Course Curriculum for Degree Programme
in
Electronics & Communication Engineering

Department of Electronics & Communication Engineering

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VISION

The Department of Electronics & Communication Engineering shall strive to create engineering technocrats for addressing the global challenges in relevant areas to cater the ever-changing needs of society at National and International level.

MISSION

1. To ensure dissemination of knowledge through effective teaching and learning in Electronics and Communication Engineering.
2. To excel in Research and Development activities in emerging areas.
3. To promote industry-institute and institute-institute linkages for sustainable development of academic, research, training and placement activities.
4. To establish centre of excellence in thrust areas to nurture the spirit of innovation and creativity among faculty and students

Programme Educational Objectives (PEOs)

The B.Tech. (Electronics & Communication Engineering) program shall produce professionals:

1. To be well acquainted with fundamentals of Electronics & Communication Engineering for leading a successful career in industry or as an entrepreneur or pursuing higher education.
2. To inculcate rational approach towards constantly evolving technologies with ethical responsibilities.
3. To foster techno-commercial skills for innovative solutions in Electronics & Communication Engineering or related areas.
4. To participate in life-long learning in the relevant domain for addressing global societal needs.

Programme Outcomes (POs)

After successful completion of B.Tech. (Electronics & Communication Engineering) program, the student will be able to:

1. Apply knowledge of Mathematics, Science and Engineering to solve technical problems in the domain of Electronics and Communication Engineering.
2. Analyse an engineering problem and formulate its appropriate solution.
3. Design solutions for Electronics and Communication Engineering problems and develop system-components, or processes to meet desired needs within realistic constraints.
4. Investigate, design and conduct experiments, interpret data, make inferences therein to provide valid conclusion.
5. Make effective use of modern tools, IT solutions and techniques for modelling complex engineering problems.
6. Address societal, legal, cultural, security, health and safety issues applicable to the design of engineering systems.
7. Provide green and sustainable products in said domain.
8. Adopt and exhibit professional knowledge with ethical responsibilities.
9. Lead and function individually as well as a member of multi-disciplinary team.
10. Communicate effectively through written and oral modes for global competency.
11. Engage in emerging technologies for life-long learning.
12. Take up administrative responsibilities involving both project and financial management confidently.
13. Participate successfully in competitive examinations, career advancement and higher studies.

Electronics and Communication Engineering

Semester-I (Group-A)							
Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	CYT-411	Applied Chemistry	3	1	0	4	4
2	HUT-412	Engineering Economics and Entrepreneurship	3	1	0	4	4
3	CST-411	Elements of Computer Programming	2	0	0	2	2
4	ECT-411	Elements of Electronics Engineering	3	1	0	4	4
5	MET-412	Workshop Technology & Practice-I	2	0	0	2	2
6	CYP-411	Applied Chemistry	0	0	2	2	1
7	CSP-411	Elements of Computer Programming	0	0	2	2	1
8	ECP-411	Elements of Electronics Engineering	0	0	2	2	1
9	MEP-413	Engineering Drawing	0	0	4	4	2
10	WSP-412	Workshop Technology & Practice-I	0	0	4	4	2
		Total	**13**	**3**	**14**	**30**	**23**

Semester-II (Group-A)							
Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-421	Engineering Mathematics	3	1	0	4	4
2	PHT-421	Applied Physics	3	1	0	4	4
3	HUT-421	English Communication & Soft Skills	3	0	0	3	3
4	EET-421	Elements of Electrical Engineering	3	1	0	4	4
5	MET-421	Elements of Mechanical Engineering	3	1	0	4	4
6	PHP-421	Applied Physics	0	0	2	2	1
7	HUP-421	English Communication & Soft Skills	0	0	2	2	1
8	EEP-421	Elements of Electrical Engineering	0	0	2	2	1
9	MEP-421	Elements of Mechanical Engineering	0	0	2	2	1
		Total	**15**	**4**	**8**	**27**	**23**
Semester-IIIA Group-A (UG: Practical Training)							
	TPS-501*	Two weeks Practical Training during summer vacations				80	2 (S/US)

Semester-III							
Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	ECT-511	Network Analysis & Synthesis	3	1	0	4	4
2	ECT-512	Signals & Systems	3	1	0	4	4
3	ECT-513	Digital Electronics	3	1	0	4	4
4	ECT-514	Electronic Devices & Circuits	3	1	0	4	4
5	ECT-515	Electronic Measurements & instrumentation	3	0	0	3	3
6	ECP-513	Digital Electronics	0	0	2	2	1
7	ECP-514	Electronic Devices& Circuits	0	0	2	2	1
8	ECP-515	Electronic Measurements & instrumentation	0	0	2	2	1
		Total	**15**	**4**	**6**	**25**	**22**
Semester III (Summer Training)							
	TPS-501*^	Summer Training					2

Semester-IV							
Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-521	Higher Engg. Mathematics	4	0	0	4	4
2	ECT-521	Analog Communication	3	1	0	4	4
3	ECT-522	Analog Electronic Circuits	3	1	0	4	4
4	ECT-523	Microprocessor & Applications	3	0	0	3	3
5	ECT-524	Digital System Design	3	0	0	3	3
6	ECP-521	Analog Communication	0	0	2	2	1
7	ECP-522	Analog Electronic Circuits	0	0	2	2	1
8	ECP-523	Microprocessor & Applications	0	0	2	2	1
9	ECP-524	Digital System Design	0	0	2	2	1
		Total	**16**	**2**	**8**	**26**	**22**

Semester-V							
Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	PHT-611	Physics of Materials	3	1	0	4	4
2	ECT-611	Digital Communication	3	1	0	4	4
3	ECT-612	EMF & Transmission Lines	3	0	0	3	3
4	ECT-613	Linear IC's & Applications	3	0	0	3	3
5	ECT-615	Microelectronics	3	0	0	3	3
6	ECT-616	Computer Communication Networks	3	0	0	3	3
7	PHP-611	Physics of Materials	0	0	2	2	1
8	ECP-611	Digital Communication	0	0	2	2	1
9	ECP-613	Linear IC's & Applications	0	0	2	2	1
10	ECS-501	Seminar	0	0	2	2	1
		Total	**18**	**2**	**8**	**28**	**24**

Semester-VI							
Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-621	Numerical Analysis	3	1	0	4	4
2	**O-62*	Respective Elective Subject	3	0	0	3	3
3	ECT-621	Electives-I	4	0	0	4	4
4	ECT-622	Microcontroller & Embedded System	3	0	0	3	3
5	ECT-623	Antenna System Engineering	3	0	0	3	3
6	ECT-624	Control System Engineering	3	1	0	4	4
7	AMP-621	Numerical Analysis	0	0	2	2	1
8	ECP-622	Microcontroller & Embedded System	0	0	2	2	1
9	ECS-601	Seminar	0	0	2	2	1
		Total	**19**	**2**	**6**	**27**	**24**
Semester- VIIA (UG: Industrial Training)							
	TPS-701*^	Industrial Training during summer vacations (6 weeks)				200	8 (S/US)

Semester-VII							
Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	HUM-711	Human Values and Professional Ethics	2	0	0	2	2
2	**O-71*	Respective Elective Subject	3	0	0	3	3
3	ECT-711	Elective-II	4	0	0	4	4
4	ECT-712	Digital Signal Processing	3	0	0	3	3
5	ECT-713	Wireless Communication	3	0	0	3	3
6	ECT-714	Microwave Engineering	3	0	0	3	3
7	ECP-712	Digital Signal Processing	0	0	2	2	1
8	ECP-714	Microwave Engineering	0	0	2	2	1
9	ECP-715	Minor Project	0	0	4	4	2
		Total	**18**	**0**	**8**	**26**	**22**

Semester-VIII							
Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	CHM-721	Environmental Studies	3	0	0	3	3
2	HUT-721	Principles of Management	3	1	0	4	4
3	**O-72*	Respective Elective Subject	3	0	0	3	3
4	ECT-721	Elective-III	4	0	0	4	4
5	ECT-722	Elective-IV	4	0	0	4	4
6	ECT-723	Optical Fiber Communication	3	0	0	3	3
7	ECP-723	Optical Fiber Communication	0	0	2	2	1
8	ECP-724	Major Project	0	0	8	8	4
		Total	**20**	**1**	**10**	**31**	**26**
***^ The credit will not be considered for CGPA calculation**							

Credit Structure

	Theory	Tutorial	Practical	Hrs.	Credits
Total Basic Sciences	19	5	8	32	28
Total Humanities	9	2	2	13	12
Total Other Engineering	13	3	16	32	24
Total Open Electives	9	0	0	9	9
Total Core Subject	79	8	26	113	100
Total Mandatory Courses	5	0	0	5	5
Projects + Seminar	0	0	16	16	8
Summer Training and Industrial Training					10
Total	**134**	**18**	**68**	**220**	**196**

List of Elective Courses for Elective-I (ECT-621), Elective-II (ECT-711), Elective-III (ECT-721) and Elective-IV (ECT-722)

Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	**ECT-621**	**Elective-I**	**4**	**0**	**0**	**4**	**4**
	A	Nanotechnology					
	B	Neural Networks & Fuzzy Logic					
	C	Information Theory & Coding					
	D	Device & Circuit simulation					
	E	Pulse and Digital Switching Circuits					
	F	Selected Topic -1					
2	**ECT-711**	**Elective-II**	**4**	**0**	**0**	**4**	**4**
	A	Optoelectronic Devices & Circuits					
	B	Satellite Communication					
	C	MEMS					
	D	MATLAB Programming					
	E	Electronics System Design					
	F	Selected Topic -2					
3	**ECT-721**	**Elective-III**	**4**	**0**	**0**	**4**	**4**
	A	VLSI Physical Design					
	B	Digital Image Processing					
	C	Industrial Electronics					
	D	Biomedical Electronics					
	E	Computer Architecture & Organization					
	F	Selected Topic -3					
4	**ECT-722**	**Elective-IV**	**4**	**0**	**0**	**4**	**4**
	A	Radar & Navigation Aids					
	B	MOS Device Physics & Modeling					
	C	Wireless Sensor Networks					
	D	Analog VLSI Design					
	E	Telecommunication Switching Systems and Networks					
	F	Selected Topic-4					

List of Open Elective Courses for Open Elective-I (ECO-62*), Open Elective-II (ECO-71*), and Open Elective-III (ECO-72*)

Sr. No	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	**O-62*	**Open Elective-I**	**3**	**0**	**0**	**3**	**3**
	ECO-621	Principle of Communication Engineering					
	ECO-622	Optical Electronics					
	ECO-623	Electronic Measurement & Instrumentation					
	ECO-624	Selected Topic-A					
2	**O-71*	**Open Elective-II**	**3**	**0**	**0**	**3**	**3**
	ECO-711	Fundamentals of Microprocessor					
	ECO-712	VLSI Technology					
	ECO-713	Nanotechnology					
	ECO-714	Selected Topic-B					
3	**O-72*	**Open Elective-III**	**3**	**0**	**0**	**3**	**3**
	ECO-721	Biomedical Electronics					
	ECO-722	Microcontroller and Embedded Systems					
	ECO-723	Wireless Communication					
	ECO-724	Selected Topic-C					

ECT-411 Elements of Electronics Engineering				
	L	**T**	**P**	**Credits**
	3	**1**	**0**	**4**
	Sessional Marks			**50**
	End Semester Examination Marks			**50**
Course Objectives	The aim of this course is to provide an introduction and basic understanding of semiconductor devices viz. diodes, bipolar junction transistors, junction field effect transistors and operational amplifiers to develop the ability to design basic electronic circuits. The course also focuses on knowledge about number systems and logic circuits introducing basic gates and flip-flops.			
Course Outcomes	1. Apply knowledge of mathematics, science and engineering to analyze the operation of electronic devices. 2. Design electronic circuits such as rectifiers, voltage regulators, transistorized amplifiers and operational amplifiers. 3. Able to represent numerical values in various number systems and perform conversions among different number systems. 4. Able to understand basic logic gates, logic circuits and flip flops.			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	W	W	W	S	W	N	N	N	M	W	S
CO2	S	S	S	S	S	M	W	W	N	N	S	M	S
CO3	S	S	N	N	N	N	N	N	N	N	W	N	S
CO4	S	S	S	M	W	S	N	N	N	N	N	N	S

Unit-I — **12 hrs**

Number system and codes: Decimal, binary, octal, and hexadecimal number system and their inter-conversions, Gray code, Excess-3 code.

Logic gates and flip flops: Definitions, symbols and truth table of NOT, OR, AND, NAND, NOR, XOR, XNOR gates, De-Morgan's theorems, realization of basic gates using universal gates; realization of simple Boolean equations using universal gates, introduction to K- map (3 variables), logic diagram, truth table and operation of latches and flip flops: RS, T, D, JK.

Unit-II — **16 hrs**

Semiconductor devices: Semiconductor materials: Ge, Si, intrinsic and extrinsic semiconductors, p-type, n-type, p-n junction theory and diodes, its V-I characteristic, equivalent model, diode applications- half wave, full wave and bridge rectifier circuits, filter circuits: inductor filters, capacitor filters, L- section filters, π- section filters, comparison of filters, clippers and clampers, Zener diode, its characteristics and application as a voltage regulator, LED, photodiode.

Unit-III — **12 hrs**

Transistors: Bipolar junction transistor(BJT): basic operation, biasing, concept of dc load line and operating point selection, CB, CE, and CC configurations, BJT as an amplifier and switch, introduction to JFET and MOSFET: construction and operation.

Unit-IV	**12hrs**
Operational amplifiers (Op-Amps.): Introduction, basic characteristics of ideal and practical Op-Amp, IC741 pin configuration, Op-Amp in different modes: inverting and non-inverting amplifier, basic applications: adder, subtractor, voltage follower, multiplier, differentiator & integrator, instrumentation amplifier.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Electronic Devices & Circuits	David A. Bell	Oxford University Press, 5th Edition 2010
2. Electronic Devices & Circuits	J. Millman & Halkias	McGraw Hill Education 3rd Edition 2010
3. Electronic Devices & Circuit Theory	Robert L. Boylsted, Louis Nashelsky	Pearson Education
4.Digital Systems: Principles and Applications	Ronald J. Tocci	PearsonEducation

ECP-411
Elements of Electronics Engineering

	L	T	P	Credits
	0	0	2	1

Course Objectives: The aim of this lab is to give practical exposure to students by analyzing-I characteristics of different semiconductor electronics devices and design of basic electronic circuits. This lab also includes verification and testing of truth table of various TTL gates and flip flops.

Course Outcomes:
1. Design practical circuits using semiconductor diodes.
2. Analyze various modes of transistors in different configurations.
3. Design circuits using Op-Amp(IC-741) for various operations.
4. Analyze and design various digital circuits using basic gates and flip flops.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	N	S	S	M	M	N	N	N	W	N	M	S
CO2	N	S	S	S	M	M	N	N	N	W	N	N	N
CO3	N	S	N	S	M	M	N	N	N	W	N	M	S
CO4	N	S	S	S	M	M	N	N	N	W	N	M	S

List of Experiments:

1. To observe and analyze V-I characteristics of PN junction diode.
2. To observe and analyze V-I characteristics of Zener diode.
3. Design and analysis of half wave rectifier with capacitor filter.
4. Design and analysis of center tap full wave rectifier with capacitor filter.
5. Design and analysis of bridge type full wave rectifier with capacitor filter.
6. Design and analysis of zener as a voltage regulator.
7. To observe V-I characteristic of PNP and NPN transistor in common base configuration.
8. Design and analysis of Op-Amp as an inverting amplifier & non-inverting amplifier.
9. Design and analysis of Op-Amp as an integrator & differentiator.
10. To observe V-I characteristic of JFET.
11. To observe V-I characteristic of MOSFET.
12. Verification of the truth tables of TTL gates, e.g., 7400, 7402, 7404, 7408, 7432, 7486.
13. Design all other gates using NAND and NOR gates.
14. Design S-R flip-flop using NOR/NAND gates.
15. Verify the truth table of J-K flip-flop (7476), D flip-flop (7474) and T flip-flop.

ECT -511
Network Analysis and Synthesis

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives

Network analysis and synthesis is the foundation on which most other courses in the electronics and electrical engineering are based. The main objective of this course is to provide platform to understand analysis of different networks and provide knowledge of network synthesis.

Course Outcomes

1. Application of basic circuital laws and simplify the network using reduction techniques.
2. Analyze circuits using Kirchhoff's law and network simplification theorems.
3. Infer and evaluate transient response, steady state response, network functions.
4. Evaluation of two port network parameters.
5. Synthesis of networks using Foster and Cauer forms.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	W	N	N	N	N	N	N	N	N	N	S
CO2	M	M	M	N	N	N	N	N	N	N	W	N	S
CO3	W	S	W	N	N	N	N	N	N	N	W	N	S
CO4	S	S	M	N	N	N	N	N	N	N	N	N	S
CO5	S	W	M	N	N	N	N	N	N	N	N	N	M

Unit-I — **14 hrs**

Basics of circuit analysis: Two terminal circuit elements (resistor, capacitor and inductor) and their characteristics, ideal voltage and current source, energy concepts in two terminal elements- Delta transformation, Kirchoff 's Laws, nodal and mesh analysis.

Network theorems: Superposition theorem, reciprocity theorem, Thevenin's theorem, Norton theorem, Millman's theorem, maximum power transfer theorem, substitution theorem, compensation theorem, Tellegne's theorem (for both AC and DC excitations).

Unit-II — **16 hrs**

Two port networks: Introduction to single and two port networks, parameters of two port networks such as impedance, admittance, hybrid, transmission, etc. relationship among different parameters, series and parallel connections of two-port networks, conditions for symmetrical and reciprocal networks, duality.

Resonance and magnetically coupled circuits: Introduction to resonance, series resonance, parallel resonance, concept of self-inductance and mutual inductance, coupling coefficient, magnetically coupled circuits, simple series and parallel circuits, dot convention, ideal transformer.

Unit-III	**12 hrs**
Transient and steady state analysis: Transients in RL, RC circuits, initial conditions, time constants,concept of phasors, impedance and admittance, analysis of RL, RC and RLC circuits with sinusoidal and driving sources, steady state analysis using phasor, network function: one-port networks and two-port networks, impedance function and admittance function, transfer function, poles and zeros of network functions, restrictions on locations of poles and zeros in driving point functions and transfer functions, review of Laplace transform, solution of network equations using Laplace transform.	
Unit-IV	**12 hrs**
Network synthesis: Hurwitz polynomials, positive real functions, synthesis of dissipative networks, Foster and Cauer realization (1,IIforms) for LC, RL and RC networks. **Graph theory:** Concept of network graph, tree, tree branches and links, tie-set and cut-set matrices, introduction to SPICE simulators and MATLAB for solving circuit problems.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Fundamentals of Electric Circuits	Charles K. Alexander and Matthew N.O.Sadiku	Tata McGraw Hill
2. Engineering Circuit Analysis	William H. Hayt and Jack Kemmerly	Tata McGraw Hill
3. Network Analysis	Van Valkenburg	Prentice Hall of India
4. Circuit and Networks: Analysis and Synthesis	A. Sudhakar and S.Palli	Tata McGraw Hill
5. Networks and Systems	D. Roy Choudhary	New Age International

ECT-512
Signals & Systems

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

This course aims to provide detailed description of continuous and discrete-time signals and systems, their properties, representations and methods that are necessary for the analysis of continuous and discrete-time signals and systems. Knowledge of time-domain and frequency-domain representation and analysis using Fourier series and Transforms, Laplace-transform, to understand principles of random signals and random processes.

Course Outcomes

1. Identify different types of signals and systems that are commonly used in engineering.
2. Differentiate between the properties of continuous-time and discrete-time systems and represent CT and DT systems in the frequency domain using Fourier analysis.
3. Apply the Laplace transform for calculation of time responses of LTI systems.
4. To understand the basic concepts of probability and random variables.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	N	M	N	N	N	N	N	N	N	N	N	S
CO2	S	M	M	N	S	N	N	N	N	N	N	N	S
CO3	S	M	M	N	S	N	N	N	N	N	N	N	S
CO4	S	N	M	N	M	N	N	N	N	N	N	N	S

Unit-I — **12 hrs**

Introduction: Definition of signals and systems, elementary signals, classification of signals and systems, properties of systems.

LTI systems: Continuous-time and Discrete-time LTI systems, their properties.

Unit-II — **14hrs**

Fourier series representation of signals: Fourier series representation of continuous-time and discrete-time periodic signals, properties of continuous-time and discrete-time Fourier series.

Fourier transform: Continuous-time Fourier transform of periodic and aperiodic signals, properties of continuous-time Fourier transform, discrete-time Fourier transform of periodic and aperiodic signals, convolution.

Unit-III — **12 hrs**

Laplace transform (LT): One-sided Laplace transform (LT) of common signals, important theorems and properties of LT.

