Code		L	T	P	C	IA	EA	TM
Course Name	AUTOTRONICS	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE-I	Syllabus Revision						
Pre-requisite	Automobile Engineering							

Course Objectives:

The course should enable the students:

1. To understand the basics of ignition, injection and engine control systems
2. To learn the various chassis and safety system operation and applications
3. To learn about various methods of sensors and actuators for engine control parameters

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Develop through basic knowledge about various ignition and injection systems.	K2
CO2	Acquire knowledge on the safety systems of the automobile.	K5
CO3	Learn about various methods of sensors for engine controls.	K4

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2	PSO 3
CO1	L	M	-	-	-	-	-	-	-	-	-	-	M	-	L
CO2	M	L	L	-	L	-	-	-	-	-	-	-	L	-	M
CO3	S	M	S	-	M	-	-	-	-	-	-	-	L	-	M

UNIT-I	INTRODUCTION	9 Hours

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, EuroV standards – Equivalent Bharat Standards, Charging systems: Working and design ofcharging circuit diagram –Alternators – Requirements of starting system - Starter motors and starter circuits

UNIT-II	IGNITION AND INJECTION SYSTEMS	9 Hours
Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution lessignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaustemissions – Electronic control of carburetion – Petrol fuelinjection – Diesel fuel injection.		
UNIT-III	SENSOR AND ACTUATORS	9 Hours
Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect,Throttle angle,temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motoractuator, vacuum operated actuator.		
UNIT-IV	ENGINE CONTROL SYSTEMS	9 Hours
Control modes for fuel control-engine control subsystems – ignition control methodologies – differentECU‟s usedin the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.		
UNIT-V	CHASSIS AND SAFETY SYSTEMS	9 Hours
Traction control system – Cruise control system – electronic control of automatic transmission – antilock brakingsystem – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized doorlocking system – climate control of cars.		
	Total Hours	45 Hours

Text Book(s)

1.	Ribbens, "Understanding Automotive Electronics", 7th Edition, Elsevier, Indian Reprint,2013

Reference Book(s)

1.	Tom Denton, “Automobile Electrical and Electronics Systems”, Edward Arnold Publishers,2000.
2.	Barry Hollembeak, “Automotive Electricity, Electronics & Computer Controls”, DelmarPublishers, 2001.
3.	Richard K. Dupuy “Fuel System and Emission controls”, Check Chart Publication, 2000.
4.	Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 1999.

Course Code		L	T	P	C	IA	EA	TM
Course Name	REMOTE SENSING &GIS	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE-II	Syllabus Revision						
Pre-requisite	Basic Knowledge of Science & Engineering							

Course Objectives:

The course should enable the students:

1. To provide students an exposure to Remote sensing
2. To ensure that students begin to understand the geographic information system

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the concepts, platforms and laws related to remote Sensing.	K2
CO2	Understand the interaction of electromagnetic radiationwith Atmosphere and earth material.	K2
CO3	Acquire knowledge about satellite orbits, different types of Satellites and the different types of remote sensors.	K1
CO4	Understand the fundamentals of GIS, maps, data structures and analysis of data.	K4
CO5	Gain knowledge about the concepts of interpretation of Satellite imagery and civil engineering applications.	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	S	M	-	-	-	L	-	M	L	-	M
CO2	S	M	-	M	S	M	-	-	-	M	-	M	M	-	L
CO3	S	M	M	M	S	M	-	-	-	M	-	M	L	-	M

CO4	S	M	M	L	M	M	-	-	-	L	-	L	M	-	M
CO5	S	M	M	M	L	M	L	-	-	L	-	L	L	-	L

UNIT-I	REMOTE SENSING	9 Hours

Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body - Active and PassiveRemoteSensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Synoptivity andRepetivity – Electro Magnetic Radiation (EMR) – EMR spectrum – Visible, Infra Red (IR), Near IR, Middle IR ,Thermal IR and Microwave – Black Body Radiation - Planck's law – Stefan-Boltzman law.

UNIT-II	EMR INTERACTION WITH ATMOSPHERE AND EARTH	9 Hours

Atmospheric characteristics – Scattering of EMR – Raleigh, Mie, Non-selective and Raman Scattering – EMRInteraction with Water vapour and ozone – Atmospheric Windows Significance ofAtmospheric windows – EMRinteraction with Earth Surface Materials – Radiance, Irradiance, Incident, Reflected, Absorbed and TransmittedEnergyReflectance – Specular and Diffuse Reflection Surfaces- Spectral Signature – Spectral Signature curves –EMR interaction with water, soil and Earth Surface