Inverse Laplace transform: Inverse LT, solutions of differential equations using LT, bilateral LT, region of convergence (ROC).

Unit-IV	**14 hrs**
Random signal theory: Concept of probability, random variables, commutative distribution function, probability density function (PDF), average value and variance of random variables, Gaussian (PDF), Rayleigh (PDF), mean, variance and PDF of the sum of random variables, correlation between two random variables. **Random processes**: Introduction, classification, correlation and auto correlation, stationary andergodic process.	

RECOMMENDED BOOKS

Title	**Author**	**Publisher**
1. Signals and Systems	Alan V. Oppenheim, Alan S.Willsky	Pearson Education Limited, (2013)
2. Signal Processing and Linear Systems	B P Lathi	Oxford University Press, (2003)
3. Signals and Systems	T. Rawat	Oxford University Press, (2010)
4. Signals and Systems	Simon Haykin, Barry Van Veen	John Wiley & Sons, (2007)

ECT-513
Digital Electronics

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives	The aim of this course is to introduce basic postulates of Boolean expressions and analyze the design of combinational circuits, sequential circuits, digital logic families, semiconductor memories and programmable logic devices.
Course Outcomes	1.Design and analysis of combinational digital circuits. 2.Design and analysis of sequential digital circuits. 3.Understand digital logic families and its limitations. 4.Understand the concept of semiconductor memories and programmable logic devices.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	N	N	M	N	N	N	N	N	N	S
CO2	S	S	S	N	N	M	M	N	N	N	N	N	S
CO3	M	S	S	N	N	M	N	N	N	N	W	N	S
CO4	M	W	M	N	N	M	M	N	N	N	W	N	S

Unit-I — **14 hrs**

Introduction: Representation of logic, logic variables, Boolean algebra, Boolean expressions and minimization of Boolean expression using K-map (up to six variables), review of logic gates, design and implementation of adder, subtractor, multiplexer, de-multiplexer, encoder, decoder, digital comparators, code converters.

Unit-II — **12 hrs**

Flip-flops: Latches, S-R flip-flop, JK flip-flop, race around condition, master slave flip-flop, D & T type flip-flop, excitation table of flip-flops, conversion of flip-flops.

Unit-III — **10 hrs**

Counters & shift registers: Design with state equations, ripple counters, design of modulo-n ripple counter, pre-settable counters, up-down counter, decade counter, design of synchronous and asynchronous counters, design of shift registers with shift-left, shift-right & parallel load facilities, universal shift registers.

Unit-IV — **16 hrs**

Digital logic families: Characteristics of digital circuits: fan in, fan-out, power dissipation, propagation delay, noise margin, transistor-transistor logic (TTL), types of TTL gates, tristate logic & its applications, emitter coupled logic (ECL), CMOS, comparison of characteristics of TTL, ECL, and CMOS, interfacing of logic families.

Semiconductor memories: Memory organization, ROM, PROM, EPROM, EEPROM, RAM, Static RAM, dynamic RAM cell, memory cell, reading & writing operation in RAM.

Kuldip Singh Vivek Harshey Dilip Kumar L. S. Solanki J.S. Ubhi A. Marwaha

RECOMMENDED BOOK		
Title	**Author**	**Publisher**
1. Digital Design	Morris Mano	PHI, 4th edition
2. Digital System Principles & Applications	R J Tocci	PHI
3. Digital Integrated Electronics	Taub Schilling	Tata McGraw Hill Education
4. Integrated Electronics	Millman & Halkias	Tata McGraw Hill Education
5. Digital Computer Electronics	Malvino Brown	Tata McGraw Hill Education
6. Modern Digital Electronics	R P Jain	Tata McGraw Hill

ECP-513
Digital Electronics

	L	T	P	Credits
	0	0	2	1
Course Objectives	The aim of this lab is to verify and design of basic digital electronics circuits. It includes designing and testing of combinational circuits, sequential circuits, digital logic families and programmable logic devices**.**			
Course Outcomes	1.Analysis of various logic gates, implementation of Boolean functions. 2.Design and analysis of combinational digital circuits. 3.Design and analysis of sequential digital circuits. 4.Design semiconductor memories and programmable logic devices.			

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	S	S	M	W	N	M	M	W	N	N	S
CO2	M	S	S	S	M	W	M	M	M	W	N	N	S
CO3	M	S	S	S	M	S	N	M	M	W	S	N	S
CO4	M	W	S	S	M	S	M	M	M	W	S	N	S

List of Experiments:

1. Introduction to Digital Electronics lab-nomenclature of digital ICs, specifications, study of the datasheet, concept of V_{cc} and ground.
2. To verify De-Morgan's Theorem.
3. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
4. To realize half/full adder and half/full subtractor using basic/universal gates.
5. To realize parallel adder/subtractor using IC 7483.
6. To verify BCD to excess-3 code conversion using NAND gates.
7. To convert Gray code to binary number and binary number to Gray code.
8. Implementation and verification of decoder/de-multiplexer and encoder using logic gates.
9. Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates. To implement the arithmetic circuits half adder, half subtractor, full adder and full subtractor using multiplexers.
10. To design and verify the operation of magnitude comparator
11. Verification of state tables of RS, J-K, T and D Flip-Flops using NAND Gates with timing diagrams.
12. To design and verify the 4-Bit serial in-parallel out, parallel in-serial out, parallel in-parallel out, serial in-serial out shift registers.
13. To design and verify the 4-bit synchronous counter.
14. To design and verify the 4-bit asynchronous counter.
15. To design 1-bit static memory cell on PSPICE/HSPICE.

*Experimentation work to be supported by simulated results.

ECT-514
Electronic Devices & Circuits

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The objective of this course is to familiarize with semiconductors devices. Qualitative analysis of PN junction diode and introduction to special purpose diodes. To study and analyze the performance of BJT, FETs, UJT on the basis of their operation and principle of working.

Course Outcomes

1. To acquire knowledge about semiconductor physics for intrinsic and extrinsic materials.
2. To learn basics of various semiconductor diodes, BJTs and their qualitative and quantitative analyses.
3. To study and analyze the performance of FETs based on their operation and working.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	W	W	W	N	N	N	N	N	M	N	S
CO2	S	S	M	S	W	N	M	N	N	N	S	N	S
CO3	S	S	M	S	W	N	M	N	N	N	S	N	S

Unit-I — **12 hrs**

Semiconductor physics: The energy band theory in crystal, charge carriers in semiconductors, carrier concentrations, Fermi level, electron and hole concentration at equilibrium, carrier drift and diffusion, conductivity and mobility, carrier life time, Poisson's and continuity equation, Hall effect.

Unit-II — **14 hrs**

The P-N junction theory: P-N junction equilibrium condition, contact potential, equilibrium Fermi level, electric field, space charge at junction, qualitative theory of P-N junction, P-N junction as a diode, diode equation, volt- ampere characteristics, temperature dependence of V-I characteristic, diode models, depletion and diffusion capacitance, junction breakdown mechanism, diode switching characteristics.

Special purpose devices: Varactor diode, Tunnel diode, Schottky barrier diode, LED, photodiode, SCR.

Unit-III — **14 hrs**

Bipolar junction transistor (BJT): Device structure and physical operation, transistor current components, modes of operation, common emitter, common base and common collector configurations, input, output characteristics, BJT specifications, DC and AC load line, transistor biasing: need for biasing, fixed bias, collector feedback bias, emitter feedback bias, collector - emitter feedback bias, voltage divider bias, bias stabilization, stability factor, stabilization against variations in V_{BE} and β, thermal runaway, thermal stability, transistor as an amplifier, small signal low frequencyhybrid π model of transistor, voltage gain, power gain and current gain, expressing gain in decibels, r_e transistor model, h-parameters, frequency response of BJT amplifier, switching times.

Kuldip Singh Vivek Harshey Dilip Kumar L. S. Solanki J.S. Ubhi A. Marwaha

Unit-IV	**12 hrs**
Junction field effect transistor: Basic n channel and p channel JFET operation, its V-I characteristics. **Metal oxide semiconductor field effect transistor**: Construction, operation and its characteristic. FET biasing, UJT.	

RECOMMENDED BOOKS

Title	Author	Publisher
1.Semiconductor Physics and Devices	Donald A. Neamen	Tata McGraw-Hill
2. Electronic Devices & Circuits	J. Millman & C Halkias	McGraw Hill Education 3rd Edition 2010
3.Microelectronic Circuits	Adel S. Sedra, Kenneth C. Smith	Oxford Press 6th Edition 2013
4. Solid State Electronics Devices	Ben G Streetman & Sanjay Banerjee	PHI 6th edition, 2013

ECP-514
Electronic Devices & Circuits

	L	T	P	Credits
	0	0	2	1

Course Objectives: The aim of this lab is give practical exposure to students by analyzing V-I characteristics of different semiconductor electronic devices i.e. diodes, transistors, JFET and MOSFET.

Course Outcomes:
1. Ability to analyze V-I characteristics of various semiconductor diodes.
2. Observe and analyze the various modes of transistors in different configurations.
3. Design and analyze various electronic circuits.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	W	M	W	M	N	N	M	M	M	N	M
CO2	S	M	W	S	M	M	M	N	M	M	S	N	M
CO3	S	S	S	S	W	M	M	N	M	M	S	N	M

List of Experiments:

1. Design and analysis of full wave rectifier with and without LC filter.
2. To observe and analyze various diode clamping circuits.
3. To observe and analyze various diode clipping circuits.
4. To observe V-I characteristics of PNP and NPN transistor in common collector configuration.
5. To observe V-I characteristic of PNP and NPN transistor in common emitter configuration.
6. To design the circuit of CE amplifier and measure its voltage and current gain.
7. To plot the frequency response characteristics of a RC single stage amplifier.
8. To observe V-I characteristics of D- MOSFET and E- MOSFET.
9. To observe and analyze V-I characteristic of SCR.
10. To observe and analyze V-I characteristic UJT.
11. To observe and analyze V-I characteristic of Varactor diode.
12. To observe and analyze V-I characteristic of Tunnel diode.
13. To observe and analyze V-I characteristic of Schottky Barrier diode.

ECT-515
Electronic Measurements and Instrumentation

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

Aim of the course is to study the basics of unit, dimensions and standards. It also gives deep insight to PMMC instrument and bridges. It discusses as to how the analog data is converted to digital and vice versa. It also discusses the CRO and concept of signal generator and analyzer.

Course Outcomes

1. Understand the various types of errors introduced in measurements.
2. Understand the working of PMMC instruments, bridge theory, A/D and D/A converters.
3. Capability to use CRO, signal generators and analyzers.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	W	M	N	N	N	N	N	N	N	N	N	N	M
CO2	N	S	M	N	N	N	N	N	N	N	N	N	M
CO3	N	S	M	N	N	N	N	N	N	N	N	N	M

Unit-I — **12 hrs**

Unit, dimensions and standards: Scientific notations and metric prefixes. SI electrical units, SI temperature scales, other unit systems, dimension and standards. measurement errors: gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, measurement error combination, basics of statistical analysis. PMMC instrument, galvanometer, DC ammeter, DC voltmeter, series ohm meter.

Unit-II — **12 hrs**

AC electronic voltmeter: Digital voltmeter systems, digital multimeter, digital frequency meter system, voltmeter and ammeter methods, Wheatstone bridge, low resistance measurements, low resistance measuring instruments AC bridge theory, capacitance bridges, Inductance bridges, Q meter.

Unit-III — **12 hrs**

Analog to digital converter: Transfer characteristics, A/D conversion technique: simple potentiometer and servo method, successive approximation method ramp type, integrating and dual slope integrating method. D/A converter: transfer characteristic, D/A conversion technique, digital mode of operation, performance characteristics of D/A convertors.

Unit-IV — **12 hrs**

CRO: CRT, wave form display, time base, dual trace oscilloscope, measurement of voltage, frequency and phase by CRO, oscilloscope probes, oscilloscope specifications and performance. signal generator and analyzer: signal generator: sine wave, non-sinusoidal signal and function generators, frequency synthesis techniques and digital signal generators. signal analyzers: spectrum analyzer and distortion, concept of ECG, EMI, EMC, and EEG etc. recorders: X-Y recorders, plotters.

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. Electronic Instrumentation and Measurements	David A. Bell	2nd Ed., PHI , New Delhi,2008
2.Electronic Measurements and instrumentation.	Oliver and Cage	TMH, 2009

ECP-515
Electronic Measurement and Instrumentation Lab

	L	T	P	Credits
	0	0	2	1

Course Objectives: The aim of this lab is to familiarize the students about the working of different instruments, digital multimeter, Maxwell, Hay's inductance bridges and transducers, CRO, tester, and analyzers.

Course Outcomes:
1. **A**ble to work with analog and digital multimeters.
2. Able to use CRO, function generator and frequency counter for performing various measurements.
3. To understand the use of different bridges, A/D converter, D/A converter and transducers.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	N	S	M	N	N	M	N	M	W	N	W
CO2	S	S	S	S	M	N	N	M	N	M	W	N	W
CO3	S	S	S	S	M	N	N	M	N	M	W	N	W

List of Experiments:

1. To use analog and digital multimeter for various measurements.
2. To extend the range of given voltmeter and ammeter for various measurements.
3. To study blockwise construction of function generator and frequency counter**.**
4. Dissection of horizontal deflection system of CRO and to measure /observe voltage/current waveforms at each important test points.
5. To measure frequency and phase using Lissajous method.
6. To find the value of unknown resistor using Wheatstone bridge.
7. To find the value of unknown capacitance and inductance using Maxwell's bridge.
8. To find the value of unknown capacitance using Wein's series and parallel bridge.
9. To study measurement of different components and parameters like Q of a coil using LCR Q-meter.
10. To determine output characteristics of LVDT and measure displacement using LVDT.
11. Design and test D/A converter using R-2R ladder network
12. Design and test A/D converter.

Design based problems (DP)/open ended problem **(using tools also like Pspice/MultiSim etc. for practical design and testing)**:

1. To design various bridges for finding the unknown quantities.
2. To design various transducer circuits systems for measuring different non-electrical quantities.
3. To design function generator and frequency counter as per given specification.

TPS-501 Summer Training				
	L	**T**	**P**	**Credits**
				2
Course Objectives	To provide hands-on experience in various domains such as hardware, software, maintenance and testing			
Course Outcomes	Students undergo two-week practical training in Department of Electronics & Communication Engineering so that they become aware of the practical application of theoretical concepts studied in the class rooms.			

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	N	S	S	S	M	M	N	M	M	N	S

ECT-521
Analog Communication Systems

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives

The course emphasizes on the use of essential analytical tools and theories of analog communication systems, understand various analog communication techniques, AM, FM transmission and reception circuits, analog pulse modulation techniques and noise in communication systems.

Course Outcomes

1. To gain knowledge about the fundamental concepts of various analog communication systems.
2. To design the AM, SSB, FM and PM transmission and reception circuits.
3. To understand the basics of PAM, PWM and PPM systems.
4. To understand practical implementation issues and evaluate fundamental communication system parameters including noise.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	N	N	N	M	S	N	N	N	M	N	S
CO2	S	S	S	S	N	M	S	N	N	N	M	N	S
CO3	S	S	N	N	N	M	N	N	N	N	N	N	S
CO4	S	S	S	S	N	M	N	N	N	N	N	N	S

Unit-I — **14 hrs**

Analog modulation techniques: Introduction to modulation, need of modulation, theory of amplitude modulation, frequency spectrum of AM wave, AM power calculations, AM modulation with a complex wave, concepts of angle modulation, theory of frequency modulation, mathematical analysis of FM, spectra of FM signals, narrow band FM, wide band FM, phase modulation, phase modulation obtained from frequency modulation, comparison of AM, FM and PM.

AM transmission: Basic principle of AM generation, square law modulation, low level and high-level modulation, grid modulated class-C amplifier circuit (Vander Bijl modulation), plate modulated class-C amplifier circuit, suppressed carrier AM generation (balanced modulator) diode ring modulator, product modulator.

Unit-II — **12 hrs**

FM transmission: FM generation methods: generation of FM by direct method, basic reactance modulator, varactor diode modulator, indirect generation of FM by Armstrong method; frequency stabilized AFC transmitter system, pre-emphasis circuit, stereophonic FM transmitter system.

SSB transmission: Introduction, advantages of SSB transmission, generation of SSB, filter method, phase shift method, Hilbert transform, representing SSB signals in terms of Hilbert transforms, SSB modulator using a Hilbert transform, third method, forms of amplitude modulation, pilot carrier system, independent sideband system (ISB), vestigial sideband system (VSB).

Unit-III	**14 hrs**
AM reception: Tuned radio frequency (TRF) receiver, super-heterodyne receiver, AM receiver characteristics. RF amplifier, Image frequency rejection, choice of intermediate frequency, frequency conversion and mixer circuits, tracking and alignment, IF amplifier, AM detector, practical diode detector with AGC, distortion in diode detectors, double heterodyne receiver, coherent AM detection, AM receiver using a phase locked loop (PLL). **FM reception**: Introduction, block diagram of FM receiver, amplitude limiter, de-emphasis circuit, basic principle of FM detection, slope detector, balanced slope detector, Foster-Seely phase discriminator, ratio detector, FM detector using PLL, zero crossing detector as a frequency demodulator, stereo FM receiver. **SSB reception:** SSB product demodulator, balanced modulator as SSB demodulator, SSB envelop detection receiver, pilot carrier SSB receiver, SSB double heterodyne receiver, ISB receiver, modern communication receiver.	
Unit-IV	**12 hrs**
Analog pulse modulation techniques: Introduction, pulse amplitude modulation (PAM), natural PAM, flat-top PAM, sampling theorem, frequency spectra for PAM, PAM time multiplexing, pulse time modulation (PTM), pulse width modulation (PWM), pulse position modulation (PPM), pulse code modulation, generation and detection of PAM, PWM, PPM and PCM. **Noise**: Introduction, external noise, internal noise, resistor noise, multiple resistor noise sources, shot noise, transit time noise, noise in reactive circuits, noise temperature, noise bandwidth, effective input noise temperature, noise figure, noise figure calculations, noise in analog modulated systems, SNR calculation for AM and FM.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Electronic Communication Systems	Kennedy, G.	Tata McGraw-Hill (2008) 4th ed
2. Communication Systems	Haykin, S.	John Wiley & Sons (2009) 4th ed.
3. Principles of Communication Systems	Taub, H**&**Schilling	John Wiley & Sons
4. Electronic Communication Systems	Wayne Tomasi	Pearson Education (2011), 5thed

ECP-521 Analog Communication Systems				
	L	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Course Objectives	This lab includes hardware kits as well software simulator to analyze different analog communication systems. The main objective is to analyze the performance of AM, FM modulation systems in time and frequency domain, to study and design the circuits for transmission and reception of AM, FM and pulse modulation systems.			
Course Outcomes	1. Design and analyze AM and FM modulation circuits on hardware as well as on MULTISIM simulator. 2. Understand transmission and reception of AM and FM systems. 3. Design and analyze various pulse modulation systems on hardware as well as on MULTISIM simulator.			

Mapping of course outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	M	S	M	N	M	M	M	S	N	S
CO2	S	S	S	M	S	M	M	M	M	M	S	N	S
CO3	S	S	S	M	S	M	N	M	M	M	S	N	S

List of Experiments (Hardware):

1.To measure the modulation index of AM signal using the sine wave method and trapezoidal method.
2.To setup the circuit of AM modulator using transistor.
3.To setup the circuit of envelop detector for AM demodulation.
4.To study the DSB/ SC AM signal and its demodulation using product detector circuit.
5.To study the generation and detection of FM signals.
6. To study the AM transmitter circuit and observe the waveforms at test points.
7.To study the FM transmitter circuit and observe the waveforms at test points.
8.To study the AM receiver circuit and observe the waveforms at test points.
9.To study the sampling process and time division multiplexing.
10.To study the pulse amplitude modulation and demodulation circuits.
11.To study the pulse width modulation and demodulation circuits.
12.To study the pulse code modulation and demodulation circuits.

Software (using MULTISIM)

1.To study the spectrum of pulses using spectrum analyzer.
2.To measure the modulation index of AM signal using the sine wave method and trapezoidal method.
3.To observe the amplitude spectrum and measure the bandwidth of AM signal.
4.To setup the circuit of AM modulator using transistor.
5.To setup the circuit of envelop detector for AM demodulation.
6.To setup the circuit of DSB/SC AM and DSB-FC AM using product modulator/multiplier.
7.To study the FM wave generated from FM source in MULTISIM and measure the modulation index by approximate method.
8.To observe the amplitude spectrum and measure the bandwidth of FM signal.
9.To generate FM signal using voltage-controlled oscillator on MULTISIM and observe the waveforms on CRO.
10. To generate pulse amplitude modulation (PAM) signal and observe its waveform.
11.To generate PWM signal using 555 timer IC and observe its waveform.
12.To generate PPM signal and observe its waveform.