UNIT-III	OPTICAL AND MICROWAVE REMOTE SENSING	9 Hours

Satellites - Classification – Based on Orbits – Sun Synchronous and Geo Synchronous – Based on Purpose – EarthResources Satellites, Communication Satellites, Weather Satellites, Spy Satellites – Satellite Sensors - Resolution –Spectral, Spatial, Radiometric and Temporal Resolution – Descriptionof Multi Spectral Scanning – Along andAcross Track Scanners – Description of Sensors in Landsat,SPOT, IRS series – Current Satellites - Radar – Speckle– Back Scattering – Side Looking Airborne Radar – Synthetic Aperture Radar – Radiometer – Geometricalcharacteristics

UNIT-IV	GEOGRAPHIC INFORMATION SYSTEM	9 Hours

GIS – Components of GIS – Hardware, Software and Organizational Context – Data – Spatial and Non-Spatial –Maps – Types of Maps – Projection – Types of Projection - Data Input – Digitizer, Scanner – Editing – Raster andVector data structures – Comparison of Raster and Vector data structure – Analysis using Raster and Vector data –Retrieval, Reclassification, Overlaying, Buffering– Data Output – Printers and Plotters.

UNIT-V	MISCELLANEOUS TOPICS	9 Hours

Visual Interpretation of Satellite Images – Elements of Interpretation - Interpretation Keys Characteristics of DigitalSatellite Image – Image enhancement – Filtering – Classification - Integration of GIS and Remote Sensing –Application of Remote Sensing and GIS – Urban Applications - Integration of GIS and Remote Sensing –Application of Remote Sensing and GIS – Water resources – Urban Analysis – Watershed

Management – ResourcesInformation Systems.	
Total Hours	**45 Hours**
Text Book(s)	
1.	Anji Reddy, Remote Sensing and Geographical Information Systems, BS Publications 2001.
2.	M.G. Srinivas, Remote Sensing Applications, Narosa Publishing House, 2001.
Reference Book(s)	
1.	Lillesand T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley andSons, Inc, New York.
2.	Janza.F.J., Blue, H.M., and Johnston, J.E., "Manual of Remote Sensing Vol.I, AmericanSociety ofPhotogrammetry, Virginia, U.S.A, 1975.

Course Code		L	T	P	C	IA	EA	TM
Course Name	BIG DATA ANALYTICS	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE-II	Syllabus Revision						
Pre-requisite	Basic Knowledge on Data bases, Data mining and Data Structures							

Course Objectives:

The course should enable the students:

1. To understand Big Data models and structure
2. Introduction to Analytic Tool –R
3. Mining Data streams for Analytics
4. Understanding Map Reduce Framework
5. Advanced Analytic Tools and Techniques

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Have Strong Foundations on Data Analytics Models and structure	K2
CO2	Understand the Role of Big Data and its importance	K2
CO3	Data modeling and Link stream Analysis	K2
CO4	Able to setup Analytical Environment using R-Studio	K3
CO5	Able to perform simple analysis application and programs using R –Scripts.	K2

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2	PSO 3
CO1	M	-	-	M	-	-	-	-	L	S	-	-	M	-	S
CO2	-	M	L	S	-	-	S	-	-	-	-	-	M	-	S
CO3	-	S	M	-	S	-	-	-	-	-	-	-	L	-	S
CO4	-	-	-	M	S	-	-	-	M	L	-	-	L	-	S
CO5	-	-	-	M	S	-	-	-	S		-	-	M	M	S

UNIT-I	INTRODUCTION TO ANALYTIC TOOL	9 Hours
R Using R for Initial Analysis of the Data -Introduction to R programming, initial exploration - analysis of the datausing R - basic visualization using R –Basic Scripting-Data Set Analysis.		
UNIT-II	**OVERVIEW OF DATA ANALYTICS**	**9 Hours**
Introduction to Big Data Analytics -definition -overview of big data - Characteristics– Importance ofBig Data – datapreparation -model planning,-Use cases-critical activities in each Phase of the lifecycle.		
UNIT-III	**MINING DATA STREAMS**	**9 Hours**
The Stream Data Model .-Sampling Data in a Stream -Filtering Streams - Counting Distinct Elementsin a Stream -Estimating Moments .- Counting Ones in a Window Link Analysis : Page Rank -Topic-Sensitive Page Rank -LinkSpam -Hubs and Authorities.		
UNIT-IV	**MAPREDUCE AND THE NEW SOFTWARE STACK**	**9 Hours**
Distributed File Systems-Map Reduce Algorithms Using Map Reduce-Extensions to MapReduce theCommunication Cost Model-Complexity Theory for Map Reduce.		
UNIT-V	**BIG DATA FROM THE TECHNOLOGY PERSPECTIVE**	**9 Hours**
Introduction to Hadoop –Components of Hadoop –Application Development in Hadoop –Pig Hive- Jaql, GettingData in Hadoop-copy Data-Flume, Other Hadoop Components-Zoo Keeper HBase- Oozie.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Jure Leskovec ,Anand Rajaraman, Jeffrey D.Ullman, “Mining of Massive Datasets” ,SecondEdition, Cambridge University Press, 2014.
2.	Paul Zikopoulos, “Understanding Big Data”, First Edition, McGraw Hill Corporations-2012.

Reference Book(s)

1.	Garrett Grolemund, “Introduction to Data Science with R”, O’Reilly media, 2014.
2.	Garrett Grolemund, “Hands-On Programming with R: Write Your Own Functions and Simulations Paperback”,O'Reilly media, 2014.

Course Code		L	T	P	C	IA	EA	TM

Course Name	COMPUTER INTEGRATED MANUFACTURING	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE-II	Syllabus Revision						
Pre-requisite	Basic Knowledge of CAD & CAM							

Course Objectives:

The course should enable the students:

1. To know about the CIM.
2. To know about the Group technology and process planning.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Develop through basic knowledge about CIM.	K2
CO2	Acquire knowledge on the applications of CIM.	K5
CO3	Learn the usage of group technology and process planning.	

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2	PSO 3
CO1	M	-	-	M	-	-	-	-	L	S	-	-	M	-	S
CO2	-	M	L	S	-	-	S	-	-	-	-	-	M	-	S
CO3	-	S	M	-	S	-	-	-	-	-	-	-	L	-	S

UNIT-I		9 Hours

Introduction to Automation -Production system Facilities, Manufacturing Support Systems, Automation inProduction Systems, Automated Manufacturing Systems, Types of Automation, Computerized manufacturingSupport System, Reasons for Automating, Manufacturing Industries and Products, Manufacturing operations,Product / Production Relationships, Production Concepts and Mathematical Models. Basic elements of anAutomated System, Advanced Automation Functions, Levels of Automation, Industrial Control Systems-ProcessIndustries versus Discrete Manufacturing Industries, Continuous versus

Discrete Control, Computer ProcessControl, Forms of Computer Process Control

UNIT-II		9 Hours

Fundamentals of CAD, CAM and CAE, CIM Definition, CIM Wheel, CIM components, Evolution ofCIM - Development of computers - Needs of CIM, Benefits of CIM. CIM Hardware & Software, CIM Models, DBMSand Network system - Data base and DBMS- requirement, features and architecture of DBMS, CIMCommunications (Network) System, Communication Matrix, Network Architectures, Tools and Techniques

UNIT-III		9 Hours

Group Technology – Introduction - coding and classification system, Production Flow Analysis, Coding System -OPTIZ, MICLASS, Benefits of Group Technology, Machine cell design. Process Planning- Structure of a ProcessPlanning, Process Planning function, CAPP - Types of CAPP, Retrieval and Generative type CAPP, Concurrentengineering, Design for Manufacturing and Assembly, Advanced Manufacturing Planning.

UNIT-IV		9 Hours

Fundamentals of NC Technology – Basic components of an NC System, NC Coordinate and MotionControlsystems, Computer Numerical Control, Features of CNC, Machine Control Unit for CNC, CNC Software, DNCMachines, Application of NC machine tools Applications, Structure of CNC Machines,CNC Controllers, NC PartProgramming, Computer-Assisted Part Programming. Featuresand Applications of CNC Turning Centre, CNCMilling Machine, CNC Turn-Mill Centre, CNC machining Centre, CNC Tooling system and Automatic ToolChanging System, Computer Aided Quality Control- contact, non-contact inspection methods, CoordinateMeasuring Machine CMM - Integration of CAQC with CAD / CAM.

UNIT-V		9 Hours

FMS -Components of FMS, Computer control and function, FMS planning, scheduling and control, KnowledgeBased Scheduling, FMS operation control, Hierarchy of computer control, supervisory control, types of softwareused in FMS, Applications and Benefits. Production Support Machines andSystems - Industrial Robots, AutomatedMaterial Handling, Automatic Guided Vehicles, Automated Storage and Retrieval system. Developments inManufacturing Technologies- AI and Expert System, Agile manufacturing, Lean Manufacturing, VirtualManufacturing, Simulation in Manufacturing – Factories of Future.

	Total Hours	45 Hours

Text Book(s)

1.	Kant Vajpayee.S, “Principles of Computer- Integrated Manufacturing”; 1st ed. PHI 2006.
2.	Mikell p. Groover, “Automation, Production Systems & CIM”, 2nd ed. PHI 2001.
3.	James A.Rehg, Henry W.Kraebber, “Computer- Integrated Manufacturing”, second Edition,Pearson Education.
4.	P.N. Rao, “CAD/CAM Principles and Applications”, Second Edition, TMH 2006.