ECT-522
Analog Electronics Circuits

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives: To study the transistor behaviour at low and high frequency and analyze the behaviour of multistage amplifier by coupling in different ways. To study different feedback configurations, oscillators, power amplifiers and tuned amplifiers.

Course Outcomes:
1.Analyze the low and high frequency response of BJT, MOSFET.
2. Learn the design approach for transistor single stage and multistage amplifiers and tuned amplifiers.
3. Design multistage amplifiers and various coupling techniques.
4. Design and analyze feedback circuits and oscillators.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	M	W	N	M	N	N	N	M	N	S
CO2	S	S	S	M	W	N	N	N	N	N	N	N	N
CO3	S	S	M	S	W	N	M	N	N	N	W	N	S
CO4	S	S	M	M	W	N	W	N	N	N	W	N	S

Unit-I — **14 hrs**

Single stage BJT amplifiers: Analysis of transistor amplifier circuit using h-parameters, CE amplifier, CB amplifier, emitter follower and comparison.
Single stage MOS amplifiers: Small signal operation and model, CS amplifier, CG amplifier and source follower and comparison. BJT current mirrors and MOS current mirrors circuits and their analyses.

Unit-II — **14 hrs**

Multistage amplifier: Multi-stage amplifier gain, effect of loading, types of coupling, direct and RC coupled amplifiers, frequency response of a BJT and FET amplifier, cut-off frequencies and bandwidth, cascode amplifiers- MOS cascode, BJT cascode, cascode current source, double cascoding, folded cascode, Darlington amplifier.
Transistor at high frequencies: High frequency model of BJT and frequency response of CE amplifier, gain-bandwidth product, Miller‘s theorem, MOSFET at high frequency, common source amplifier at high frequencies, analysis using Miller theorem.

Unit-III — **12 hrs**

Feedback amplifiers: Properties of negative feedback, four basic feedback topologies, analysis of current-series, current-shunt, voltage-series and voltage-shunt feedback amplifiers.
Oscillators- The oscillation criteria, Wien bridge, phase shift, LC tuned oscillators, crystal oscillators, astable multivibrator.

Unit-IV	**12 hrs**
Output stages and power amplifiers: Classification of output stages, analysis of class-A output stage, class-B output stage, class AB output stage, class C output stage, harmonic distortion. **Tuned amplifiers**: Basic principle, inductor losses, amplifiers with multiple tuned circuits, synchronous and stagger tuning, class C tuned amplifier.	

RECOMMENDED BOOKS

Title	Author	Publisher
1.Microelectronic Circuits	Adel S. Sedra, Kenneth C. Smith	Oxford Press 6th Edition 2013
2. Integrated Electronics	Millman & Halkias	Tata McGraw -Hill Education
3. Electronics devices and circuit theory	Robert L Boylestad & Louis Nashelsky	Pearson Education

ECP-522
Analog Electronics Circuits

	L	T	P	Credits
	0	0	2	1

Course Objectives: This lab includes the analysis of analog electronic circuits using hardware kits as well as on ORCAD spice simulator. It also includes the study of response of multistage amplifiers under various coupling techniques. Further in this lab student will observe the frequency response of various amplifiers.

Course Outcomes:
1. Analyze the frequency response of various coupling amplifiers.
2. Analyze the frequency response of FET amplifier.
3. Analyze the class A, B amplifiers and tuned voltage amplifier.
4. Design various oscillator circuits.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	S	M	S	N	W	N	N	N	M	N	W
CO2	S	S	M	M	S	N	W	N	N	N	S	N	N
CO3	S	M	M	S	W	N	W	N	N	N	W	N	W
CO4	S	M	M	S	M	N	W	N	N	N	W	N	W

List of Experiments:

Note: Experiments based upon hardware using hardware kits and rest using simulation with the help of simulation packages

1. To measure the h-parameters of CE configuration.
2. To determine the voltage gain of a two stage RC coupled amplifier.
3. To plot frequency response characteristics of Transformer coupled amplifier.
4. To plot frequency response characteristics of direct coupled amplifier.
5. To study the gain and frequency response of CS FET amplifier.
6. To plot frequency response of a tuned voltage amplifier and to calculate its resonant frequency.
7. To study the double ended tuned amplifier.
8. To study the class A power amplifier and find its efficiency.
9. To study the class B power amplifier and find its efficiency.
10. To study the cascode amplifier.
11. To study the concept of feedback in voltage amplifier.
12. To study the RC phase shift oscillator and measure its frequency of operation.
13. To study the LC oscillator and measure the frequency of operation.
14. To plot the frequency response of a Darlington amplifier. Calculate gain and bandwidth.

×Compare the results of each aim of experiment with ORCAD spice simulation.

ECT-523
Microprocessor & its Applications

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The objective of this course is to introduce the architecture and learn programming of the microprocessor 8085 and learning about communication interfaces and various applications basic and advanced microprocessors.

Course Outcomes

1. Understand the basic functioning of 8085 and develop the programs.
2. Understand design of memory systems and develop programs for communications and peripherals interfacing.
3. Understanding basic functioning of advanced microprocessors.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	W	M	N	N	N	N	N	M	N	S
CO2	S	S	M	W	W	N	M	N	N	N	S	N	S
CO3	S	S	S	S	M	N	M	N	N	N	S	N	S

Unit-I **12hrs**

Introduction: Digital computing, computer languages, from large chip computers to single chip microcomputers, microcomputers organization, and 4-bit microprocessors.

Introduction to 8-bit microprocessor architecture: Microprocessor architecture & its operations, memory, input/output, interfacing devices MPU, 8085 based microcomputer, instruction classification, instruction format, instruction timings, 8080 a MPU, overview of 8085/8080a instruction set.

Unit-II **12 hrs**

Programming using 8085 microprocessors: Data transfer instructions, arithmetic operations, logic operations, branch operations, programming techniques using looping counting & indexing, dynamic debugging, time delays, counters, stack, subroutines, conditional call, and return instructions, advanced subroutine concepts.

Unit-III **12 hrs**

Interrupts: The 8080A interrupts the 8085 interrupts, restart instructions, additional I/O concepts & processes.

Parallel input/output and interfacing applications: Basic interfacing concepts, interfacing output displays, interfacing input keyboards, memory mapped I/O, interfacing memory, interfacing D/A & A/D converters.

Unit-IV **12 hrs**

General purpose programmable peripheral devices: Introduction to 8155/8156, 8255 a programmable peripheral interface, 8253 programmable interval timers, 8259 a programmable interrupt controller, SID & SOD lines, 8251 USART.

Microprocessor applications: Temperature controller, traffic light controller, stepper motor control, comparison of 8 bit, 16 bit & 32 bit microprocessors, introduction to Pentium processors.

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1.Microprocessor Architecture-Programming & Applications with 8085/8080A	Ramesh S Gaonkar	5th Edition, Penram International Publishing
2.Introduction of Microprocessors & Microcomputers	Ram B	4th Edition, Dhanpat Rai Publisher (P) Ltd.
3.Microprocessor Interfacing Technique	RodnayZaks and Austin Lesea	1st Indian Edition, BPB Publication
4.An introduction to Intel family of Microprocessors	James L Antonakes	3rd Edition, Pearson Education
5.Microprocessor Principles and Applications	Charles M Gilmore	2nd Edition, McGraw Hill

ECP-523
Microprocessor & its Applications

	L	T	P	Credits
	0	0	2	1

Course Objectives

This lab includes programming part of microprocessor and its interfacing to different I/O devices. It includes various programs to perform specific tasks i.e addition, sorting, multiplication and many more. Students will be interface microprocessor 8085 kit to various peripheral devices such as RS-232C, 8255.

Course Outcomes

1. Student will be able to perform various arithmetic and sorting operations with the help of microprocessor.
2. Interfacing to 7-segment display through 8255.
3. Interfacing to various peripheral devices such as external keyboard, printer, 8253, personal computers using RS232C.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	W	M	N	N	N	N	N	M	N	S
CO2	S	S	M	W	W	N	M	N	N	N	S	N	S
CO3	S	S	S	S	M	N	M	N	N	N	S	N	S

List of Experiments:

1. 2's compliment of 8 bit number.
2. 2's compliment of 16 bit number.
3. Program to shift a block of data from one memory location to another.
4. Multiplication by two, employing bit rotation.
5. Separation of hexadecimal number into two digits.
6. Interface ADC chip with microprocessor kit and verify its operation.
7. Interface DAC chip with microprocessor kit and verify its operation.
8. Interface an external 8253/8254 to the microprocessor kit at the address given. Hence,
   i) generate a pulse train of specified duty cycle at the given output line,
   ii) operate as a: N counter,
   iii)Count a train of pulses for a given duration.
9. Interface seven segment display through 8255A.
10. Use the SOD line to generate a square wave of the specified duty cycle at a given frequency.

ECT-524
Digital System Design

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

This course provides a modern introduction to logic design and the basic building blocks used in digital system. The course deals with sequential circuits, random access memories, and modern logic devices such as field programmable logic gates. State machines will then be discussed and illustrated through case studies of more complex systems using programmable logic devices. The course has an accompanying lab component that integrates hands-on experience with modern computer-aided design software including logic simulation, minimization and an introduction of the use of hardware description language (VHDL/ Verilog HDL). The hands-on assignments will make use of the Xilinx ISE tool chain for the design and implementation of a variety of projects.

Course Outcomes

1. An ability to analyze and design combinational systems composed of standard combinational modules, such as multiplexers and decoders.
2. An ability to demonstrate knowledge of simple synchronous and asynchronous sequential systems.
3. An ability to analyze and design simple systems composed of programmable logic, such as ROMs PLDs, FPGAs and CPLDs.
4. An ability to describe, design, simulates, and synthesize combinational and sequential logic using the VHDL/Verilog HDL.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	W	M	N	N	N	N	N	M	N	S
CO2	S	S	M	W	W	N	M	N	N	N	S	N	N
CO3	S	S	S	S	M	N	M	N	N	N	S	N	S
CO4	S	S	S	W	S	N	M	N	N	N	S	N	M

Unit-I — **12 hrs**

Design of combinational circuits and implementation using multiplexers, decoders, ROM, PLA and PAL.

Unit-II — **12 hrs**

Synchronous sequential circuits: The finite state machine, design of single multimode and ring counters, Mealy state diagram, Moore state diagram, state transition tables, state reduction techniques, state assignments, synthesis of sequential circuits.

ASM modules: The algorithm state m/c, ASM charts, ASM tables, linking of ASM modules.

Unit-III — **12 hrs**

Asynchronous sequential circuits: Races, hazards, asynchronous, state diagrams, primitive flow tables, state reductions and row merging, design of asynchronous state.

Programmable logic devices: Introduction to CPLDs and FPGAs

Kuldip Singh Vivek Harshey Dilip Kumar L. S. Solanki J.S. Ubhi A. Marwaha

Unit-IV	**12 hrs**
Introduction to VHDL: Overview of digital design with VHDL, basic language elements, data objects, classes and data types, operators, overloading, logical operators, VHDL representation of digital design entity and architectural declarations, introduction to behavioural, dataflow and structural models, applications of VHDL to FPGA design.	

RECOMMENDED BOOKS

Title	**Author**	**Publisher**
1. An Engineering Approach to Digital Design	Fletcher William, I	3rd Indian reprint, PHI, (1994).
2. Digital Design	Morris Mano M	3rd Edition, Pearson Education (2002).
3. VHDL-Analysis and Modeling of Digital Systems	Navabi Z	McGraw Hill.
4. Fundamentals of Logic Design	Charles H. Roth Jr	4th Edition, Jaico Publishers (2002).
5. VHDL for Programmable Logic	Skahill Kevin	1st Indian Reprint, Pearson Education (2004).
6. Verilog HDL: A Guide to Digital Design and Synthesis	Samir Palnitkar	2nd Edition, Prentice Hall PTR

ECP-524
Digital System Design

	L	T	P	Credits
	0	0	2	1

Course Objectives: This lab includes the designing part of Digital systems. It includes design, simulation and synthesis of various sequential machines, counters, flip flops, registers, decoders, full adder and many more.

Course Outcomes:
1. Students will be able to design, simulate and synthesize various digital systems i.e. n bit register, JK flip flop, tri- state driver, 4-bit counter, 2:1 multiplier.
2. Design and synthesize 3 to 8 line decoder, full adder, T flip flop.
3. Design and implement various synchronous sequential machines.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	S	S	W	N	N	N	N	N	W	N	W
CO2	M	S	S	S	W	N	N	N	N	N	M	N	M
CO3	M	S	S	S	W	N	N	N	N	N	W	N	W

List of Experiments:

1. Design and implement a circuit for a 3 bit parallel adder using NAND gates only.
2. Design and implement a circuit using only NOR gates for a given function.
3. Design a 4 bit binary to BCD code converter & implement it using two 8 to 1 MUXs.
4. Design a combinational circuit to get 2's compliment of 4 bit binary input &implement it using single 8 to 1 MUX
5. Design even parity bit generator for 4 bit input & implement it using 4 to 16 line Decoder.
6. Design a sequential machine using T flip flops for a given state diagram.
7. Design, simulate and synthesize an odd bit Parity generator for 4-bit word using VHDL in data flow style of modelling.
8. Design, simulate and synthesize a given function using VHDL in structural style of modelling.
9. Design, simulate and synthesize 2 bit comparator using VHDL in data flow style of modelling.
10. Design, simulate and synthesize 2 to 4 decoder using VHDL in behavioural style of modelling.
11. Design, simulate and synthesize 1 to 8 demux using VHDL in behavioural style of modelling.
12. Design, simulate and synthesize full subtractor using VHDL in structural style of modelling.

Kuldip Singh Vivek Harshey Dilip Kumar L. S. Solanki J.S. Ubhi A. Marwaha

ECT-611
Digital Communication

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The main objective of the course is to understand the fundamentals of digital communication system, the advantages over analog communication system and to provide in-depth knowledge of digital modulation schemes. It emphasizes on the performance analysis of digital communication system in the presence of noise, by calculating the probability of error for matched filter Rx and various digital modulation techniques.

Course Outcomes

1. Understand the theoretical aspects of digital communication system, useful for today's multidisciplinary applications.
2. Gain knowledge about various data formats for digital data transmission.
3. Analyze the generation and detection of various digital modulation schemes.
4. Analyze the performance of different types of digital pulse and band pass modulation techniques in terms of error rate and spectral efficiency.
5. Calculate probability of error for matched filter receiver and various digital modulation technique to analyze the performance of digital communication system in the presence of noise.

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	N	M	M	M	S	N	N	N	N	N	N	N	M
CO2	S	M	M	S	S	M	S	S	M	M	S	N	S
CO3	W	M	N	N	W	N	N	N	N	M	M	W	S
CO4	S	S	M	M	S	N	N	W	W	N	M	N	S
CO5	S	S	S	M	M	W	N	M	W	N	M	N	S

Unit-I **14 hrs**

Elements of digital communication system: Block diagram of digital communication system, digital representation of analog signals, advantages and disadvantages of digital communication system, noisy communication channels, information and entropy.

Pulse code modulation: Sampling theorem for baseband and band pass signals, aliasing, signal recovery through holding, quantization of signals, quantization error, uniform and non-uniform quantization, dynamic range, A-law and μ-law companding, pulse code modulation (PCM), differential pulse code modulation (DPCM), need of predictor, delta modulation (DM), adaptive delta modulation (ADM), comparison of PCM, DPCM and DM.

Unit-II **12 hrs**

Line coding schemes: Power spectral density (PSD) of sequence of random pulses, power spectral density of digital data, introduction to line codes and its properties, unipolar, polar and bipolar signalling formats, NRZ& RZ modulation formats, ON-OFF signalling, AMI and Manchester coding and their power spectra, comparison among various line codes, pulse shaping.

Unit-III	**14 hrs**
Digital modulation techniques: Digital modulation formats, binary amplitude shift keying (BASK) modulator, coherent and non-coherent ASK detection, binary phase shift keying (BPSK) transmitter, coherent BPSK detection, differential PSK, quadrature phase shift keying modulation (QPSK) transmitter and receiver, offset QPSK, M-ary BPSK, quadrature amplitude modulation (QAM), binary frequency shift keying (BFSK) transmitter, non-coherent FSK detector, coherent FSK detector, M-ary FSK, minimum shift keying (MSK) and Gaussian minimum shift keying (GMSK), power spectral analysis and comparison of signal constellations for digital modulation techniques.	
Unit-IV	**14 hrs**
Optimal reception of digital signal: Introduction, baseband signal receiver, probability of error for the baseband signal, optimum receiver for baseband and bandpass signals, optimum filter transfer function, matched filter and its probability of error, coherent system of signal reception (correlation receiver). **Error calculations for digital modulation techniques:** Probability of error for BPSK, effect of imperfect phase synchronization and imperfect bit synchronization on probability of error in AWGN channel, probability of error calculations for QPSK, QASK and FSK schemes, use of signal space for calculation of error probability, relationship between bit error rate (BER) and symbol error rate (SER).	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Principles of Communication Systems	Goutam Saha , Herbert Taub , Donald Schilling	Tata Mcgraw Hill Education Private Limited, 3rd Edition, 2008
2. Communication Systems	Simon Haykin, Michael Moher	John Wiley & Sons Publication, 5th Edition, 2009
3. Digital Communications	Bernard Sklar	Pearson Education Limited, 2014
4. Modern Analog and Digital Communication	Bhagwandas Pannalal Lathi, Zhi Ding	Oxford University Press, 2010
5. Digital Communication System	John G. Proakis, Masoud Salehi	McGraw-Hill, 2008

ECP-611
Digital Communication Lab

	L	T	P	Credits
	0	0	2	1

Course Objectives: This lab includes the generation and observation of frequency spectrum of various digital modulation techniques on hardware as well as on software simulator. Analysis of various digital modulators and demodulators circuits using hardware and software simulator.

Course Outcomes:
1. To analyze various digital modulation techniques.
2. To understand and analyze the modulators and demodulators for various digital Shift keying techniques.
3. To understand various signaling formats.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	S	M	W	N	N	M	N	N	M	N	M
CO2	S	M	S	S	S	N	N	M	M	N	M	N	S
CO3	S	S	S	W	W	N	N	S	N	S	S	N	S

List of Experiments:

Experiments based upon hardware using communication kits and simulation with the help of simulation packages.

Hardware

1. To study time division multiplexing system.
2. to study pulse code modulation and demodulation.
3. To study delta modulation and demodulation and observe effect of slope overload.
4. To study pulse data coding techniques for various formats.
5. To study amplitude shift keying modulator and demodulator.
6. To study frequency shift keying modulator and demodulator.
7. To study phase shift keying modulator and demodulator.

Software

1. To generate BASK signal and observe the frequency spectrum on MULTISIM software.
2. To generate BPSK signal and observe the frequency spectrum on MULTISIM software.
3. To generate BFSK signal and observe the frequency spectrum on MULTISIM software
4. To setup the model for BPSK baseband modulation for scatter plot to observe the constellation on MATLAB/SIMULINK software.
5. To setup the model for QPSK baseband modulation for scatter plot on to observe the constellation on MATLAB/SIMULINK software.
6. To setup the model for BFSK baseband modulation for scatter plot on to observe the constellation on MATLAB/SIMULINK software.
7. To setup the BPSK model with AWGN channel and perform error rate calculation/BER plot on MATLAB/SIMULINK software.
8. To setup the QPSK model with AWGN channel and perform error rate calculation/BER plot on MATLAB/SIMULINK software.
9. To setup the BFSK model with AWGN channel and perform error rate calculation/BER plot on MATLAB/SIMULINK software.

ECT-612 EMF & Transmission Lines				
	L	**T**	**P**	**Credits**
	3	**0**	**0**	**3**
	Sessional Marks			**50**
	End Semester Examination Marks			**50**
Course Objectives	The objective of the course is to study the basic concepts, theories, principles related to electrostatics, electromagnetics and transmission lines.			
Course Outcomes	1. Understand and analyze the static electric and magnetic fields, time-varying electric and magnetic fields. 2. Understand physical interpretation and application of Maxwell's equations to analyze EM waves. 3. Understanding of basic concepts of the guided electromagnetic waves by constructive multiple reflections from conductors and dielectrics and have knowledge of cut-off frequency. 4. Obtain knowledge about the techniques for the measurement of basic transmission line parameters, such as the reflection coefficient, standing wave ratio and impedance.			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	M	S	M	N	N	N	N	N	N	N	M
CO2	S	S	M	W	M	N	M	M	N	M	N	N	S
CO3	S	W	W	N	W	N	N	W	N	S	M	N	S
CO4	S	S	M	M	W	W	N	W	W	W	M	N	W

Unit-I **12 hrs**

Introduction: Review of vector theory, gradient, divergence and curl, coordinate system: rectangular, cylindrical, spherical and their transformations.