Reference Book(s)

1.	Radhakrishnan.P, Subramanyan. S, Raju.V, “CAD/CAM/CIM”, Second Edition, New AgeInternationalpublishers, 2000
2.	Daniel Hunt.V., “Computer Integrated Manufacturing Hand Book”, Chapman & Hall, 1989
2.	Ranky Paul. G., “Computer Integrated Manufacturing”, Prentice Hall International, 1986.

Course Code		L	T	P	C	IA	EA	TM

Course Name	OPERATIONALRESEARCH	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE-II	**Syllabus Revision**						
Pre-requisite	Basic knowledge of Mathematics							

Course Objectives:

The course should enable the students:

1. To improve a quantitative decision-making procedure.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the Concept of Routing Problems	**K2**
CO2	Understand the Integer Programming and Replacement Problems	**K5**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO1	M	-	-	M	-	-	-	-	L	S	-	-	M	-	S
CO2	-	M	L	S	-	-	S	-	-	-	-	-	M	-	S

UNIT-I	LINEAR PROGRAMMING AND SIMPLEX METHOD	9 Hours

Mathematical formulation of the problem - Graphical solution method - Exceptional cases – General linearprogramming problem - Canonical and standard forms of linear programming problem - The simplex method -Computational procedure : The simplex algorithm - Artificial variable techniques :Big M method, Two phasemethod - problem of degeneracy.

UNIT-II	TRANSPORTATION, ASSIGNMENT AND ROUTING PROBLEMS	9 Hours

Mathematical formulation of the transportation problem - Triangular basis - Loops in a transportationtable – Findinginitial basic feasible solution (NWC, IBM and VAM methods) - Moving towards optimality- Degeneracy intransportation problems- Transportation algorithm (MODI method) – Unbalanced transportation problems -Mathematical formulation of the assignment problem - Assignment algorithm Hungarian assignment method –Routing problems : Travelling salesman problem.

UNIT-III	GAME THEORY AND SEQUENCING PROBLEMS	9 Hours
Two person zero sum games - Maxmin Minmax principle - Games without saddle points (Mixed strategies) - Solution of 2 X 2 rectangular games - Graphical method - Dominance property - Algebraic method for m x n games- Matrix oddments method for m x n games - Problem of sequencing - Problems with n jobs and 2 machines -Problems with n jobs and k machines – Problemswith 2 jobs and k machines.		
UNIT-IV	**INTEGER PROGRAMMING AND INVENTORY CONTROL**	**9 Hours**
Gomory's All I.P.P method - Gomory's mixed integer method - Branch and bound method - Reasons for carryinginventory - Types of inventory - Inventory decisions - Economic order quantity - Deterministic inventory problem– EOQ problem with price breaks - Multi item deterministic problem.		
UNIT-V	**REPLACEMENT PROBLEMS AND PERT/CPM**	**9 Hours**
Replacement of equipment or asset that deteriorates gradually - Replacement of equipment that fails suddenly -Recruitment and promotion problem - Network and basic components - Rules of network construction – Timecalculations in networks - Critical path method (CPM) - PERT - PERT calculations - Negative float and negative Slack - Advantages of network (PERT/CPM).		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, Eighth Edition, SultanChand & Sons,New Delhi, 1999.
Reference Book(s)	
1.	H.A.Taha, Operations Research, Sixth Edition, MacMillen.
2.	Richard Bronson, Operations Research, Schaum's Outline Series, McGraw Hill, 1982. J.K.Sharma, OperationResearch (Theory and Applications), MacMillen, 1997.

Course Code		L	T	P	C	IA	EA	TM

Course Name	**3D PRINTERS & APPLICATIONS**	3	0	0	3	40	60	100
Course Category	Open Elective Course II	**Syllabus Revision**						
Pre-requisite	Basic knowledge of Control & Instrumentation							

Course Objectives:

The course should enable the students-

1. To develop CAD models for 3D printing
2. To import and export CAD data and generate. STL file
3. To select 3D printing process for an application.ect a specific material for the given application
4. To produce a product using 3D printing or Additive Manufacturing (AM)

Course Outcomes:

On completion ofthe course,thestudentwill beable to

Course outcomes	Description	HighestBloom's Taxonomy
CO1	Develop CAD models for 3D printing.	**K2**
CO2	Import and Export CAD data and generate STL file.	**K2**
CO3	Select a specific material for the given application.	**K3**
CO4	Select a 3D printing process for an application.	**K4**
CO5	Produce a product using 3D Printing or Additive Manufacturing (AM).	**K6**

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	P O6	PO 7	PO 8	PO 9	PO 10	P O 11	PO 12	PS O1	PS O2	PSO3
CO1	S	S	-	-	S	-	-	-	-	-	-	L	M	-	S
CO2	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	-	M	-	-	-	-	-	-	-	L	L	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	L	-	S
CO5	S	S	-	M	-	-	-	-	-	-	-	L	M	M	S

UNIT-I	3D PRINITING (ADDITIVE MANUFACTURING)	9Hours

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.		
UNIT-II	**CAD FOR ADDITIVE MANUFACTURING**	**9Hours**
CAD Data formats, Data translation, Data loss, STL format.		
UNIT-III	**ADDITIVE MANUFACTURING TECHNIQUES**	**9Hours**
Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process election for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, HealthCare, Defence, Automotive, Construction, Food Processing, Machine Tools.		
UNIT-IV	**MATERIALS**	**9Hours**
Polymers, Metals, Non-Metals, Ceramics - Various forms of raw material – Liquid, Solid, Wire, Powder,Powder Preparation and their desired properties, Polymers and their properties. Support Materials.		
UNIT-V	**ADDITIVE MANUFACTURING EQUIPMENT AND POST PROCESSING**	**9Hours**
Process equipment- design and process parameters -Governing bonding mechanism -Common faults andtroubleshooting- Process design- Post processing: requirement and techniques Product quality – Inspectionand testing- Defects and their causes		
	Total Hours	**45Hours**

Text Book(s)

1. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping andManufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototypingto Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN- 13: 978-1493921126.

Reference Book(s)

1. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.
2. CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”,WorldScientific, 2017.
3. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series inMaterialScience, 2013.
4. L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”,KulwerAcademic Press, 2001.
5. Zhiqiang Fan And Frank Liou, “Numerical Modeling of the Additive Manufacturing (AM)Processes ofTitanium Alloy”, InTech, 2012.

Course Code		L	T	P	C	IA	EA	TM
Course Name	SENSORS&ACTUATORS	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE-III	Syllabus Revision						
Pre-requisite	Basic knowledge of Basic Electronics							

Course Objectives:

The course should enable the students:

1. To acquire knowledge about the principles and analysis of sensors.
2. To emphasis on characteristics and response of micro sensors.
3. To acquire adequate knowledge of different transducers and Actuators.
4. To learn about the Micro sensors and Micro actuators.
5. To select sensor materials for fabrication for different applications

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Analyze the basics and design the resistive sensors.	K4
CO2	Identify the materials and designing of inductive and capacitive sensors.	K5
CO3	Analyze various types of Actuators.	K4
CO4	Design Micro sensors and Micro actuators for various applications.	K6
CO5	Implement fabrication process and technologies and compare various Micro-machiningprocesses	K5

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2	PSO 3
CO1	S	S	-	-	S	-	-	-	-	-	-	L	M	-	S
CO2	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	-	M	-	-	-	-	-	-	-	L	L	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	L	-	S
CO5	S	S	-	M	-	-	-	-	-	-	-	L	M	M	S

UNIT-I	SENSORS	9 Hours
Difference between sensor, transmitter and transducer - Primary measuring elements - selection andcharacteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance,backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulicsignal; Electronic Signal. Principle of operation, construction details, characteristics and applications ofpotentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer,Resistance Hygrometer, Photo-resistive sensor.		
UNIT-II	INDUCTIVE AND CAPACITIVE TRANSDUCERS	9 Hours
Inductive transducers: - Principle of operation, construction details, characteristics and applicationsofLVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn. Capacitivetransducers: - Principle of operation, construction details, characteristics of Capacitive transducers –different types & signal conditioning- Applications:- capacitor microphone, capacitive pressure sensor,proximity sensor.		
UNIT-III	ACTUATORS	9 Hours
Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators,Pneumati cactuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulicactuator - Control valves; Construction, Characteristics and Types, Selection criteria. Electrical actuatingsystems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.Cmotors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.		
UNIT-IV	MICRO SENSORS AND MICRO ACTUATORS	9 Hours
Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed microsensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flowmicro sensors.Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity.Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.		
UNIT-V	SENSOR MATERIALS AND PROCESSING TECHNIQUES	9 Hours
Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials. Processing techniques:Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micromachining: Bulk silicon micromachining, Surface silicon micromachining, LIGA process.		
	Total Hours	45 Hours

Text Book(s)

1.	Patranabis.D, Sensors and Transducers, Wheeler publisher, 1994.
2.	Sergej Fatikow and Ulrich Rembold, Microsystem Technology and Microbotics First edition,Springer – Verlag Newyork, Inc, 1997.