Static electric field: Force between point charges, Coulomb`s law, electric field intensity, superposition of electric fields, electric scalar potential, charge density, gradient of potential, electric flux, electric flux density or displacement density, Gauss's law, application of Gauss's law, energy in capacitor, divergence theorem, Poisson's equation and Laplace's equation, current density, continuity equation, current and field in boundary.

Unit-II **12 hrs**

Static magnetic field: Magnetic induction and Faraday's law, magnetic flux density, magnetic field strength, current density in a conductor**,** Ampere`s law, Stokes theorem, energy stored in magnetic field, force on moving charge and current element, Biot-savart law, magnetic vector potential, boundary relation in magnetic fields.

Time varying fields: Maxwell equation from Faraday`s law, displacement current, Maxwell's equation from Ampere's law, equation of continuity for time varying fields, Maxwell`s equations in integral and differential forms for free space, conditions at boundary surface.

Unit-III	**12 hrs**
Wave transmission: EM wave in a homogeneous medium, Maxwell`s equations, wave equations in free space, uniform plane wave propagation, intrinsic impedance, wave equations for conducting medium, sinusoidal time variations, conductors and dielectrics, linear, elliptical and circular polarization, reflection of plane waves at interfaces, normal and oblique incidences, reflection coefficient, Brewster angle, group velocity, phase velocity, power and energy relations, Poynting vector, waves between parallel planes, TE, TM and TEM waves.	
Unit-IV	**12 hrs**
Transmission lines: Introduction, basic principles, termination of lines with load, voltage and current distribution, characteristic impedance, propagation constant, attenuation constant, phase constant, reflection coefficient, VSWR, open and short-circuited transmission lines and their impedances, stub matching, types of high frequency transmission lines, smith charts.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Elements of Electromagnetics	M Sadiku	Oxford University Press
2. Electromagnetics	J AEdminister	Schaum's Series
3. Electromagnetics	Kraus	McGraw Hill
4. Electromagnetic Fields and Waves	K D Parsad	Parkash Publications
5. EM waves & Radiating	Jordan, Balmain	Prentice Hall
6. Electromagnetic	W H Hayt	McGraw Hill

ECT-613
Linear IC's & Applications

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The aim of this course is to introduce the basic building blocks of linear integrated circuits and acquire knowledge of fundamental characteristics of op-amps. The course analyzes op-amps with and without feedback and determines the negative feedback affects the performance of op-amps. It also includes learning of linear and non-linear applications of operational amplifiers and studies various applications using 555 timer and PLL.

Course Outcomes

1. To understand the basic concepts of op-amps.
2. To design different circuits using op-amp.
3. Design and analyse linear and non-linear op-amp applications, active filters and detectors.
4. Design and analyse different types of wave generator circuits.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	S	S	M	N	N	M	M	N	M	N	S
CO2	S	S	S	S	M	N	N	M	W	N	N	N	S
CO3	M	M	S	S	W	N	N	M	W	W	M	N	S
CO4	S	S	S	S	S	N	N	S	N	M	S	N	S

Unit-I **12 hrs**

Introduction: Introduction, emitter coupled differential amplifier, DC and AC analysis, cascaded differential amplifier stages, level translator.

Operational amplifiers (Op-amp): Basic op-amp and its schematic symbol, block diagram of a typical op-amp, integrated circuits and their types, IC package types, pin identification and temperature range, overview of typical set of data sheets, characteristics and performance parameters of op-amp, equivalent circuit of an op-amp, ideal op-amp and its characteristics, ideal voltage transfer curve.

Op-Amp parameters: Input offset voltage, input bias current, input offset current, total output offset voltage, thermal drift, variation of op-amp parameters with supply voltage and temperature, noise, common mode configuration and common mode rejection ratio, slew rate

Unit-II **12 hrs**

Op-Amp configurations and frequency response: Open loop configurations: differential, inverting & non-inverting. negative feedback configurations: block diagram representation of feedback configurations, voltage-series feedback amplifier, voltage shunt feedback amplifier, differential amplifiers with one op-amp, two op-amps and three op-amps. frequency response, compensating networks, frequency response of internally compensated op-amps, frequency response of non-compensated op-amps, closed loop frequency response.

Unit-III **12 hrs**

Applications of op-amps: DC and AC amplifiers, peaking amplifier, summing, scaling and averaging amplifier, instrumentation amplifier, V to I and I to V converter, log and antilog amplifier, integrator and differentiator.

Active filters: First order and second order filter, higher order low-pass filter, second order high

pass filter, band pass filter, wide band-pass filter. band reject filter, all-pass filter.
Wave generator: Square wave generator, triangular wave generator, saw tooth wave generator and voltage-controlled oscillator, comparator, zero crossing detector, Schmitt trigger, window detector, V to F and F to V converters, A to D and D to A converters, peak detector.

Unit-IV	**12 hrs**

Specialized IC applications: IC 555, pin configuration, block diagram, application of 555 as monostable and astable multivibrator, operating principles & applications of 565PLL.
Voltage regulators: Fixed voltage regulators, adjustable voltage regulators, switching regulators.

RECOMMENDED BOOKS

Title	Author	Publisher
1. Op Amps & Linear Integrated circuits	Ramakant Gayakwad	Pearson Education
2. Fundamental of Microelectronics	B Razavi	Wiley India
3. Linear Integrated Circuits	D. Roy Choudhary	New Age International
4. Design with Operational Amplifiers and Analog Integrated Circuits	Sergio Franco	Tata Mc-Graw Hill

ECP-613
Linear IC's & Applications

	L	T	P	Credits
	0	0	2	1

Course Objectives: This lab includes complete analytical as well as designing circuits using op-amp. It includes design of various applications using op-amp as integrator, differentiator, log, antilog and wave generation circuits.

Course Outcomes:
1. Examine the performance of op-amp in inverting as well as in non-inverting modes.
2. Design of various applications using op-amp.
3. Design of 555 timer and PLL circuit.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	S	M	N	N	M	M	N	M	N	S
CO2	S	S	S	S	M	M	M	N	W	N	M	N	S
CO3	S	S	S	S	S	N	N	S	W	M	S	N	S

List of Experiments:

1. Design and analyze RC-circuit as low pass and high pass using active filters.
2. Design and analyze RC-circuit as low pass and high pass using passive filters.
3. Verify the differential amplifier configurations.
4. Measure the performance parameters of an op-amp.
5. Application of op-amp as inverting and non-inverting amplifier.
6. Verify the frequency response of an op-amp
7. Use the op-amp as summing, scaling & averaging amplifier.
8. Use the op-amp as instrumentation amplifier
9. Design and analyze differentiator and integrator using op-amp.
10. Application of op-amp as log and antilog amplifier.
11. Application of op-amp as saw tooth wave generator.
12. Application of op-amp as Schmitt Trigger.
13. Design and analyze multivibrator circuits using 555.
14. To examine the operation of a PLL and to determine the free running frequency, the capture range and the lock in range of PLL.

ECT-615 Microelectronics				
	L	**T**	**P**	**Credits**
	3	**0**	**0**	**3**
	Sessional Marks			**50**
	End Semester Examination Marks			**50**
Course Objectives	This course will introduce the students to the world of semiconductor IC technology fabrication. Emphasis will be laid on covering the basics of all key process-flow steps in advanced CMOS fabrication. The course will also provide comprehensive flavour of MOS transistor structure and operation under bias.			
Course Outcomes	1. Understand the physical and electrical properties of semiconductor materials and their use in microelectronic circuits. 2. Understand the basics of fabrication process, its requirements and challenges. 3. Process integration for NMOS, CMOS and Bipolar circuits and latest trends in VLSI Technology.			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	S	M	N	N	W	N	W	S	N	S
CO2	S	W	S	M	S	N	S	M	N	N	M	N	M
CO3	S	M	M	W	N	N	N	M	N	M	S	N	S

Unit-I — **10 hrs**

Introduction: Modern semiconductor IC fabrication, industrial/academic landscape, classification, scaling thick film, thin film and hybrid integrated circuits, crystal structures.

Unit-II — **10 hrs**

Monolithic architecture: Overview of CMOS process flow-basic steps.

Crystal growth: Bridgeman and Czochralski techniques, clean room basics- environment, infrastructure, advanced MOS cleaning, gettering etc.

Oxidation: Surface passivation using oxidation, dry oxidation, wet oxidation, kinetics of oxide growth.

Unit-III — **14 hrs**

Lithography: Photoreactive materials**,** types of photoresists, pattern generation and mask-making, pattern transfer, lithography process steps.

Diffusion and ion implantation: Interstitial diffusion, substitutional diffusion, interstitialcy diffusion, diffusion equation, Fick`s first law and second law, ion implant distribution, penetration range, nuclear stopping, electronics stopping, implantation damage and annealing.

Epitaxy and thin film deposition: Historical development and basic concepts, chemical vapor deposition (CVD), atmospheric pressure chemical vapor deposition (APCVP), vapor phase epitaxy (VPE), liquid phase epitaxy (LPE), molecular beam epitaxy (MBE),

Unit-IV	**14 hrs**
Etching: Historical development and basic concepts, wet etching, selectivity, isotropy and etch bias, common wet etchants, orientation dependent etching effects. **Metallization:** Contact formation, interconnect and vias. **Fabrication of BJT and MOSFET:** Introduction, fabrication process flow; basic steps, BJT. CMOS, layout design rules, full-custom mask layout design.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. VLSI Design	Sze	Tata Mcgraw Hill, 2003
2. Analog MOS IC Circuit Design	Paul R Gray	IEEE, 2001
3.CMOS Digital Integrated Circuits	Sung-Mo Kang	Tata McGraw Hill, 2003

ECT-616 Computer Communication Networks				
	L	**T**	**P**	**Credits**
	3	**0**	**0**	**3**
	Sessional Marks			**50**
	End Semester Examination Marks			**50**
Course Objectives	Aim of the course is to study the basics of computer networks, transmission media and network topologies. Emphasis will be laid on covering the basic layers used in TCP/IP model.			
Course Outcomes	1. Understand the basics of TCP/IP models and different types of network. 2. Understand the function of physical layer. 3. Understand the function of data link layer and network layer. 4. Understand the function of transport layer and application layer.			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	N	S	S	M	M	W	N	M	M	N	M	N	M
CO2	S	M	S	S	M	M	M	M	N	M	M	N	M
CO3	W	S	S	M	S	W	W	S	W	M	S	N	W
CO4	S	S	S	S	S	W	W	S	M	M	S	N	M

Unit-I **12hrs**

Introduction to computer networks: Basics of computer networks, need and evolution of computer networks, introduction to network topology, difference between wired networks and wireless networks, classification of computer networks- LAN, MAN, PAN, WAN. internet, intranet and extranet, OSI and TCP/IP models, comparison of OSI and TCP/IP.

Unit-II **12 hrs**

Physical layer: Data and signals, digital and analog transmission, bandwidth utilization, transmission media and switching.

Unit-III **14 hrs**

Data link layer and network layer: Introduction to data link layer, error detection and correction, data link control, medium access control, ethernet, and other networks, network layer protocols, unicast and multicast routing.

Unit-IV **10 hrs**

Transport layer and application layer: Process to process delivery: TCP and UDP, application layer protocols, FTP, HTTP.

RECOMMENDED BOOKS

Title	Author	Publisher
1. B.A. Forouzan	Data Communication and Networking	4th Ed., Tata McGraw-Hill.
2. A.S Tanenbaum	Computer Networks	4th Ed., Pearson Education.
3. W. Stallings	Data and Computer Communication	8th Ed., Prentice-Hall.

ECS-501 Seminar				
	L	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Course Objectives	To carry out a presentation in one of the specializations of the program with substantial multidisciplinary component			
Course Outcomes	1. An ability to write technical documents and give oral presentations related to the work completed and improve personality development and communication skills 2. Train the students to approach ethically any multidisciplinary engineering challenges with economic, environmental and social contexts and to set them for future recruitment by potential employers. 3. Identify and apply appropriate well-rehearsed note-taking interactive and time management strategies to their academic studies. 4. Develop audience-cantered presentations meeting concrete professional objectives and integrating ethical and legal visual aids. 5. Identify and critically evaluate the quality of claims, explanation, support, and delivery in public and professional discourse, and understand the factors influencing a speaker's credibility			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	S	S	S	N	N	M	M	S	M	M	N
CO2	N	M	N	N	S	S	S	S	S	S	S	S	N
CO3	N	N	N	W	N	N	N	M	W	S	S	N	N
CO4	M	W	N	W	W	N	N	M	S	S	W	S	S
CO5	N	N	N	N	S	S	N	M	S	S	M	M	S

ECO-621
Principle of Communication Engineering

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The main focus of the course is on understanding the importance and theories of communication systems. The students will study the various analog and digital communication techniques, generation, detection, transmission and reception methods.

Course Outcomes

1. Gain knowledge about the fundamental concepts of various analog and digital communication systems.
2. Understand the methods of generation and detection of AM and FM
3. Understand various pulse communication schemes.
4. Acquire knowledge about the basic concepts of digital modulation and demodulation techniques.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	M	M	M	N	N	M	N	M	W	N	S
CO2	S	S	S	S	M	M	W	M	M	M	W	N	S
CO3	W	W	W	N	W	N	N	M	W	W	S	N	S
CO4	M	W	W	M	N	N	N	W	W	N	W	N	S

Unit-I **12 hrs**

Introduction: Communication, information, message and signals, electromagnetic spectrum, classification of signals, periodic and non-periodic signals, analog and digital signals, deterministic and random signals, elements of a communication system, modulation and its types, need for modulation.

Amplitude modulation: Definition, expression of AM wave, modulation index, frequency spectrum, bandwidth, power contents of sidebands and carrier.

Unit-II **12 hrs**

Angle modulation: Concepts of angle modulation, theory of frequency modulation, mathematical analysis of FM, spectra of FM signals, narrow band FM, wide band FM, phase modulation, phase modulation obtained from frequency modulation, comparison of AM, FM and PM.

Generation of AM and FM waves: Basic principle of AM generation, basic principle of FM generation, varactor diode modulator. DSB-SC, SSB, their comparison and areas of applications.

Unit-III **12 hrs**

Pulse modulation: Sampling process, sampling theorem, natural sampling, flat top sampling, sampling rate, aliasing, basic idea about PAM, PWM and PPM and typical applications, reconstruction of message, pulse code modulation (PCM), block diagram of PCM system, quantization.

Unit-IV	**12 hrs**
Elements of digital communication: Block diagram of digital communication system, digital representation of analog signals, advantages and disadvantages of digital communication system, **Digital carrier modulation techniques**: Introduction, amplitude shift keying (ASK), ASK spectrum, ASK modulator, frequency shift keying (FSK), PSK. **Digital carrier demodulation techniques:** Coherent ASK detector, non-coherent ASK detector, non-coherent FSK detector, coherent FSK detector**.**	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Communication Systems(Analog and Digital)	Sanjay Sharma	S.K. Kataria& Sons
2. Electronic Communication Systems	Kennedy	Tata McGraw Hill
3. Electronic Communications	Roddy and Coolen	Prentice Hall of India
4. Principles of Communication Systems	Taub and Schilling	Tata McGraw Hill

ECO-622
Optical Electronics

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

To familiarize the design concept of optoelectronics devices and circuits by using different design technologies used for design of optoelectronics devices. Implementation approach of optoelectronics devices in modern communication system. To study the design and evaluation of modern optoelectronics integrated systems.

Course Outcomes

1. To gain knowledge about the fundamental concepts of various optoelectronics devices.
2. Ability to utilized optoelectronics devices in high speed optic communication systems.
3. Ability to analyze, model and implement advanced techniques in optoelectronics fabrication.
4. Ability to use advanced optoelectronics devices for research projects and other applications.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	S	S	S	N	M	M	N	M	S	N	M
CO2	S	S	S	S	S	M	N	S	M	M	S	N	M
CO3	S	S	M	M	S	N	W	S	M	M	S	N	M
CO4	S	S	S	S	M	W	M	S	M	M	S	N	W

Unit-I — **8 hrs**

Elements of light and solid-state physics: Wave nature of light, polarization, interference, diffraction, light source, review of quantum mechanical concept, review of solid state physics, generic optical systems and fundamental building blocks, basics of semiconductor optoelectronics, elemental and compound semiconductor, electronic properties and optical processes in semiconductors.

Unit-II — **14 hrs**

Optical sources and modulator: Emission and absorption of radiation, absorption of radiation, population inversion, optical feedback, threshold conditions-laser losses, line shape function, population inversion and pumping threshold conditions, laser modes, classes of laser, single mode operation, frequency stabilization, VCSEL, mode locking, Q switching, laser applications, high power applications of lasers, LEDs electro-optic effect, electro-optic switch and modulator, Kerr modulators, MZM modulators, electro-absorption modulator..

Unit-III — **14 hrs**

Photo detectors: Principle of optical detection, detector performance parameters, thermal detectors, photon devices, solar cell.

Display devices: Luminescence, photoluminescence, cathode luminescence, cathode ray tube, electro luminescence, injection luminescence and light emitting diodes, plasma displays, display brightness, LCD, numeric displays.

Unit-IV	**12 hrs**
Optoelectronic integrated circuits: Introduction, hybrid and monolithic integration, application of optoelectronic integrated circuits, integrated transmitters and receivers, guided wave devices.	

RECOMMENDED BOOKs

Title	Author	Publisher
1. Semiconductor Optoelectronic Devices	Pallab Bhattacharya	Pearson Education Inc
2. Photonics - Optical Electronics in Modern Communications	A. Yariv and P. Yeh,	Oxford University Press
3. Opto Electronics – As Introduction to materials and devices	Jasprit Singh	McGraw-Hill International
4. Opto Electronics – An Introduction	J. Wilson and J. Haukes	Prentice Hall, 1995

ECO-623
Electronic Measurements and Instrumentation

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

Aim of the course is to study the basic concepts of measurements and use of general electronic measuring instruments. It also gives deep insight into the electronic transducers. It also discusses as to how the data converters and other digital display works. It also discusses the basic concepts of electronic data transmission using different methods including telemetry.

Course Outcomes

1. It enables students to understand measurement methods for measuring resistance, capacitance and inductance using AC/DC brides and other electronic instruments.
2. It enables them to understand the classification and choice of different types of transducers and their underlying principle of operation.
3. It enables them to understand different types of data converters and display devices.
4. It enables the students to understand the concept of data transmission and telemetry using electronic communication method.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	M	S	M	N	N	N	N	N	M	N	S
CO2	S	M	M	S	S	M	M	M	N	M	W	N	M
CO3	S	S	S	W	M	M	M	M	M	M	S	N	W
CO4	S	W	W	M	W	N	N	M	W	N	W	N	M

Unit-I **12hrs**

Electronic measurements: Measurements, measurement methods, generalized measurement system, Wheatstone bridge, AC bridge theory, capacitance and inductance measurement using AC bridges, electronic instruments, electronic voltmeter, voltmeter using photodiode, electronic multi-meter, cathode ray oscilloscope and its constructional details, measurement of voltage, frequency and phase using CRO, digital storage oscilloscope, digital frequency meter, signal generator, LCR meter and Q meter.

Unit-II **12 hrs**

Electronic transducers: Classification and choice of transducers, transducer parameters, resistive transducers, capacitive transducers, inductive transducers, strain gauge transducer, load cell, pressure transducer, flow transducer, thermistors, resistance temperature detector, thermocouple, IC temperature detector, LVDT transducer, RVDT transducer, piezoelectric transducer, hall-effect transducer and opto-electronic transducers.

Unit-III	**12 hrs**
Data converters and display devices: Analog-to-digital and digital-to-analog converters, Transfer characteristics, A/D conversion technique: simple potentiometer and servo method, successive approximation method ramp type, integrating and dual slope integrating method. D/A Converter: transfer characteristic, D/A conversion technique, digital mode of operation, performance characteristics of D/A convertors, digital display units, seven-segment display, bcd to seven segment converter, dot matrices, bcd to dot matrix converter, nixie tube, light emitting diode, liquid crystal diode, segmental gas discharge display.	
Unit-IV	**12 hrs**
Data transmission and telemetry: Data transmission methods, general telemetry system, types of telemetry system, landline telemetry system, radio frequency telemetry, modulation methods, amplitude, frequency and phase modulation, frequency modulation telemetry system, pulse modulation pulse-amplitude modulation telemetry, pulse code modulation, pulse code modulation telemetry, channels and media, radio link and power line carrier channel.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Electronic Instrumentation and Measurements	David A. Bell	2nd Ed., PHI, New Delhi, 2008
2. Electronic Measurements and Instrumentation	Oliver and Cage	TMH, 2009.
3. A Course in Electrical and Electronic Measurements and Instrumentation	A.K. Sawhney and Puneet Sahney	Dhanpat Rai & Co. (P) Ltd., New Delhi, 2010

ECT-621A
Nanotechnology

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives: It gives an understanding of the fundamentals of nanotechnology, gives a general introduction to different classes of nanomaterials. Basic knowledge on various synthesis and characterization techniques involved in Nanotechnology will be imparted. Students will be familiarized with nanotechnology potential.