3.	Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourthedition,Springer, 2010.
Reference Book(s)	
1.	Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002.
2.	Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBHpublishing Co. Pvt.Ltd.,
3	Massood Tabib and Azar, Micro actuators Electrical, Magnetic, thermal, optical, mechanical,chemical andsmart structures, First edition, Kluwer academic publishers, Springer, 1997.
4	Manfred Kohl, Shape Memory Actuators, first edition, Springer

Course Code		L	T	P	C	IA	EA	TM
Course Name	ADHOC NETWORKS	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE-III	Syllabus Revision						
Pre-requisite	Basic knowledge of Data Communication Networks							

Course Objectives:

The course should enable the students:

1. To study the wireless networks
2. To understand the concept of wireless protocols

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the fundamentals of sensor networks	K1
CO2	Understand the various wireless sensor protocols	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO1	S	S	-	-	S	-	-	-	-	-	-	L	M	-	S
CO2	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S

UNIT-I	INTRODUCTION TO WIRELESS NETWORKS	9 Hours

Characteristics of wireless channels, Fundamentals of WLANs, IEEE 802.11 standard, HIPERLANStandard, First-, Second, third and beyond 3G - generation cellular systems, WLL, Wireless ATM, IEEE802.16 standard, HIPERACCESS, AdHoc Wireless Internet.

UNIT-II	MAC, ROUTING AND MULTICAST ROUTING PROTOCOLS	9 Hours

MAC Protocols: Design issues, goals and classification, Contention –based protocols with reservationandscheduling mechanisms, Protocols using directional antennas. Routing protocols: Design issues andclassification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficientflooding mechanisms, Hierarchical and power-aware routing protocols. Multicast Routing Protocols:

Designissues and operation, Architecture reference model, classification, Tree based and Mesh-based protocols, Energy-efficient multicasting.		
UNIT-III	**TRANSPORT LAYER AND SECURITY PROTOCOLS**	**9 Hours**
Transport layer Protocol: Design issues, goals and classification, TCP over AdHoc wireless Networks,Security, Security requirements, Issues and challenges in security provisioning, Network security attacks,Security routing. Quality of Service: Issues and challenges in providing QoS, Classification ofQoS solutions,MAC layer solutions, Network layer solutions, QoS frameworks		
UNIT-IV	**WIRELESS SENSOR NETWORKS**	**9 Hours**
Architecture, Data dissemination, Date gathering, MAC protocols, location discovery, Quality of a sensornetwork.		
UNIT-V	**ENERGY MANAGEMENT**	**9 Hours**
Classification of battery management schemes, Transmission power management schemes, System powermanagement schemes. Performance Analysis -ABR beaconing, Performance parameters,Route-discoverytime, End-to-end delay performance, Communication throughput performance, Packet loss performance,Route reconfiguration repair time, TCP/IP based applications.		
	Total Hours	**45 Hours**

Text Book(s)

1.	C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures andprotocols, Prentice Hall PTR, 2004.
2.	C.K.Toh, AdHoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR,2001

Reference Book(s)

1.	Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, CRC press, 2002.
2.	Charles E. Perkins, AdHoc Networking, Addison – Wesley, 2000.
3	Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile AdHocNetworking, Wiley – IEEE press, 2004

Course Code		L	T	P	C	IA	EA	TM
Course Name	ARTIFICIAL INTELLIGENCE	3	0	0	3	40	60	100
Course Category	Open Elective Course III	Syllabus Revision						
Pre-requisite	Basic knowledge of Computer Architecture							

Course Objectives:

The course should enable the students-

1. To understand the basic building blocks of Intelligent Systems.
2. To gain knowledge in problem formulation and building intelligent agents.
3. To understand some of the searching approaches to build Intelligent Systems.
4. To understand the types of logic and knowledge representation schemes.
5. To acquire knowledge in planning and learning algorithms.

Course Outcomes:

On completion of the course, the student will be able to

Course outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the basic concepts and techniques of Artificial Intelligence	K2
CO2	Acquire Knowledge on intelligent agents and problem solving by using various search strategies.	K2
CO3	Apply AI algorithms for solving practical problems.	K3
CO4	Design and Implement an example using Knowledge representation.	K6
CO5	Apply planning and reasoning algorithms for solving real life problems.	K3

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	M	S	M	-	-	-	-	-	-	-	-	-	-	-
CO2	L	S	S	S	L	-	-	-	-	-	-	M	M	M	M
CO3	L	S	S	S	L	-	-	-	-	-	-	S	M	M	S
CO4	L	S	S	S	L	-	-	-	-	-	-	M	-	-	M
CO5	L	S	S	M	-	-	-	-	-	-	-	M	-	-	M