Course Outcomes:
1. To understand how basic nano-systems work.
2. To acquire knowledge of nano particle synthesis and size dependent physical properties
3. Use physical reasoning to develop simple nanoscale models to interpret the behavior of such physical systems

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	S	M	W	S	S	M	N	N	S	N	M
CO2	M	M	M	M	S	S	S	S	S	W	S	N	W
CO3	M	M	M	W	W	S	S	S	M	M	S	N	W

Unit-I — **12 hrs**

Introduction: An overview, insights and intervention into the nano world, societal implications & ethical issues in nano science and nanotechnology

Applications: Applications of nanotechnology in different areas of food, agriculture, textile and medical sciences

Unit-II — **14hrs**

Semiconductor nano particles synthesis: Cluster compounds, quantum-dots from MBE and CVD, wet chemical methods, reverse micelles, electro-deposition, pyrolytic synthesis, self-assembly strategies.

Semiconductor nano particles- size–dependent physical properties: Melting point, solid-state phase transformations, excitons, band-gap variations-quantum confinement.

Unit-III — **14hrs**

Semiconductor nano particles–applications: Optical luminescence and fluorescence from direct band gap semiconductor nanoparticles, surface-trap passivation in core-shell nanoparticles, carrier injection.

Doping: Electroluminescence, barriers to nanoparticle lasers, doping nanoparticles, Mn-Zn-Se phosphors, light emission from indirect semiconductors, light emission form Si Nanodots

Unit-IV — **12hrs**

Semiconductor nanowires: Fabrication strategies, quantum conductance effects in semiconductor nanowires, porous silicon, nanobelts, nanoribbons, nano springs.

Physical methods: Inert gas condensation, arc discharge, RF-plasma, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. Encyclopedia of Nanotechnology	Hari Singh Nalwa	Springer Inc.
2. Springer Handbook of Nanotechnology	Bharat Bhusan	Springer Inc.
3. Introduction to Nanotechnology	Poole Jr., C.P., Owens, F.J	Wiley Inc.
4. A Textbook of Nanoscience and Nanotechnology	B S Murthy	Springer Inc.

ECT 621B
Neural Networks and Fuzzy Logics

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The course will cover a variety of contemporary approaches to neural networks and fuzzy logic for various applications and introduce the underlying principles. Fundamental concepts of neural networks and fuzzy logic are covered in detail. After taking this course, the student will be ready to understand the structure, design and training of neural network and fuzzy logic based systems and will be competent enough to apply these algorithms for the solution of a wide variety of problems in engineering

Course Outcomes

1. Understand the principle of artificial intelligence and its realization using artificial neural networks.
2. To understand the working of multilayer feed-forward artificial neural network as universal problem solver.
3. Understand the concept of fuzzy logic.
4. Application of fuzzy logic system to solve a real-world problem in the domain of engineering.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	M	S	S	W	W	N	N	N	S	N	N
CO2	S	S	M	W	S	M	W	M	W	S	S	N	N
CO3	M	S	M	M	M	N	N	M	W	M	M	N	N
CO4	S	M	M	W	S	N	N	S	M	W	M	N	W

Unit-I — **15 hrs**

Neural network fundamentals: Artificial intelligence, human brain, neural networks, neuron physiology, artificial neuron model, artificial neural network, artificial neural network architecture, network topologies, ANN parameters, learning methods, supervised learning, unsupervised learning, reinforced learning, competitive learning, delta rule, gradient descent rule, hebbian learning, Rosenblatt's perceptron, ADALINE and MADALINE Networks.

Unit-II — **15 hrs**

Back-propagation networks: Back-propagation network architecture, perceptron model, perceptron learning procedure, single layer artificial neural network, multilayer perceptron model, back-propagation learning, mathematical analysis, learning rate and momentum.

Unit-III — **12 hrs**

Fuzzy logic: Fuzzy set theory, fuzzy versus crisp, crisp sets, operations on crisp sets, fuzzy set, membership functions fuzzy set operators, crisp relation, cartesian product, operations on relations, fuzzy relations, fuzzy cartesian product, operations on fuzzy relations.

Unit-IV — **14 hrs**

Fuzzy systems: Propositional logic, propositional logic inference, predicate logic, predicate logic formula, predicate logic inference, fuzzy quantifiers, fuzzy inference, fuzzy rule based system, defuzzification methods and fuzzy cruise-controller design.

Kuldip Singh Vivek Harshey Dilip Kumar L. S. Solanki J.S. Ubhi A. Marwaha

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. Understanding Neural Networks and Fuzzy Logic	Stamatios V. Kartalopoulos	Prentice Hall of India Private Limited, New Delhi, 2000
2. Fuzzy Systems Design	Riza C.	Chand Publishers
3. Neural Networks, Fuzzy Logics and Genetic Algorithms (Synthesis and Applications).	S. Rajasekaran, G.A. Vijaylakshmi Pai	PHI Learning Private Limited, 2011

ECT-621C
Information Theory and Coding

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives

The aims of this course are to introduce the principles and applications of information theory. The course will study how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies; how these are used to calculate the capacity of a communication channel, with and without noise; how discrete channels and measures of information generalize to their continuous forms; complexity, compression, and efficient coding of text, and audio-visual information coding schemes; including error detecting and correcting codes, block coding, convolutional coding, Viterbi decoding algorithm, Trellis coded modulation and information security: cryptographic coding.

Course Outcomes:

1. Learn the concept of Information and to calculate the information content of a random variable from its probability distribution
2. Understand the physical significance of entropy and to imbibe a clear-cut idea about the various entropies associated with a communication system
3. Gain comprehensive understanding about capacity, efficiency and redundancy of a communication channel
4. Perform bit error analysis for digital modulation techniques.
5. Devise efficient coding techniques of communication channels.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	N	N	N	N	N	N	M	N	W	N	M
CO2	W	N	N	N	M	N	N	N	W	N	N	N	M
CO3	S	M	N	N	M	M	N	N	W	N	W	N	M
CO4	N	S	N	S	N	M	N	N	N	N	M	N	S
CO5	S	N	M	N	N	S	S	N	M	N	M	M	S

Unit-I **14 Hrs.**

Information theory: Concept of amount of information -units, entropy -marginal, conditional and joint entropies -relation among entropies, mutual information, information rate, channel capacity, redundancy and efficiency of channels.

Discrete channels: Symmetric channels, binary symmetric channel, binary erasure channel, cascaded channels, repetition of symbols, binary symmetric channel, Shannon theorem, continuous channels – capacity of band limited Gaussian channels, Shannon-Hartley theorem, trade-off between band width and signal to noise ratio, capacity of a channel with infinite band width, optimum modulation system.

Unit-II **14 Hrs.**

Source coding: Encoding techniques, purpose of encoding, instantaneous codes, construction of instantaneous codes, Kraft's inequality, coding efficiency and redundancy, noiseless coding theorem, construction of basic source codes – Shannon-Fano algorithm, Huffman coding, arithmetic coding, ZIP coding.

Source coding, text, audio and speech: Text: Adaptive Huffman coding, arithmetic coding,

LZW algorithm audio: perceptual coding, masking techniques, psychoacoustic model, MEG audio layers I, II, III, Dolby AC3 speech: channel vocoder, linear predictive coding.

Source coding, image and video: Image and video formats – GIF, TIFF, SIF, CIF, QCIF, image compression: READ, JPEG, video compression: principles-I, B, P frames, motion estimation, motion compensation, H.261, MPEG standard.

Unit-III **14 Hrs.**

Codes for error detection and correction: Parity check coding, linear block codes, error detecting and correcting capabilities, generator and parity check matrices, standard array and syndrome decoding.

Block codes: Definitions and principles: Hamming weight, Hamming distance, minimum distance decoding - single parity codes, hamming codes, repetition codes - linear block codes, cyclic codes - syndrome calculation, encoder and decoder – CRC.

Unit-IV **14 Hrs.**

Convolution codes: Code tree, trellis, state diagram, structural properties, encoding – decoding: sequential search and Viterbi algorithm – principle of turbo coding, soft-decision decoding, Viterbi decoding algorithm.

Advanced coding techniques and cryptography: BCH codes, trellis coded modulation, introduction to cryptography, overview of encryption techniques, symmetric cryptography, DES, IDEA, asymmetric algorithms, RSA algorithm.

RECOMMENDED BOOKS

Title	Author	Publisher
1. Information Theory, Coding and Cryptography,	Ranjan Bose	Tata McGraw Hill
2. Applied Coding and Information Theory for Engineers	Richard B. Wells	Pearson
3. Coding and Information Theory,	.R.W.Hamming	Prentice Hall, 2nd edition,
4. Information Theory and Reliable Communication,	R.G.Gallager,	Wiley
5. The Theory of Information and Coding.	R.J. McEliece	Addison –Wesley
6. Introduction to information Theory	M.Mansuripur,	Prentice Hall
7. Principles of communication	Taub & Schilling	McGraw Hill
8. Elements of Information Theory	Thomas Cover & Joy Thomas	John Wiley & Sons

ECT-621D
Device & Circuit Simulation

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

It will develop the ability to analyze electronic circuits using simulation software for their AC & DC analysis, with a basic understanding of various circuit parameters, frequency response, simulation time and transient solution for static models. Model active and passive devices will be introduced.

Course Outcomes

1. Analyse components associated with modelling and simulation of electronic systems.
2. Demonstrate proficiency in the use of appropriate equipment and devices for simulation of electronic circuit.
3. Analyse electronics devices and circuits using computer simulations and Design a model to develop an electronic system.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	M	S	S	W	W	M	M	N	S	N	S
CO2	S	S	S	S	S	M	W	S	M	W	S	N	S
CO3	S	S	S	M	M	N	N	M	S	M	M	S	S

Unit-I — **14 hrs**

Introduction: SPICE, HSPICE, PSPICE generating a netlist file & operating point analysis
DC operation- modeling of various sources, Ohm's Law, Kirchhoff's Law, capacitors and inductors in dc circuits, dc sensitivity and dc sweep.

Transfer function and transient response: Small signal dc analysis, circuit gain, input output resistance, nonlinearities, plotting small signal gain, frequency response, simulating time, graphic outputs and calculations, problems of time stepped and transient solutions for static problems**,** transfer function analysis plotting of I-V curves, transient analysis of RC circuits.

Unit-II — **14 hrs**

Device models and noise analysis: Models for passive and active devices, scaling component values, sweeping component values, temperature analysis and sweeping temperature. noise calculations and S/N, graphics output, inserting noise sources.

PN-junction diodes: DC current-voltage characteristics, static model, large signal model, small-signal model, temperature and area effects on the diode model parameters, SPICE, HSPICE and PSPICE models.

Unit-III — **10 hrs**

Bipolar junction transistor: Ebers-Moll Static, large-signal and small-signal models, input, model parameters and their measurements, temperature and area effects on the BJT model parameters, SPICE, HSPICE and PSPICE models.

Unit-IV	**14 hrs**
Junction field-effect transistors (JFET): Static model, small signal model, temperature and area effects on the JFET model parameters, SPICE, HSPICE and PSPICE models. **Metal oxide semiconductor field effect transistor(MOSFET):** Structure and operating region of the MOSFET, static models, small-signal models, effect of temperature on the MOSFET model parameters, SPICE, HSPICE and PSPICE models **MOSFET parameter measurements**: Long-channel parameters, short channel parameters, measurements of capacitance	

RECOMMENDED BOOKS

Title	Author	Publisher
1. A Guide to Circuit Simulation and Analysis Using PSICE	Paul W. Tuinenga	Prentice Hall, 1995
2.Semiconductor Device Modelling with SPICE	Giuseppe Massobrio, Paolo Antognetti	Tata McGraw-Hill Edition, 2010
3.Introduction to Device Modelling and Circuit Simulation	Tor A. Fjeldly, Trond Ytterdral, Michaels. Shur	Wiley, 1998.
4. MOSFET Models for SPICE Simulation	Willium Liu	Wiley-IEEE Press, February 2001

ECT-621E
Pulse and Digital Switching Circuits

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The course describes various linear wave shaping circuits, switching characteristics of diode, transistor and non-linear wave shaping circuits. The design of multivibrators circuits, Schmitt trigger circuit using transistors, blocking oscillator circuits and the design operation of time base circuits is also explained.

Course Outcomes

1. Design linear wave shaping circuits like high pass and low pass RC circuits for various input signals.
2. Design non-linear wave shaping circuits like clippers and clampers using diodes and transistors.
3. Design and analyze different types of multivibrators.
4. Design and analyze time base generator circuits and blocking oscillator circuits**.**

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	S	S	M	N	N	M	M	W	W	N	M
CO2	S	S	S	S	M	M	N	M	N	M	W	N	S
CO3	M	W	W	M	W	N	N	M	M	W	N	N	M
CO4	S	M	M	M	N	W	W	S	N	M	W	N	M

Unit-I **14 Hrs**

Linear wave shaping: High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square, ramp and exponential inputs, high pass RC circuit as differentiator and low pass RC circuit as integrator, attenuators, RL and RLC circuits and their response for step input, ringing circuit.

Non-linear wave shaping: Diode clippers, transistor clippers, clipping at two independent levels, emitter coupled clipper, diode comparators, applications of voltage comparators, clamping operation, clamping circuits using diode with different inputs, clamping circuit theorem, practical clamping circuits, effect of diode characteristics on clamping voltage.

Unit-II **12 Hrs**

Switching characteristics of devices: Diode as a switch, diode switching times, temperature variation of saturation parameters, design of transistor as a switch, transistor switching times, transistor in saturation.

Bistable multivibrators: Stable states of a bistable multivibrator, design and analysis of fixed bias and self-biased bistable multivibrator, direct connected binary circuit, Schmitt trigger circuit using transistors, emitter coupled bistable multivibrator.

Unit-III **12 Hrs**

Monostable and astable multivibrators: Monostable multivibrator, design and analysis of collector coupled and emitter coupled monostable multivibrator, triggering of monostable multivibrator, astable multivibrator, collector coupled and emitter coupled astable multivibrator.

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Unit-IV	**14 Hrs**
Time base generators: General features of a time base signal, methods of generating time base waveform, Miller and Bootstrap time base generators – basic principles, transistor Miller time base generator, transistor Bootstrap time base generator, current time base generators, methods of linearity improvements. **Blocking oscillator circuits**: Triggered transistor blocking oscillator, an astable transistor blocking oscillator, applications of blocking oscillators.	

RECOMMENDED BOOKS

Title	**Author**	**Publisher**
1. Pulse, Digital and Switching Waveforms 3rd Edition, 2008.	Millman and Taub	Tata McGraw-Hill
2.Microelectronic Circuits, 7th Edition 2014	Sedra and Smith	Oxford University Press
3. Pulse and Digital Circuits, 2006	Motheki S. Prakash Rao	Tata McGraw-Hill
4. Fundamental of Microelectronics, 2nd Edition 2009	B.Razavi	John-Wiley

ECT-622
Microcontroller and Embedded System

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives: This course provides the knowledge about microcontrollers and embedded systems and emphasizes on the basic working of a microcontroller system and its programming language.

Course Outcomes:
1. Acquire knowledge about microcontrollers and embedded processors.
2. Acquire programming skills of microcontroller.
3. Understand the design concept of embedded systems.
4. Understand the role of embedded systems in industry.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	S	S	S	M	M	S	M	N	S	N	M
CO2	S	S	M	W	M	N	N	S	M	M	S	N	M
CO3	S	S	S	M	M	W	W	S	W	M	S	N	M
CO4	N	N	N	N	S	S	N	M	S	S	M	M	S

Unit-I — **12 hrs**

Introduction: Overview of 8051 microcontroller families and embedded system. 4bit microcontroller, 8 bit microcontroller, 16 bit microcontroller, 32 bit microcontroller.

Unit-II — **12 hrs**

8051 microcontrollers: Pin description and architecture of 8051 microcontroller, arithmetic, logic and single bit instructions, addressing modes. I/O instructions, memory read/write-only instructions, stack operations, conditional and un-conditional instructions, basic programming concepts.

Unit-III — **12 hrs**

Embedded system design: Processor embedded into a system, embedded hardware units and devices in a system, embedded software in a system, and embedded system on chip. complex system design and processors, design process in embedded system, formalization of system design, design process and design example. classification of embedded system, skill required for an embedded system designer.

Unit-IV — **12 hrs**

Communication devices and protocols: I/O types and examples, serial communication devices, parallel devices port, sophisticated interfacing features in device design. serial bus communication protocol, parallel bus devices protocol-parallel communication network using ISA, PCI, PCI-X and advanced buses.

RECOMMENDED BOOKS

Title	Author	Publisher
1.The 8051 Microcontroller and Embedded Systems	M.Mazidi, JG Maizidi	Pearson Education
2. Embedded Systems	Raj Kamal	Tata McGraw Hill
3. The 8051 Microcontroller	Kenneth J. Ayala	Pearson Education

ECP-622
Microcontroller and Embedded system

	L	T	P	Credits
	0	0	2	1

Course Objectives	The aim of this lab is to familiarize the students with the programming of microcontroller for performing various arithmetic operations. Students will learn how to interface various peripheral devices with the microcontroller.
Course Outcomes	1. Ability to perform various basic operations using assembly language. 2. Interfacing of various peripheral devices with microcontroller. 3. Interfacing of ADC and DAC with microcontroller.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	M	S	M	N	N	S	W	S	W	N	M
CO2	S	S	M	W	M	N	N	S	M	M	S	N	M
CO3	S	S	S	M	M	W	W	S	W	M	S	N	M

List of Experiments:

1. Write a program to toggle all the bits of port 1 by sending to it the values 55H and AAH continuously. Put a time delay in between each issuing of data to port 1.
2. Multiply 25 by 10 using the technique of repeated addition.
3. Write a program to add the first 10 natural numbers.
4. Write a program to add two BCD numbers.
5. Write a program to perform the subtraction of two numbers.
6. Write a program to perform the division of two numbers.
7. Write a program using 8051 to split a byte into two nibbles and show results.
8. Create a square wave that has a high portion of 1085 μs and a low portion of 15 μs. Assume XTAL = 11.0592 MHz. Use Timer 1.
9. Write the following programs:
   a) Create a square wave of 50% duty cycle on bit 0 of port 1.
   b) Create a square wave of 66% duty cycle on bit 3 of port 1.
10. Assuming XTAL =22 MHz, write a program to generate a pulse train of 2 seconds period on pin P2.4. Use Timer 1 in mode 1.
11. Design a counter for counting the pulse of an input signal. The pulse to be counted is fed to pin3.4. XTAL = 22MHz.
12. Design a circuit to interface ADC with microcontroller.
13. Design a circuit to interface DAC with microcontroller.
14. Design a circuit to interface LCD with microcontroller.
15. Design a circuit to interface keyboard with microcontroller.

ECT-623
Antenna and Wave Propagation

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The aim of course is to understand radiation principles, antenna fundamentals and their basic parameters. Various antennas, arrays and their special features and applications will also be discussed. The wave propagation will enable the students to learn the atmospheric electrical structure and its propagation properties.

Course Outcomes

1. Understand the various antenna parameters and the radiated fields.
2. Discussion about the formation of various antennas and their arrays. In addition, understanding about the synthesized radiation patterns of arrays.
3. Describe the various special antennas with their distinct radiation patterns formations and their applications.
4. Describe the atmospheric and terrestrial effects on radio wave propagation and influence of ionosphere on propagation.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	S	S	M	M	W	M	N	S	N	M
CO2	S	S	S	M	S	S	W	S	W	W	S	N	M
CO3	S	S	M	M	M	W	M	S	M	M	S	N	W
CO4	S	M	M	M	M	W	M	S	M	W	M	N	W

Unit-I — **12 hrs**

Basic antenna parameters: Radiation mechanism, radiation patterns, antenna beam area, antenna beam width, radiation intensity, gain, directive gain, power gain, directivity (D), antenna bandwidth, effective height, reciprocity theorem, self-impedance, mutual impedance, radiation resistance, front to back ratio, radiation power density.

Radiation principles: Retarded vector potential, isotropic radiators, near field and far field concept, radiation from a half wavelength dipole, power radiated by a current element and its radiation resistance.

Unit-II — **12 hrs**

Wire radiators: Voltage and current distribution, asymptotic current distribution in dipole, analysis of linear wire elements, Hertz dipole antenna, monopole radiators, resonant and non-resonant antennas.

Special antennas: Aperture antennas, E & H -plane horn antennas, pyramidal horn, lens and reflector antenna, frequency independent antennas, log periodic antenna, antenna measurements, microstrip antennas & their advantages, antenna for receiving and transmitting TV signals e.g. Yagi-Uda and turnstile antennas.

Unit-III — **12 hrs**

Antennas array: Introduction, linear uniform arrays of isotropic sources, principles of pattern multiplication. broadside arrays, end fire arrays, array pattern synthesis, uniform array, binomial array, Chebyshev arrays.

Unit-IV	**12 hrs**
Propagation of radio waves: Structure of ionospheric region, different modes of propagation: ground waves, space waves, space wave propagation over flat and curved earth, optical and radio horizons, surface waves and troposphere waves, wave propagation in the ionosphere, critical frequency, maximum usable frequency (MUF), skip distance, virtual height, radio noise of terrestrial and extra-terrestrial origin, effect of earth's curvature, duct propagation, troposphere scatter propagation.	

RECOMMENDED BOOKS

Title	**Author**	**Publisher**
1. Antennas	Kraus	Mc Graw Hill
2. Antennas	Balanis	Mc Graw Hill
3. Antenna and Wave Propagation	K D Parsad	Parkash Publications
4. Electromagnetic Waves and Radiating Systems	K. G Balmain, E. C Jordan	PHI

ECT-624
Control System Engineering

	L	T	P	Credits
	3	1	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The aim of this course is to understand the basic elements of control system and its illustrative examples, concept of servomechanism. This course will contain physical modeling of electric-mechanical system, finding the transfer function using block diagram reduction and signal flow graphs and analysis of steady state and transient state. To understand the concept of stability using various techniques such as Routh's Hurwitz criterion, root locus technique, Nyquist, bode plots and state space analysis.

Course Outcomes

1. Develop the basic understanding of control system theory and its role in engineering design.
2. Understand concept of poles and zeros of a transfer function and their effect on physical behavior of a system.
3. Understand the concept of time domain and frequency domain analysis and to analyze the physical behavior of systems.
4. Compute state variable analysis of systems and the relationship with state variable representation and transfer functions.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	M	S	M	N	N	N	M	N	M	N	S
CO2	S	W	W	W	W	N	N	M	W	W	W	N	S
CO3	S	S	M	M	W	N	N	N	N	N	W	N	S
CO4	S	S	S	W	M	W	W	M	N	S	M	N	S

Unit-I **14 Hrs.**

Introduction: Introduction to control systems, servomechanism, open loop control system, closed loop control system with block diagrams and illustrative examples, AC and DC servomotors, stepper motor, concept of transfer function, characteristic equations, physical system modeling, formulation of equations for linear electrical, mechanical, thermal, hydraulic and pneumatic systems, electrical- mechanical analogies. signal flow graphs, block diagram simplification for linear systems.

Unit-II **14 hrs**

System response: Time domain and frequency domain response of the first and second order systems. time domain specifications, steady state error and coefficients, type and order of system with P, PI, PD and PID controller, relation between time and frequency response for second order systems.

Unit-III **14 hrs**

Stability analysis: Pole-zero location and stability, Routh-Hurwitz criterion, root locus, log. magnitude versus phase angle plot, bode plots, Nyquist criterion for stability, necessity of compensation, lead, lag and lead-lag compensation networks.

Unit-IV	**10 hrs**
State variable analysis: State space representation of continuous time systems, state equations, transfer function from state variable representation, solution of state equations, controllability and observability, state space representation of discrete time systems.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Modern Control Engineering	Ogata K	Prentice Hall, 5th Edition 2010
2. Automatic Control Systems	Kuo BC	Prentice Hall, 9th Edition 2014
3. Modern Control Systems Engineering,	Nagrath I J and Gopal M	New age international, 3rd Edition, 2014.
4. Linear Control System	B S Manke	Khanna Publishers, 12th edition

ECS-601 Seminar				
	L	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Course Objectives	To carry out a presentation in one of the specializations of the program with substantial multidisciplinary component			
Course Outcomes	1. An ability to write technical documents and give oral presentations related to the work completed and improve personality development and communication skills. 2. Train the students to approach ethically any multidisciplinary engineering challenges with economic, environmental and social contexts and to set them for future recruitment by potential employers. 3. Identify and apply appropriate well-rehearsed note-taking interactive and time management strategies to their academic studies. 4. Develop audience-cantered presentations meeting concrete professional objectives and integrating ethical and legal visual aids. 5. Identify and critically evaluate the quality of claims, explanation, support, and delivery in public and professional discourse, and understand the factors influencing a speaker's credibility.			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	S	S	S	N	N	M	M	S	M	M	N
CO2	N	M	N	N	S	S	S	S	S	S	S	S	N
CO3	N	N	N	W	N	N	N	M	W	S	S	N	N
CO4	M	W	N	W	W	N	N	M	S	S	W	S	S
CO5	N	N	N	N	S	S	N	M	S	S	M	M	S

ECO-711
Fundamental of Microprocessors

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The objective of this course is to make introduction to the architecture and programming of the microprocessor 8085 and learning about communication interfaces and various applications basic and advanced microprocessors.

Course Outcomes

1. Understand the basic functioning of 8085 and develop the programs.
2. Understand design of memory systems and develop programs for communications and peripherals interfacing.
3. Understanding basic functioning of advanced microprocessors.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	M	M	W	N	N	M	W	N	W	N	M
CO2	M	S	S	S	S	W	W	S	M	S	S	N	M
CO3	M	M	M	M	W	M	W	S	M	M	S	N	M

Unit-I — **12 hrs**

Introduction: Digital computing, computer languages, from large chip computers to single chip microcomputers, microcomputers organization, and 4-bit microprocessors.

Introduction to 8-bit microprocessor architecture: Microprocessor architecture & its operations, memory, input / output, interfacing devices MPU, 8085 based microcomputer, instruction classification, instruction format, instruction timings, 8080 A MPU, overview of 8085/8080A instruction set.

Unit-II — **12 hrs**

Programming using 8085 microprocessor: Data transfer instructions, arithmetic operations, logic operations, branch operations, programming techniques using looping counting & indexing, dynamic debugging, time delays, counters, stack, subroutines, conditional call, and return instructions, advanced subroutine concepts.

Unit-III — **12 hrs**

Interrupts: The 8080A interrupts the 8085 interrupts, restart instructions, additional I/O concepts & processes.

Parallel input/output and interfacing applications: Basic interfacing concepts, interfacing output displays, interfacing input keyboards, memory mapped I/O, interfacing memory, interfacing D/A & A/D converters.

Unit-IV — **12 hrs**

General purpose programmable peripheral devices: Introduction to 8155/8156,8255 A programmable peripheral interface, 8253 programmable interval timer, 8259 programmable interrupt controller, SID & SOD lines, 8251 USART.

Microprocessor applications: Temperature controller, traffic light controller, stepper motor control, comparison of 8 bit, 16 bit& 32 bit microprocessors, introduction to Pentium processors.

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1.Microprocessor Architecture-Programming & Applications with 8085/8080A	Ramesh S Gaonkar	5th Edition, Penram International Publishing
2.Introduction of Microprocessors & Microcomputers	Ram B	4th Edition, Dhanpat Rai Publisher (P) Ltd.
3.Microprocessor Interfacing Technique	RodnayZaks and Austin Lesea	1st Indian Edition, BPB Publication
4. An Introduction to Intel Family of Microprocessors	James L Antonakes	3rd Edition, Pearson Education
5. Microprocessor Principles and Applications	Charles M Gilmore	2nd Edition, McGraw Hill

ECO-712
VLSI Technology

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives	The objective of the subject microelectronics is to discuss the design and fabrication process of thick film, thin film and hybrid IC's. It also aims to understand each and every step of fabrication from crystal growth to photolithography to manufacturing and to have a deep knowledge of fabrication process flow and learning design and fabrication of MOSFET.
Course Outcome:	1. Understand the basics of fabrication process, its requirements and challenges. 2. Process integration for NMOS, CMOS and bipolar circuits and latest trends in VLSI Technology.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	W	S	M	S	N	S	M	N	N	M	N	M
CO2	S	M	M	W	N	N	N	M	N	M	S	N	S

Unit-I — **14 hrs**

Introduction to VLSI technology: Clean room and safety requirements, wafer cleaning process and wet chemical etching techniques, impurity incorporation: solid state diffusion modelling and technology, ion Implantation modeling, technology and damage annealing, characterization of impurity profiles.

Oxidation: Kinematics of silicon dioxide growth for, thick thin and ultrathin films, oxidation technologies in VLSI and ULSI, characterization of oxide films, high k and low k dielectrics for ULSI.

Unit-II — **12 hrs**

Lithography: Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI, Mask generation.

Chemical vapour deposition techniques(CVD): CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films, epitaxial growth of silicon: modeling and technology

Unit-III — **12hrs**

Metal film deposition: Evaporation and sputtering techniques, failure mechanisms in, metal interconnects and multi-level metallization schemes.

Plasma and rapid thermal processing: PECVD, Plasma etching and RIE techniques, RTP techniques for annealing, growth and deposition of various films for use in ULSI.

Unit-IV — **10 hrs**

Process integration: Process integration for NMOS, CMOS and bipolar circuits.

Advance MOS technology: Introduction and latest trends in VLSI technology.

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RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. The Science and Engineering of Microelectronic Fabrication	Stephen A. Campbell	Oxford University Press, 2012
2. VLSI Technology 2nd edition	Sze	McGraw-Hill Book Company, New Delhi, 1988
3. VLSI Fabrication Principles	Sorab K. Gandhi	John Wiley, 1994

ECO-713
Nanotechnology

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives

It gives an understanding of the fundamentals of nanotechnology, gives a general introduction to different classes of nanomaterials. Basic knowledge on various synthesis and characterization techniques involved in Nanotechnology will be imparted. Students will be familiarized with nanotechnology potential.

Course Outcomes

1. To understand how basic Nano-systems work.
2. To acquire knowledge of Nano particle synthesis and size dependent physical properties
3. Use physical reasoning to develop simple nanoscale models to interpret the behaviour of such physical systems

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	S	M	W	S	S	M	N	N	S	N	M
CO2	M	M	M	M	S	S	S	S	S	W	S	N	W
CO3	M	M	M	W	W	S	S	S	M	M	S	N	W

Unit-I — **12 hrs**

Introduction: An overview, insights and intervention into the nano world, societal implications & ethical issues in nano science and nanotechnology

Applications: Applications of nanotechnology in different areas of food, agriculture, textile and medical sciences

Unit-II — **12 hrs**

Semiconductor nano particles synthesis: Cluster compounds, quantum-dots from MBE and CVD, wet chemical methods, reverse micelles, electro-deposition, pyrolytic synthesis, self-assembly strategies.

Semiconductor nano particles- size–dependent physical properties: Melting point, solid-state phase transformations, excitons, band-gap variations-quantum confinement.

Unit-III — **12 hrs**

Semiconductor nano particles–applications: Optical luminescence and fluorescence from direct band gap semiconductor nanoparticles, surface-trap passivation in core-shell nanoparticles, carrier injection.

Doping: Electroluminescence, barriers to nanoparticle lasers, doping nanoparticles, Mn-Zn-Se phosphors, light emission from indirect semiconductors, light emission form Si Nanodots

Unit-IV — **12 hrs**

Semiconductor nanowires: Fabrication strategies, quantum conductance effects in semiconductor nanowires, porous silicon, nano belts, nano ribbons, nano springs.

Physical methods: Inert gas condensation, arc discharge, RF-plasma, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis

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RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. Encyclopedia of Nanotechnology	Hari Singh Nalwa	Springer Inc.
2. Springer Handbook of Nanotechnology	Bharat Bhusan	Springer Inc.
3. Introduction to Nanotechnology	Poole Jr., C.P., Owens, F.J	Wiley Inc.
4. A Textbook of Nanoscience and Nanotechnology	B S Murthy	Springer Inc.

ECT-711A
Optoelectronics Devices and Circuits

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The objective of this course is to get familiar with the design concept of optoelectronics devices and circuits by using different design technologies used for design of optoelectronics devices. Implementation approach of optoelectronics devices in modern communication system. To study the design and evaluation of modern optoelectronics integrated systems.

Course Outcomes

1. Know the fundamental concepts of various optoelectronics devices.
2. Utilized optoelectronics devices in high speed optic communication systems.
3. Analyze, model and implement advanced techniques in optoelectronics fabrication.
4. Use advanced optoelectronics devices for research projects and other applications.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	S	S	S	N	M	M	N	M	S	N	M
CO2	S	S	S	S	S	M	N	S	M	M	S	N	M
CO3	S	S	M	M	S	N	W	S	M	M	S	N	M
CO4	S	S	S	S	M	W	M	S	M	M	S	N	W

Unit-I — **10 hrs**

Introduction: Semiconductors, optical waves, photon generation, optoelectronics, need of optoelectronics, advantages, applications-network, military, civil, industrial, sensors etc.

Unit-II — **14 hrs**

Optoelectronic sources: Introduction, basic concepts, optical emission from semiconductor, semiconductor injection laser & its various structures, injection laser characteristics, threshold condition, wavelength tunable lasers, LED power and efficiency, heterojunction, LED structure designs, characteristics, modulation response of an LED.

Optoelectronic detectors: Introduction, device types, basic principal of optoelectronic detection, absorption, quantum efficiency, responsivity, wavelength cut-off, types of photodiodes with and without internal gain, mid-infrared photodiode, phototransistors, photo conducting detectors, noise considerations

Unit-III — **16 hrs**

Passive network components & sensors: Introduction, couplers/splitters, WDM multiplexers, demultiplexers, filters, isolators, circulators, attenuators, electro-optic modulators, acousto-optic modulators and their application areas, optical sensors: classification-point, distributed, intensity, phase & spectral. smart structures & applications

Optical amplifiers and integrated optics: Introduction, semiconductor optical amplifiers (SOA), erbium-doped fiber amplifiers (EDFA), fiber Raman amplifiers (FRA), application areas of optical amplifiers, some integrated optical devices, OEICs, optical bistability and digital optics, optical computation.

Unit-IV	**12 hrs**
Optoelectronic integrated circuits: Introduction, hybrid and monolithic integration, application of opto electronic integrated circuits, integrated transmitters and receivers, guided wave devices.	

RECOMMENDED BOOKs

Title	Author	Publisher
1. Semiconductor Optoelectronic Devices	Pallab Bhattacharya	Pearson Education Inc
2. Photonics - Optical Electronics in Modern Communications	A. Yariv and P. Yeh,	Oxford University Press
3.Opto Electronics – As Introduction to materials and devices	Jasprit Singh	McGraw-Hill International
4.Opto Electronics – An Introduction	J. Wilson and J. Haukes	Prentice Hall, 1995

ECT-711B
Satellite Communication

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives

This course provides fundamental knowledge about orbital theory and satellite link design. Students will understand the role of various modulation, multiplexing and multiple access techniques used in satellite communication networks. Study of various satellite services also presented in this course.

Course Outcomes

1. Identify the characteristics of common orbits used by communications and other satellites and assess launch methods and technologies.
2. Acquired knowledge about various multiplexing techniques used in satellite communication.
3. Identify the systems required by a communications satellite to function and the trade-offs and limitations encountered in the design of a communications satellite system.
4. Assess the analog and digital technologies used for satellite communications networks and the topologies and applications of those networks.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	M	M	M	N	W	M	N	N	S	N	W
CO2	S	S	S	S	S	M	M	S	S	M	S	N	M
CO3	W	M	M	S	S	M	W	S	W	S	M	N	W
CO4	S	S	M	M	S	N	W	S	M	W	S	N	W

Unit-I — **12 hrs**

Introduction: Origin and brief history of satellite communication, satellite frequency bands for communication, current state of satellite communication;
Orbital theory: Orbital mechanism, locating the satellite in the orbit with respect to earth, look angle determination, azimuth and elevation angle calculations.

Unit-II — **16 hrs**

Satellites and satellite link design: Satellite subsystems, attitude and orbit control system, telemetry, tracking and command (T&C), communications subsystems, transponders, satellite antennas, satellite link design: basic transmission theory, noise figure and noise temperature, design of downlinks, satellite systems using small earth stations, uplink design, design of satellite link for specified (C/N).

Unit-III — **12 hrs**

Modulation, multiplexing, multiple access techniques: FM modulation, analog FM transmission by satellite, S/N ratio for satellite FM video transmission; digital transmission, baseband and bandpass transmission of digital data, digital modulation: BPSK, QPSK; multiplexing: FDM, TDM; access techniques: FDMA, TDMA, CDMA.

Unit-IV	**12 hrs**
Propagation effects and satellite services: Quantifying attenuation and depolarization, atmospheric absorption, cloud attenuation, rain and ice effects, prediction of rain attenuation. VSAT technology, direct broadcast satellite (DBS) for TV and radio, satellite navigation and GPS system, mobile satellite services.	

RECOMMENDED BOOKS

Title	Author	Publisher
1.Satellite Communications	Timothy Pratt, Charles W. Bostian, Jeremy Allnutt	John Wiley & Sons, 2002
2.Satellite Communications Systems: Systems, Techniques and Technology	Gerard Maral, Michel Bousquet	John Wiley & Sons Ltd, 2002
3. Communication satellite systems	J Martin	Prentice Hall publication, 1978
4.Satellite Communication	Dennis Roddy	McGraw-Hill, 4th Edition 2006.

ECT-711C
MEMS

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The course aims to give the students a basic knowledge about state-of-the-art MEMS including technology, device architecture, design and modelling, scalability, figures of merit and RF IC novel functionality and performance. Reliability and packaging are also considered as key issues for industrial applications.

Course Outcomes

1. To gain basic knowledge about MEMS and its various micro system products.
2. Student will acquire knowledge about different factors and properties of materials used in design of MEMS.
3. To understand basic idea fluid mechanics in micro and macro scales.
4. To attain knowledge about various levels of packaging of microsystems.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	M	S	M	M	M	M	W	N	S	N	M
CO2	M	M	M	M	W	N	W	W	W	N	S	N	W
CO3	S	S	W	W	N	N	S	W	N	W	S	W	W
CO4	M	M	W	M	W	N	W	S	W	W	S	N	W

Unit-I **12 hrs**

MEMS and microsystems: MEMS and micro system products, evaluation of micro fabrication, Microsystems and microelectronics, applications of microsystems, working principles of Microsystems, micro sensors, micro actuators, MEMS and micro actuators, micro accelerometers.

Scaling laws in miniaturization: Introduction, scaling in geometry, scaling in rigid body dynamics, the trimmer force scaling vector, scaling in electrostatic forces, electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection.

Unit-II **14 hrs**

Materials for MEMS and microsystems: Substrates and wafers, silicon as a substrate material, ideal substrates for MEMS, single crystal Silicon and wafers crystal structure, mechanical properties of Si, Silicon compounds; SiO_2, SiC, Si_3N_4 and polycrystalline silicon, silicon piezo resistors, gallium arsenide, quartz, piezoelectric crystals, polymers for MEMS, conductive polymers.

Engineering mechanics for microsystems design: Introduction, static bending of thin plates, circular plates with edge fixed, rectangular plate with all edges fixed and square plates with all edges fixed. Mechanical vibration, resonant vibration, micro accelerometers, design theory and damping coefficients. thermo mechanics, thermal stresses. fracture mechanics, stress intensity factors, fracture toughness and interfacial fracture mechanics.

Unit-III	**14 hrs**
Basics of fluid mechanics in macro and mesco scales: Viscosity of fluids, flow patterns Reynolds number. basic equation in continuum fluid dynamics, laminar fluid flow in circular conduits, computational fluid dynamics, incompressible fluid flow in micro conducts, surface tension, capillary effect and micro pumping, fluid flow in sub micrometer and nanoscale, rarefied gas, Kundsen and Mach number and modeling of micro gas flow, heat conduction in multilayered thin films, heat conduction in solids in sub micrometer scale, thermal conductivity of thin films - heat conduction equation for thin films.	
Unit-IV	**14 hrs**
Micro system packaging and applications of MEMS: Micro system packaging, general considerations, the three levels of microsystems packaging, die level, device level and system level, essential packaging technologies, die preparation, surface bonding wire bonding and sealing, three-dimensional packaging, assembly of microsystems, selection of packaging materials. **The MEMS switch and its design consideration:** The MEM resonator and its design considerations, micromachining-enhanced planar microwave passive elements.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. MEMS and Microsystems Design and Manufacture	Tai-Ran Hsu	Tata McGraw Hill
2. Fundamentals of Micro fabrication	Mark Madou	CRC Press
3. Micro sensors: Principles and Applications	J. W. Gardner	John Willey ,2009
4. Semiconductor Sensors	S. M. Sze	Tata McGraw Hill
1.An Introduction to Microelectromechanical Systems Engineering	Nadim Maluf and Kirt Williams	Artech, 2nd Edition, 2004
2.Introduction to Microelectromechanical Microwave Systems	Hector J. De Los Santos	Artech, 2nd Edition, 2004

ECT-711D
MATLAB Programming

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives

The aim of this course is to introduce the students to the MATLAB programming language for numerical computations and its application in engineering and technology.