UNIT-I	INTRODUCTION TO AI-AI TECHNIQUES	9Hours
Introduction – Foundations of AI, the History of AI –Intelligent Agent – Agent and Environment, Good Behavior: The Concept of Rationality, Nature of Environments, Structure of Agents- Problem Solving Agents -Example Problems		

UNIT-II	SEARCHING TECHNIQUES- UNIFORMED SEARCH ALGORITHM	9Hours
Uninformed Searching strategies-Breadth First Search, Depth First search, Depth limited search, Iterative deepening search, Bidirectional Search - Avoiding repeated States - Searching with Partial information –Informed search strategies – Greedy Best First Search-A* Search-Heuristic Functions- Local Search Algorithms for Optimization Problems-Local search in Continuous Spaces.		

UNIT-III	SEARCHING TECHNIQUES- ONLINE SEARCH ALGORITHM	9Hours
Online Search Agents and Unknown Environments-Online Search Problems, Online Search Agents- OnlineLocal search, learning in Online Search – Constraint Satisfaction Problems- Backtracking CSP, TheStructure of Problems-Adversarial Search-Games, Optimal Decisions in Games, Alpha- Beta Pruning.		

UNIT-IV	KNOWLEDGE AND REASONING	9Hours
Logical agents – Knowledge Based Agents, The Wumpus World, Propositional Logic-A very simpleLogic–First Order logic– inferences in first order logic – forward chaining – backward chaining – Unification –Resolution.		

UNIT-V	PLANNING	9Hours
Planning with state space search – Partial-order planning – Planning graphs – Planning and acting in the real world.		

Total Hours	45Hours

Text Book(s)

1.	S. Russel and P. Norvig, "Artificial Intelligence –A Modern Approach", Second Edition,Pearson Education 2003
2.	

Reference Book(s)

1.	David Poole, Alan Mackworth, Randy Goebel, "Computational Intelligence: a Logical Approach", Oxford University Press, 2004.
2.	G. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving",Fourth Edition, Pearson Education, 2002

Course Code		L	T	P	C	IA	EA	TM
Course Name	TOTAL QUALITY MANAGEMENT	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE-III	Syllabus Revision						
Pre-requisite	Principles of Management and Professional Ethics							

Course Objectives:

The course should enable the students:

1. To introduce the basic functions of Total Quality Management
2. To learn the principles of TQM
3. To impart knowledge on statistical process control techniques
4. To study the usage of tools for problem solving
5. To familiarize various system standards

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the basics of TQM	K1
CO2	Explain the principles of TQM	K3
CO3	Solve problems on statistical process control	K3
CO4	Use the tools for finding solutions	K2
CO5	Gain knowledge on system standards.	K2

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O2	PSO 3
CO1	S	S	-	-	S	-	-	-	-	-	-	L	M	-	S
CO2	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S
CO4															
CO5	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S

UNIT-I	INTRODUCTION	9 Hours
Definition of quality, dimensions of quality, quality planning, quality costs - analysis Techniques forqualityCosts, basic concepts of total quality management, historical review, principles of TQM, leadership –concepts, Role of senior management, quality council, quality statements, Strategic planning, demingphilosophy, Barriers to TQM implementation.		
UNIT-II	TOTAL QUALITY MANAGEMENT PRINCIPLES	9 Hours
Customer satisfaction – customer perception of quality, customer complaints, service quality, customerretention, employee involvement – motivation, empowerment, teams, recognition and reward, performanceappraisal, benefits, continuous process improvement – Juran trilogy, pdsa cycle, 5s, kaizen, supplierpartnership – partnering, sourcing, supplier selection, supplier rating, relationshipdevelopment, performancemeasures – basic concepts, strategy, performance measure.		
UNIT-III	TOTAL QUALITY MANAGEMENT TOOLS	9 Hours
Bench marking – reasons to benchmark, benchmarking process, quality function deployment (QFD) –houseof quality, QFD process, benefits, taguchi quality loss function, total productive maintenance (TPM) –concept, improvement needs, FMEA – stages of FMEA.		
UNIT-IV	QUALITY SYSTEMS	9 Hours
Quality Auditing - Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System –Elements, Implementation of Quality System, Documentation, TS 16949, ISO 14000 – Concept,Requirements and Benefits.		
UNIT-V	STATISTICAL PROCESS CONTROL (SPC)	9 Hours
The seven tools of quality, statistical fundamentals – measures of central tendency and dispersion,population and sample, normal curve, control charts for variables and attributes, process capability, conceptof six sigma, new seven management tools.		
	Total Hours	45 Hours

Text Book(s)