Course Outcomes

1. Students should be able to apply computer methods for solving a wide range of engineering problems.
2. Students should be able to use computer engineering software to solve and present problem solutions in a technical format.
3. Students should be able to utilize computer skills to enhance learning and performance in other engineering and science courses.
4. And finally, students should be able to demonstrate professionalism in interactions with colleagues, faculty, and staff.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	M	S	W	W	M	M	N	S	N	W
CO2	M	S	S	S	S	M	W	S	M	M	S	W	S
CO3	S	S	S	S	S	N	N	S	S	W	S	N	W
CO4	S	M	M	M	M	W	N	S	S	S	S	W	N

Unit-I — **14 hrs**

Interactive computation: Basics of MATLAB, MATLAB windows, input-output, file types, general commands, working with arrays of numbers, creating and plotting simple plots, creating, saving and executing script and function files, language specific features, and advanced data objects.

Unit-II — **12 hrs**

Matrices and vectors manipulation: Matrices and vectors input, indexing, matrix manipulation, creating vectors, matrix and array operations, arithmetic operations, relational operations, logical operations, elementary math functions, matrix functions and character strings.

Unit-III — **14 hrs**

Linear algebra, interpolation and data analysis: Solving a linear system, gaussian elimination, finding eigen values & eigenvectors, matrix factorization, polynomial curve fitting, least squares curve fitting, interpolation, data analysis and statistics, MATLAB applications in linear algebra, curve fitting and interpolation, data analysis and statistics.

Unit-IV — **12 hrs**

Graphics manipulation: Basic 2-D plots, style options, labels, title, legend, and other text objects, axis control, zoom-in and zoom-out, modifying plots, overlay plots, specialized 2-D plots and introduction to 3-D plots.

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RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. Getting Started with MATLAB	Rudra Pratap,	Oxford University Press
2. MATLAB Programming	Y. Kirani Singh, B. B. Chaudhuri	PHI
3. MATLAB and Its Applications in Engineering	Raj Kumar Bansal	Pearson Education India
4. MATLAB by Examples	Abhishek Kr Gupta,	Finch Publications

EC-711E
Electronic System Design

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

Students will be introduced to active and passive components specifications required for design an electronic circuit. Designing of various power supply circuits. Selection of components will be explained. Problems in the transistor amplifier and how to use op amp to solve these problems will be explained. This is necessary and essential in understanding the design of heat sink, and importance of grounding. It will impart practical knowledge of electronic system design.

Course Outcomes

1. Explain and identify the devices which can be used in applications like power supply, amplifiers etc.
2. Design linear and variable power supply.
3. Design an amplifier using transistor and op-amp
4. Design different base drive circuits.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	M	M	M	N	N	W	N	W	W	N	W
CO2	M	S	S	S	S	M	W	S	M	M	S	N	W
CO3	S	S	S	M	W	M	S	M	N	W	S	N	S
CO4	S	M	W	M	W	N	N	S	W	W	M	N	W

Unit-I **14 hrs**

Practical circuit design issues and techniques: Passive components, understanding and Interpreting data sheets and specifications of various passive and active components. design of electronic circuits by using these types of components, understanding and interpreting data sheets and specifications of various CMOS and TTL logic devices. CMOS/TTL interfacing issues, benefits and challenges on migration of 5V to 3.3V low voltage supplies.

Unit-II **14 hrs**

Power supply design techniques: Regulated and unregulated power supply, conditions for proper operation of Zener regulator, transistor series voltage regulator, transistor Shunt voltage regulator, short circuit protection, foldback protection circuit, IC voltage regulators, fixed voltage regulators, adjustable voltage regulators design, dual voltage regulators design, differences between linear voltage power supply and SMPS.

Unit-III **12 hrs**

Amplifiers design challenges and techniques: Basic amplifiers design, single stage amplifier, how transistor amplifies? Transistor audio power amplifier, small signal and large signal amplifier, difference between voltage and power amplifiers, operational amplifiers, circuit analysis using operational amplifier in different configurations.

Unit-IV **12 hrs**

Cooling and grounding of electronic system: Heat transfer approach to thermal management, mechanisms for cooling, basic thermal calculations, heat sink selection, and heat sink design. Safety grounds, signal grounds, high frequency ground methods, low frequency grounding methods, chassis grounding.

Kuldip Singh Vivek Harshey Dilip Kumar L. S. Solanki J.S. Ubhi A. Marwaha

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. Electronic Instrument Design, 1st edition	Kim R.Fowler	Oxford University Press.
2. Digital Design Principles& Practices, 3rd edition	John F. Wakerly	Prentice Hall
3. Practical Analog Design Techniques	Adolofo Garcia and Wes Freeman	Seminar Materials
4.The Art of Electronics	Paul Horowitz	Cambridge University Press, 2011

ECT-712
Digital Signal Processing

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The aim of this course is to acquire knowledge of discrete time systems, Z-transform, discrete Fourier transform (DFT) and fast Fourier transform (FFT) methods. Implementation and designing of FIR and IIR filters and realization of their structures. The concept of multirate signal processing and sample rate conversion will also be discussed.

Course Outcomes

1. Analyze linear time invariant systems.
2. Compute z-transform, DFT and FFT of discrete time signals.
3. Design FIR and IIR filters using standard techniques.
4. Understand the concepts of multirate signal processing.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	M	W	N	N	N	N	N	W	N	M
CO2	S	S	S	S	S	N	W	S	M	S	S	N	M
CO3	M	S	S	S	M	W	N	S	N	N	S	N	S
CO4	S	S	S	S	M	W	W	S	W	W	M	N	W

Unit-I **10 hrs**

Introduction: Advantages of digital signal processing over analog signal processing and its applications; basic elements of digital signal processing systems, concept of frequency in discrete time sinusoidal and harmonically related complex- exponential signals, review of discrete-time signals and systems, analysis of discrete-time systems, discrete-time systems described by difference equation, correlation of discrete-time signals.

Unit-II **16 hrs**

Z-transform: Introduction to Z- transform and inverse Z-transform, region of convergence, properties of Z transform, analysis and characteristics of LTI systems using Z- transforms.

Discrete fourier transform (DFT): Introduction to DFT, inverse DFT, DFT as a linear transform, relationship of DFT with other transforms, properties of DFT, circular convolution, use of DFT in linear filtering, filtering of long sequences. efficient computation of the DFT, fast Fourier transform algorithm using decimation in time and decimation in frequency techniques.

Unit-III **16 hrs**

Implementation of discrete time system: Structures for the realization of discrete-time systems, structure for FIR & IIR systems, fixed point and floating point representations, effects of coefficient unitization, effect of round off noise in digital filters, limit cycles.

Design of digital filters: General consideration, linear phase FIR filters, design methods for FIR filters using windows, IIR filter design by impulse invariance, bilinear transformation and matched Z-transformation.

Unit-IV		**06 hrs**
Multirate signal processing: Introduction, interpolation and decimation.		
RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. Discrete Time Signal Processing, 3rd Edition 2014	Oppenheim A V &Sehafer R W	Prentice Hall
2. Digital Signal Processing, 4th Edition 2006	Proakis J G &Manolakis D G	Pearson
3. Signal & Systems, 2nd Edition 2009	Oppenheim A V, Willsky A S & Young I T	Wiley Eastern Ltd N. Delhi
4. Digital Signal Processing, 4th Edition 2013	S.K Mitra	Tata Mc-Graw Hill

ECP-712
Digital Signal Processing

	L	T	P	Credits
	0	0	2	1

Course Objectives	This lab aims to get familiar the students about the software MATLAB and its use to verify various mathematical function i.e convolution, correlations as well as to design of various digital time causal systems. Later on Students will learn how to design Low Pass, High Pass, Band Pass and FIR filter with the help of MATLAB.
Course Outcomes	Students will able to understand the various functions of MATLAB. 1. Design of discrete time causal system. 2. Design of various filter circuits. 3. Verify various mathematical operations with the help of MATLAB.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	M	W	N	N	N	N	N	W	N	W
CO2	S	S	S	S	S	N	W	S	M	S	S	N	M
CO3	M	S	S	S	M	W	N	S	N	N	S	N	M
CO4	S	S	S	S	M	W	W	S	W	W	M	N	W

List of Experiments:

1. Write a program in Matlab to generate standard sequences.
2. Write a program in Matlab to compute power density spectrum of a sequence.
3. To write a Matlab program to verify correlation and autocorrelation.
4. Write a program in Matlab to verify linear convolution.
5. Write a program in Matlab to verify the circular convolution.
6. To write a Matlab programs for pole-zero plot, amplitude, phase response and impulse response from the given transfer function of a discrete-time causal system.
7. Write a program in Matlab to find frequency response of different types of analog filters.
8. Write a program in Matlab to design FIR filter (LP/HP) through rectangular window technique.
9. Write a program in Matlab to design FIR filter (LP/HP) through triangular window technique.
10. Write a program in Matlab to design FIR filter (LP/HP) through Kaiser window technique.
11. Write a program in Matlab to find the FFT.
12. Implementation of low-pass, high pass and band-pass filter on some chosen signal.

ECT-713
Wireless Communication

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives: The aim of this course is to study the basics of cellular systems, impart knowledge about the fading effects. The emphasis will be to analyze different modulation techniques used for mobile communication and understand the concepts of CDMA and GSM wireless communication standards.

Course Outcomes:
1. Understand the concept of cellular system.
2. Understand the effect of different types of fading on wireless communication.
3. Analyze various modulation techniques used in wireless communication.
4. Distinguish between different multiple access techniques and understand the basic principles of GSM & CDMA technology.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	N	N	W	N	N	W	N	N	S	N	S
CO2	W	M	S	S	W	N	N	S	W	M	M	N	M
CO3	S	M	W	M	M	N	W	S	W	W	M	N	M
CO4	M	M	N	N	W	N	N	W	N	N	S	N	S

Unit-I — **12hrs**

Introduction to wireless communication systems: Concept of cellular communication system, basics of wireless cellular system, mobile unit, base station, mobile switching centre, frequency reuse, channel assignment strategies, co-channel interference, determining the frequency reuse distance, hand-off strategies, interference and system capacity, trunking efficiency, improving capacity of cellular system, cell splitting and sectoring.

Unit-II — **12 hrs**

Mobile radio propagation: Introduction to radio wave propagation, free space propagation model, basic propagation mechanisms, reflection, diffraction, scattering, outdoor propagation models, indoor propagation models, signal penetration into buildings, types of small-scale fading, fading effects due to Doppler spread and delay spread, diversity techniques.

Unit-III — **12 hrs**

Modulation techniques: Introduction to linear modulation techniques, minimum shift keying, Gaussian minimum shift keying, spread spectrum modulation techniques, DS-SS, and FH-SS systems, performance of modulation schemes, power spectrum and error performance in fading channels.

Unit-IV — **12 hrs**

Wireless communication standards: Introduction to GSM, GSM services and features, system architecture, radio subsystem and channel types. cellular code division multiple access (CDMA) systems: principle, power control, effects of multipath propagation on code division multiple accessand introduction to third generation wireless networks, long term evolution (LTE) and standards.

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1.Wireless Communications	T.S Rappaport	Pearson Education, 2003.
2.Principles of Mobile Communication	Gordon L. Stuber	Springer International Ltd., 2001.
3.Wireless Communications	Andrea Goldsmith	Cambridge University Press, 2007

ECT-714
Microwave Engineering

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The aim of this course is to understand the basic properties and application areas of microwave to understand the principles underlying microwave devices and networks to have fundamental understanding of microwave components and circuits in terms of scattering parameters, to learn the principle of transmission lines, waveguides, microwave network analysis and its application to impedance matching.

Course Outcomes

1. Understand the basic properties and application areas of microwaves, analyze the waveguides, analyze the microwave networks.
2. Apply analysis methods to determine circuit properties of passive/active microwave devices.
3. Know how to model and determine the performance characteristics of a microwave circuit or system.
4. Have knowledge of transmission and waveguide structures and how they are used as elements in impedance matching and filter circuits for development of real time applications.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	M	S	W	N	M	W	M	N	S	N	M
CO2	S	S	S	S	M	N	W	S	W	M	S	N	W
CO3	S	S	M	S	S	N	W	S	M	M	S	N	M
CO4	S	S	S	S	S	W	W	S	M	M	S	N	W

Unit-I **12 hrs**

Microwave components: Introduction, microwave frequency spectrum, familiarization with bands and wavelength, wave guides: basic concepts and properties, rectangular and circular waveguides, wave guide coupling, ferrite device, faraday rotation, isolators, circulators, detector mounts, magic tee, frequency meter, cavity resonator, microwave filters, directional couplers, loop directional couplers, two-hole directional coupler, phase shifters, attenuators, introduction to S parameters.

Unit-II **12 hrs**

Microwave tubes: Problem with conventional tubes, lumped elements at microwave frequencies, velocity modulations, multi cavity klystron, mathematical analysis of two cavity klystrons, performance, reflex klystron, mathematical analysis, repeller voltage, accelerating voltage mode, frequency tuning, magnetrons, travelling wave tube: performance and application.

Unit-III	**16 hrs**
Semiconductor microwave devices: Limitations of conventional solid state devices at microwaves, transistors, varactor diodes, step recovery diode, tunnel diode, Gunn effect, Gunn diode application, avalanche effect, characteristics and application of avalanche diode, IMPATT diode, TRAPPAT diode, PIN diodes & its application, parametric amplifier. **Microwave integrated circuits**: MIC, advantages of MIC's, evolution of MICs, planner transmission line, lumped element of MICs, substrate for MIC, hybrid technology, monolithic technology, strip line, micro strip line, strip like transmission line, slot line, losses in strip like transmission line.	
Unit-IV	**8 hrs**
Microwave measurements: General measurement setup with microwave bench, measurement devices, power measurement, attenuation measurement, measurement of VSWR, measurement of impedance, measurement of Q of a cavity resonator, and set up for S parameter measurement.	

RECOMMENDED BOOKS

Title	**Author**	**Publisher**
1. Microwave and Radar Engineering	M Kulkarni	Umesh Publications, Delhi
2. Foundation of Microwave Engg	R. E. Collin	McGraw-hill
3. Microwave Engineering	Das A and Das S K	Tata McGraw-Hill
4. Microwaves	K C Gupta	New Age International
5. Microwave Devices and Circuits	Liao S Y	Prentice Hall of India
6. Microwave Principles	Reich A J	East-West Press Pvt. Ltd
7. Microwave Filter, Impedance, matching N/W and Coupling Structures	Mathai,Young,Jones	McGraw-hill.
8. Microwave Laboratory Manual	Sisodia	Wiley

ECP-714 Microwave Engineering				
	L	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Course Objectives	This lab aims to get familiarize the students about the various communication antennas used in microwave range. It includes their design, gain, directivity, VSWR and various other characteristics. Further in this lab students will attain the knowledge about operation of various Plane-Tee.			
Course Outcomes	1. To evaluate gain, directivity and properties of different antennas. 2. To attain the knowledge about operation the H Plane, E Plane and Magic Tee. 3. To determine the VSWR, Standing Wave ratio, Reflection Coefficient and many more other parameters of various antennas and able to design an efficient antenna for microwave frequency range.			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	M	M	S	N	N	M	N	N	M	N	W
CO2	M	M	S	S	M	N	N	M	W	M	M	N	M
CO3	S	S	S	S	M	N	W	S	M	W	S	N	W

List of Experiments:

1. To understand the working of the Motorized antenna trainer.
2. To investigate the properties of a Yagi antenna comprising a dipole and a parasitic element.
3. To know the form of a Yagi antenna and examine multi element antenna. To see how gain and directivity increase as element numbers increase.
4. Be familiar with the log periodic form of antenna. To investigate the gain, and directivity of the log Periodic antenna over a wide frequency range.
5. To plot the radiation pattern of a directional antenna.
6. To measure antenna parameters (directivity, gain, beam width, half power beam width, front to back ratio) with polar plot of dipole antenna.
7. To measure antenna parameters of monopole antenna.
8. To measure antenna parameters of patch array antenna.
9. Identification of different waveguide components.
10. Study of the characteristics of klystron tube and to determine its electronic tuning range.
11. By use of slotted waveguide, to observe how the load impedance affects the VSWR.
12. To measure the VSWR of the antenna.
13. To determine the frequency & wavelength in a rectangular waveguide working on TE_{10} mode.
14. To be familiar with the operation of directional coupler.
15. To determine the standing wave-ratio and reflection coefficient.
16. To be familiar with the operation of E Plane-Tee.
17. To be familiar with the operation of H Plane-Tee.
18. To be familiar with the operation of Magic-Tee.
19. Measurement of the gain of horn antenna – using Method of the two antennas.
20. To measure antenna parameters of horn (E, H, Pyramidal) & open waveguide antenna.
21. To measure antenna parameters of conical horn antenna.
22. To setup a satellite communication link.

ECP-715 Minor Project				
	L	**T**	**P**	**Credits**
	0	**0**	**4**	**2**
Course Objectives	To guide the students in such a way so that they carry out a work on a topic as a forerunner to the full-fledged project work to be taken subsequently in VIII semester. The project work shall consist of substantial multidisciplinary component			
Course Outcomes	Upon completion of the course, the students will be able to 1. Select a suitable project making use of the technical and engineering knowledge gained from previous courses with the awareness of impact of technology on the society and their ethical responsibilities. 2. Collect and disseminate information related to selected project. 3. Identify the modern tools required for the implementation of the project. 4. Form a team and distribute the work among themselves. 5. Communicate technical and general information by means of oral as well as written presentation skills with professionalism.			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	S	S	S	W	M	M	M	S	M	M
CO2	W	S	M	M	S	N	N	S	S	M	M	N	W
CO3	S	S	S	S	S	M	S	S	S	S	S	N	M
CO4	M	W	N	M	S	S	N	W	S	S	M	S	S
CO5	W	W	M	S	M	N	N	S	S	S	M	N	W

TEC-701 Industrial Training				
	L	**T**	**P**	**Credits**
	0	**0**	**200**	**8**
Course Objectives	To provide hands-on experience in various domains such as hardware, software, maintenance and testing in industry / training centres/ corporate offices so that they become aware of the practical application of theoretical concepts studied in the class rooms.			
Course Outcomes	1. To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions. 2. To have hands-on experience in the students' related field so that they can relate and reinforce what has been taught at the university. 3. To promote cooperation and to develop synergetic collaboration between industry and the university in promoting a knowledgeable society. 4. To set the stage for future recruitment by potential employers			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	S	M	M	M	W	S	S	M	M	M	M
CO2	W	M	M	S	S	N	N	S	M	M	M	N	W
CO3	S	S	S	S	S	S	W	S	M	M	S	M	M
CO4	M	M	M	M	M	W	N	S	S	S	S	M	M

ECO-721
Biomedical Electronics

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

To familiarize constructional and functional details of man-instrument system including underlying principle of electro-physiological signal measurement and analysis, constructional and functional details of the different biomedical equipment as well as understanding signal processing techniques for extracting information of physiological parameters.

Course Outcomes

1. Understanding linkages between the life sciences and engineering techniques to have fair understanding about anatomy and physiology of human body.
2. Familiarizing with constructional and functional details of man-instrument system including underlying principle of electro-physiological signal measurement and analysis.
3. Conceptualization of underlying technology with regard to constructional and functional details of biomedical equipment is achieved.
4. Conceptualization of underlying signal processing techniques in extracting information about malfunctioning of physiological systems of human body is attained.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	M	M	M	W	W	W	N	N	M	N	W
CO2	M	S	S	S	S	W	M	S	M	W	S	N	W
CO3	M	N	N	S	S	S	S	M	W	N	M	N	W
CO4	S	M	M	M	S	N	W	S	M	W	S	N	W

Unit-I — **10 hrs**

Biomedical instrumentation: Man-instrument system, physiological systems of human, transducers for biomedical applications, sources of bioelectric potentials, resting and action potentials, propagation of action potentials, bioelectric potential, electrode theory, bioelectric potential electrodes, biochemical transducers,

Unit-II — **14 hrs**

Biomedical recording systems: Basic recording system, general considerations for signal conditioners, preamplifiers, biomedical signal analysis techniques, signal processing techniques, amplifier and driver stage, writing systems, inkjet recorders, potentiometric recorders, digital recorders, electrocardiograph, vector cardiograph, phonocardiograph, electroencephalograph, electromyography, oximeters, blood flow meters, spirometry and pulmonary function measurements.

Unit-III — **12 hrs**

Modern imaging systems: Basics of diagnostic radiology, digital radiography, constructional and operational details of X-ray machine, X-ray computed tomography, nuclear medical imaging system, magnetic resonance imaging system, ultrasonic imaging system and thermal imaging system.