1.	Dale H. Besterfiled, et al., “Total Quality Management”, Pearson Education, Inc. 2003.(Indian reprint2004).

Reference Book(s)

1.	James R.Evans& William M.Lidsay, “The Management and Control of Quality”, (5thEdition),South-Western (Thomson Learning), 2002.
2.	Oakland.J.S. “Total Quality Management”, Butterworth – Hcinemann Ltd., Oxford. 1989.
3	Narayana V. And Sreenivasan, N.S. “Quality Management – Concepts and Tasks”, New AgeInternational 1996.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	GLOBAL POSITIONING SYSTEMS	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE-III	**Syllabus Revision**						
Pre-requisite	Basic knowledge of Communication Systems							

Course Objectives:

The course should enable the students-

1. To understand the basics of GPS.
2. To know the concepts of different coordinate system and its services.
3. To learn various codes and range models.
4. To understand the concepts of GPS propagation.
5. To study the various applications of GPS.

Course Outcomes:

On completion of the course, the student will be able to

Course outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Analyze the basics of GPS.	K2
CO2	Demonstrate the impact of various coordinate system and its services.	K2
CO3	Analyze the various codes and range models	K3
CO4	Describe the concepts of GPS propagation.	K6
CO5	Analyze the various applications of GPS.	K3

Correlation between Course Outcomes(COs) and Program Outcomes(POs):

COs	**Program Outcomes(POs)**												**Program Specific Outcomes(PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO 3**
CO1	M	s	-	-	-	-	L	-	-	L	-	L	L	L	-
CO2	M	M	-	-	-	-	L	-	-	M	-	-	L	L	M
CO3	S	L	-	-	-	-	M	-	-	M	-	-	-	-	L
CO4	M	L	-	-	-	-	S	-	-	L	-	L	-	L	M
CO5	L	L	-	-	-	-	S	-	-	S	-	L	L	L	S

UNIT-I	INTRODUCTION TO GPS	**9Hours**

History of GPS – BC-4 System – HIRAN – NNSS – NAVSTAR GLONASS and GNSS Systems –GPS Constellation – Space Segment – Control Segment – User Segment – Single and Dual Frequency– Point – Relative – Differential GPS – Static and Kinematic Positioning – 2D and 3D – reportingAnti Spoofing (AS); Selective Availability (SA) – DOP Factors.

UNIT-II	COORDINATE SYSTEMS AND SERVICES	**9Hours**

Coordinate Systems – Geo Centric Coordinate System – Conventional Terrestrial Reference System – Orbit Description – Keplerian Orbit – Kepler Elements – Satellite Visibility – Topocentric Motion – Disturbed Satellite Motion – Perturbed Motion – Disturbing Accelerations - Perturbed Orbit – Time Systems – Astronomical Time System – Atomic Time – GPS Time – Need for Coordination – Link to Earth Rotation – Time and Earth Motion Services

UNIT-III	CODES AND MODELS	**9Hours**

C/A code; P-code; Y-code; L1, L2 Carrier frequencies – Code Pseudo Ranges – Carries Phases – Pseudo Ranges – Satellite Signal Signature – Navigation Messages and Formats – Undifferenced and Differenced Range Models – Delta Ranges – Signal Processing and Processing Techniques – Tracking Networks – Ephemerides – Data Combination: Narrow Lane; Wide Lane – OTF Ambiguity.

UNIT-IV	PROPAGATION CONCEPTS	**9Hours**

Propagation Media – Multipath – Antenna Phase Centre – Atmosphere in brief – Elements of Wave Propagation – Ionospheric Effects on GPS Observations – Code Delay – Phase Advances – Integer Bias – Clock Error – Cycle Slip – Noise-Bias – Blunders – Tropospheric Effects on GPS Observables– Multipath Effect – Antenna Phase Centre Problems and Correction.

UNIT-V	GPS APPLICATIONS	**9Hours**

Inter Disciplinary Applications – Crystal Dynamics – Gravity Field Mapping – Atmospheric Occulation– Surveying – Geophysics – Air borne GPS – Ground Transportation – Space borne GPS –Metrological and Climate Research using GPS

	Total Hours	**45Hours**

Text Book(s)

B.Hoffman - Wellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice", 4threvised edition, Springer, Wein, New york, 1997

A.Leick, "GPS Satellites Surveying", 2nd edition, John Wiley & Sons, NewYork, 1995

Reference Book(s)

B.Parkinson, J.Spilker, Jr. (Eds), "GPS: Theory and Applications", Vol.I & Vol.II, AIAA,Enfant Promenade SW, Washington, DC 20024, 1996

A.Kleusberg and P.Teunisen (Eds), “GPS for Geodesy”, Springer-Verlag, Berlin, 1996