Unit-IV:	**12 hrs**
Biotelemetry: Physiological parameters adaptable to biotelemetry, components of biotelemetry system, implantable units, applications in patient care and monitoring, wireless telemetry, single channel telemetry system, multi-channel wireless telemetry system, multi-patient telemetry, implantable telemetry system, analog physiological signal transmission over telephone lines and telemedicine.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Biomedical Instrumentation and Measurements	Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer	Pearson Prentice Hall2006
2. Introduction to Biomedical Equipment Technology	Joseph J. Carr and John M. Brown	Pearson Education India, 2001
3. Handbook of Biomedical Instrumentation	R.S.Khandpur	Tata-McGraw Hill Education, 2003

ECO-722 Microcontroller and Embedded System				
	L	**T**	**P**	**Credits**
	3	**0**	**0**	**3**
	Sessional Marks			**50**
	End Semester Examination Marks			**50**
Course Objectives	This course provides the knowledge about microcontrollers and embedded systems, and emphasizes on the basic working of a microcontroller system and its programming language.			
Course Outcomes	1. Acquire knowledge about microcontrollers and embedded processors. 2. Acquire programming skills of microcontroller. 3. Understand the design concept of embedded systems. 4. Understand the role of embedded systems in industry.			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	S	S	S	M	M	S	M	N	S	N	M
CO2	S	S	M	W	M	N	N	S	M	M	S	N	M
CO3	S	S	S	M	M	W	W	S	W	M	S	N	M
CO4	N	N	N	N	S	S	N	M	S	S	M	M	S

Unit-I **12 hrs**

Introduction: Overview of 8051 microcontroller families and embedded system. 4-bit microcontroller, 8 bit microcontroller, 16 bit microcontroller, 32 bit microcontroller.

Unit-II **12 hrs**

8051 Microcontroller: Pin description and architecture of 8051 microcontroller., arithmetic, logic and single bit instructions, addressing modes. I/O instructions, memory read/write-only instructions, stack operations, conditional and un-conditional instructions, basic programming concepts.

Unit-III **12 hrs**

Embedded system design: Processor embedded into a system, embedded hardware units and devices in a system, embedded software in a system, and embedded system on chip. complex system design and processors, design process in embedded system, formalization of system design, design process and design example. classification of embedded system, skill required for an embedded system designer.

Unit-IV **12 hrs**

Communication devices and protocols: I/O types and examples, serial communication devices, parallel devices port, sophisticated interfacing features in device design. serial bus communication protocol, parallel bus devices protocol-parallel communication network using ISA, PCI, PCI-X and advanced buses.

RECOMMENDED BOOKS

Title	Author	Publisher
1.The 8051 Microcontroller and Embedded Systems	M.Mazidi, JG Maizidi	Pearson Education
2. Embedded Systems	Raj Kamal	Tata McGraw Hill

3. The 8051 Microcontroller	Kenneth J. Ayala	Pearson Education

ECO-723
Wireless Communication

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives	The aim of this course is to study the basics of cellular systems, impart knowledge about the fading effects. The emphasis will be to analyze different modulation techniques used for mobile communication and understand the concepts of CDMA and GSM wireless communication standards.
Course Outcomes	1. Understand the concept of cellular system. 2. Understand the effect of different types of fading on wireless communication. 3. Analyze various modulation techniques used in wireless communication. 4. Distinguish between different multiple access techniques and understand the basic principles of GSM & CDMA technology.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	N	N	W	N	N	W	N	N	S	N	S
CO2	W	M	S	S	W	N	N	S	W	M	M	N	M
CO3	S	M	W	M	M	N	W	S	W	W	M	N	M
CO4	M	M	N	N	W	N	N	W	N	N	S	N	S

Unit-I **12hrs**

Introduction to wireless communication systems: Concept of cellular communication system, basics of wireless cellular system, mobile unit, base station, mobile switching centre, frequency reuse, channel assignment strategies, co-channel interference, determining the frequency reuse distance, hand-off strategies, interference and system capacity, trunking efficiency, improving capacity of cellular system, cell splitting and sectoring.

Unit-II **12 hrs**

Mobile radio propagation: Introduction to radio wave propagation, free space propagation model, basic propagation mechanisms, reflection, diffraction, scattering, outdoor propagation models, indoor propagation models, signal penetration into buildings, types of small-scale fading, fading effects due to Doppler spread and delay spread, diversity techniques.

Unit-III **12 hrs**

Modulation techniques: Introduction to linear modulation techniques, minimum shift keying, Gaussian minimum shift keying, spread spectrum modulation techniques, DS-SS, and FH-SS systems, performance of modulation schemes, power spectrum and error performance in fading channels.

Unit-IV	**12 hrs**
Wireless communication standards: Introduction to GSM, GSM services and features, system architecture, radio subsystem and channel types. cellular code division multiple access (CDMA) systems: principle, power control, effects of multipath propagation on code division multiple access and introduction to third generation wireless networks, long term evolution (LTE) and standards.	

RECOMMENDED BOOKS

Title	Author	Publisher
1.Wireless Communications	T.S Rappaport	Pearson Education, 2003.
2.Principles of Mobile Communication	Gordon L. Stuber	Springer International Ltd., 2001.
3.Wireless Communications	Andrea Goldsmith	Cambridge University Press, 2007

ECT-721A
VLSI Physical Design

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives: To develop understanding of state-of-the-art tools and algorithms, which address design tasks such as floor planning, module placement and signal routing for VLSI logic and physical level design.

Course Outcomes:
1. Sketch the Layout of different MOS based circuit.
2. Understand the different Partition algorithm.
3. Understand the different design rules.
4. Understand the relationship between design automation algorithms and various constraints posed by VLSI fabrication and design technology.
5. Adapt the design algorithms to meet the critical design parameters.
6. Identify layout optimization techniques and map them to the algorithms

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	S	S	M	N	N	N	N	N	M	N	N
CO2	M	M	S	M	M	W	W	M	W	N	S	N	S
CO3	M	M	S	S	S	N	W	S	W	W	S	N	M
CO4	S	S	S	S	S	W	W	S	W	N	S	N	W
CO5	M	M	S	M	M	W	W	S	W	M	M	N	S
CO6	S	S	S	S	S	N	M	S	N	M	S	N	W

Unit-I — **12 hrs**

Introduction: Layout and design rules, materials for VLSI fabrication, basic algorithmic concepts for physical design, physical design processes and complexities.

Unit-II — **14 hrs**

Partition: Kernigham-Lin's algorithm, Fiduccia Mattheyes algorithm, Krishnamurty extension, hMETIS algorithm, multilevel partition techniques.

Unit-III — **14 hrs**

Floor-Planning: Hierarchical design, wirelength estimation, slicing and non-slicing floorplan, polar graph representation, operator concept, Stockmeyer algorithm for floor planning, mixed integer linear program

Unit-IV — **12 hrs**

Placement: Design types: ASICs, SoC, microprocessor RLM; placement techniques: simulated annealing, partition-based, analytical, and hall's quadratic; timing and congestion consideration

RECOMMENDED BOOKS

Title	Author	Publisher
1. An Introduction to VLSI Physical Design	Sarrafzadeh, M. and Wong, C.K	Tata McGraw Hill
2. Modern VLSI Design System on Silicon	Wolf, W	Pearson Education

3. Practical Problems in VLSI Physical Design Automation	Lim, S.K,	Springer

ECT-721B
Digital Image Processing

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives: This course imparts knowledge about the fundamentals of digital image processing and its applications. it also incorporates the concepts of image enhancement, image restoration, segmentation and compression.

Course Outcomes:
1. Understand image fundamentals and the various steps in digital image processing.
2. Understand various techniques of image enhancement and restoration.
3. Understand various techniques of image segmentation and compression.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	W	S	M	W	W	M	M	N	N	N	W
CO2	M	S	W	W	W	N	W	M	M	W	S	N	W
CO3	S	M	M	M	S	N	W	S	W	W	S	N	W

Unit-I — **14 hrs**

Image model: Human vision, digital image representation, image acquisition, storage, processing, communication and display, image geometry, image transformations, discrete Fourier transformation, fast Fourier transformation, other represent able image transformation

Unit-II — **12 hrs**

Image enhancement: Spatial domain and frequency domain methods, enhancement by point processing, spatial filtering, enhancement in frequency domain, color image processing.

Unit-III — **12 hrs**

Image restoration: Degradation model, minimum mean square restoration, constrained least square restoration, interactive restoration, and restoration in spatial domain.

Unit-IV — **14 hrs**

Image compression and segmentation: Image compression models, lossless and lossy image compression methods, image segmentation, detection of discontinuities, edge detection and boundary detection, shareholding, region-oriented segmentation.

RECOMMENDED BOOKS

Title	Author	Publisher
1. Digital image processing	Rafael C. Gonzalez	Addison Wesley
2. Digital Image Processing	Jain Tenber	PHI
3. Vision and Image Processing	Adrian Low	McGraw Hill
4. Digital Processing	Rasenfeld P Kak	Academic Press

ECT-721C
Industrial Electronics

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives

The course aims to equip the student with the basic understanding of the operating characteristics of power semiconductor devices and fundamentals of power converter circuits including ac/dc rectifiers, dc/ac inverters, dc/dc converters and ac/ac converters.

Course Outcomes

1. Acquire knowledge about fundamental concepts and techniques used in power electronics.
2. Ability to analyse various single phase and three phase power converter circuits and understand their applications.
3. Foster ability to understand the use of power converters in commercial and industrial applications.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	W	S	S	S	W	W	N	M	W	N	W	N	M
CO2	M	M	W	M	M	N	M	M	M	S	M	N	M
CO3	S	S	S	S	S	M	M	S	S	M	S	N	M

Unit-I — **16 hrs**

Introduction: Concept of power electronics, applications of power electronics, power electronic systems, power semiconductor devices, types of power electronic converters, power electronic modules.

Semiconductor switching devices: Review of thyristor, two transistor model of SCR and V-I characteristics, thyristor turn-on methods, thyristor ratings and protection, gate characteristics, series and parallel connections of SCR, other members of thyristor family-DIAC, TRIAC, GTO, power MOSFET, firing circuits for thyristors, thyristor commutation techniques.

Unit-II — **12 hrs**

Power rectification: Principle of phase control, classification of rectifiers, single phase and three-phase rectifiers, semi converters, full converters, freewheeling diodes, transformer utility factor, effect of source impedance on the performance of rectifier, dual converters.

Unit-III — **12 hrs**

Inverters: Introduction, single phase voltage source inverters, current source inverters, force-commutated thyristor inverters, voltage control in single phase inverters, PWM inverters, series inverters, single phase parallel inverters.

Unit-IV — **14 hrs**

Choppers: Principles of chopper operation, control strategies, types of chopper circuits, thyristor chopper circuits.

Cyclo-converters: Principle of cyclo-converter operation, step-up and step down cyclo-converter, three phase half wave cyclo-converters, output voltage equation for a cyclo-converter.

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. Power Electronics-Circuits, Devices and Applications	M H Rashid	PHI, 2nd Edition (1998).
2. Industrial Electronics	G K Mithal	Khanna Publishers, Delhi, 18th Edition (1998).
3. Industrial Electronics	S N Biswas	Dhanpat Rai and Company, Delhi, 3rd Edition (2000).
4. Power Electronics	P S Bhimbra,	Khanna Publishers, Delhi, 3rd Edition (2002).
5. Power Electronics	M D Singh, Khanchandani K B	TMH, 6th reprint (2001).

ECT-721D
Biomedical Electronics

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

To familiarize constructional and functional details of man-instrument system including underlying principle of electro-physiological signal measurement and analysis, constructional and functional details of the different biomedical equipment as well as understanding signal processing techniques for extracting information of physiological parameters.

Course Outcomes

1. Understanding linkages between the life sciences and engineering techniques to have fair understanding about anatomy and physiology of human body.
2. Familiarizing with constructional and functional details of man-instrument system including underlying principle of electro-physiological signal measurement and analysis
3. Conceptualization of underlying technology with regard to constructional and functional details of biomedical equipment is achieved.
4. Conceptualization of underlying signal processing techniques in extracting information about malfunctioning of physiological systems of human body is attained.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	M	M	M	W	W	W	N	N	M	N	W
CO2	M	S	S	S	S	W	M	S	M	W	S	N	W
CO3	M	N	N	S	S	S	S	M	W	N	M	N	W
CO4	S	M	M	M	S	N	W	S	M	W	S	N	W

Unit-I — **12 hrs**

Biomedical instrumentation: Man-instrument system, physiological systems of human, transducers for biomedical applications, sources of bioelectric potentials, resting and action potentials, propagation of action potentials, bioelectric potential, electrode theory, bioelectric potential electrodes, biochemical transducers,

Unit-II — **14 hrs**

Biomedical recording systems: Basic recording system, general considerations for signal conditioners, preamplifiers, biomedical signal analysis techniques, signal processing techniques, amplifier and driver stage, writing systems, inkjet recorders, potentiometric recorders, digital recorders, electrocardiograph, vector cardiograph, phonocardiograph, electroencephalograph, electromyography, oximeters, blood flow meters, spirometry and pulmonary function measurements.

Unit-III — **12 hrs**

Modern imaging systems: Basics of diagnostic radiology, digital radiography, constructional and operational details of X-ray machine, X-ray computed tomography, nuclear medical imaging system, magnetic resonance imaging system, ultrasonic imaging system and thermal imaging system.

Unit-IV	**14 hrs**
Biotelemetry: Physiological parameters adaptable to biotelemetry, components of biotelemetry system, implantable units, applications in patient care and monitoring, wireless telemetry, single channel telemetry system, Multi-channel wireless telemetry system, multi-patient telemetry, implantable telemetry system, analog physiological signal transmission over telephone lines and telemedicine.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Biomedical Instrumentation and Measurements	Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer	Pearson Prentice Hall2006
2. Introduction to Biomedical Equipment Technology	Joseph J. Carr and John M. Brown	Pearson Education India, 2001
3. Handbook of Biomedical Instrumentation	R.S.Khandpur	Tata-McGraw Hill Education, 2003

ECT- 721E
Computer Architecture and Organisation

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The course introduces foundation of computer organization and architecture, hardware-software interface, hierarchical memory system including cache memory, associative memory and virtual memory. The course familiarizes the students with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations, and concepts of the parallel processing.

Course Outcomes

1. Be familiar with the representation of data, addressing modes, instructions sets.
2. Design of Arithmetic circuits, ALU and control unit.
3. Understand parallel processing architecture.
4. Be familiar with the cost-performance issues and design trade-offs in designing and constructing a computer processor including memory.
5. Evaluate quantitative performance of computer systems and memory.
6. Be familiar with the cache subsystem.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	M	M	M	W	W	W	N	N	M	N	S
CO2	M	S	S	S	S	W	M	S	M	W	S	N	S
CO3	M	N	N	S	S	S	S	M	W	N	M	N	S
CO4	S	M	M	M	S	N	W	S	M	W	S	N	S
CO5	S	S	M	N	M	M	W	N	N	N	M	N	S
CO6	S	S	S	N	S	S	N	N	N	N	S	N	S

Unit-I **10 hrs**

Introduction: Evolution of computer, hardware, software and firmware, computer architecture, types of computer, different types of buses.
Data representation: Signed number representation, fixed and floating-point representations, character representation.

Unit-II **14 hrs**

Computer instruction set: Introduction, opcode encoding, addressing modes, instruction types, data transfer, arithmetic, logical, program and system control, reduced instruction set computers, RISC vs CSIC, basic parallel processing techniques: instruction level, thread level and process level.

Unit-III **14 hrs**

Execution unit: Introduction, general register and combinational shifter design, flag register, computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication - shift-and-add, booth multiplier, carry save multiplier, division - non-restoring and restoring techniques, floating point arithmetic, ALU design, bit slice processor, coprocessors.
CPU control unit design: Introduction, basic concepts, hardwired and micro-programmed design approaches, case study - design of a simple hypothetical CPU.

Unit-IV	**14 hrs**
Memory organization: Introduction, memory interleaving, characteristics of memory systems, main memory design, concept of hierarchical memory organization, cache memory: cache size vs block size, mapping functions, replacement algorithms, write policy, associative memory, virtual memory and memory management concepts. **Peripheral devices and their characteristics**: Input-output subsystems, basic concepts programmed I/O, standard vs memory mapped I/O, I/O transfers - program controlled, interrupt driven and DMA, software interrupts and exceptions.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Computer Organization and Embedded Systems	Carl Hamachar, Zvonco Vranesic and SafwatZaky	5th Edition, McGraw-Hill, 2002
2. Computer Organization and architecture – Designing for Performance	William Stallings	6th Edition, Pearson, 2003

ECT-722A
Radar and Navigation Aids

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

Objective of the course is to introducebasic concepts of radar system and identify the various performance parameters of radar system. The students will study about various types of radar systems, radar transmitter and receiver circuits. Various scanning radars. The course details the basic concepts of navigation and have thorough knowledge about the modern navigational aids used.

Course Outcomes

1. Design basic radar system and analyze its performance based on the system parameters.
2. Distinguish between the procedures used by MTI pulse radar and CW radars for the measurement of range.
3. Design the radar transmitter and receiver circuits.
4. Analyse the operation of different types of tracking radars.
5. Design the navigational circuits based on the civil or defence applications for the benefit of society.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	S	M	N	N	N	N	N	S	N	M
CO2	S	S	S	W	M	W	N	M	N	N	M	N	M
CO3	S	M	M	W	W	M	W	W	M	M	N	W	M
CO4	S	M	M	M	M	M	W	S	W	W	S	N	M
CO5	S	S	S	S	S	M	N	N	N	W	S	N	M

Unit-I **12 hrs**

Introduction and principles of radar: Basics of radar, block diagram and operation, radar frequencies, applications, the simple form of radar equation, prediction of range, minimum detectable signal, receiver noise, signal to noise ratio, matched filter impulse response, radar cross section of targets, cross section fluctuations, radar clutter, transmitter power, false alarms and CFARs pulse repetition frequency and range ambiguities, system losses, propagation effects.

Unit-II **16 hrs**

MTI and pulse Doppler radar and CW and FM radar: Doppler effect, moving target indicator (MTI) radar, delay line cancellers, blind speeds, multiple or staggered pulse repetition frequencies, range gated Doppler filters, block diagram of digital signal processor, example of MTI radar processor, blind phases, pulse Doppler radar, non-coherent MTI; basic CW radar, FMCW radar, range and Doppler measurement, block diagram of FM-CW radar using sideband super heterodyne receiver, multiple frequency CW radar: block diagram and operation for the measurement of range.

Unit-III	**14 hrs**
Radar Systems and tracking and scanning: Radar transmitters, basic configurations: self-excited power oscillator, master oscillator power amplifier(MOPA), comparison of tubes for radar transmitters, modulators, pulse forming network, block diagram of radar receiver, mixers, duplexers, displays; tracking with radar, sequential lobing, conical scanning, block diagram and operation, simultaneous lobing or monopulse tracking radar, amplitude comparison monopulse radar, block diagram and description for one angular coordinate and two (angular azimuth and elevation) coordinates, phase comparison monopulse radar.	
Unit-IV	**14 hrs**
Navigation and modern navigation: Introduction, four methods of navigation, radar beacons radio direction finding: loop antenna as null direction finder, goniometer, errors in direction finding, adcock direction finder, and its advantages over loop antenna, automatic direction finder, range and accuracy of direction finders. hyperbolic systems of navigation: LORAN, DECCA navigation system; instrument landing system (ILS) and ground-controlled approach (GPA), GPS: principle of operation, position location determination, principle of GPS receiver.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Introduction to Radar Systems	Skolnik, M.	Tata McGraw-Hill, 2001
2. Elements of Electronic Navigation Systems	N.S.Nagaraja	Tata McGraw-Hill, 2000
3. Radar Principles	Peyton Z. Peebles	JohnWiley, 2004
4. Principles of Radar	J.C Toomay	PHI, 2004
5. Introduction to Radar Engineering	Sen &Bhattachrya	PHI

ECT-722B
MOS Device Physics and Modelling

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

The course introduces active and passive components specifications required for design an electronic circuit. It includes designing of various power supply circuits, selection of components, problems in the transistor amplifier and how to use op amp to solve these problems. The course emphasis on designing of heat sink, importance of grounding and also imparting practical knowledge of electronic system design.

Course Outcomes

1. Analyze current distribution in the devices like transistors, MOS devices.
2. Creates models for the behavior of the electrical devices based on fundamental physics, such as the doping profiles of the devices.
3. Creates SPICE Transistor models (compact model)
4. Compute terminal voltage and current characteristics for MOS transistors using SPICE Transistor model.
5. Extract device parameters such as: effective channel length, threshold voltage, and drain and source series resistances.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	S	M	W	N	N	N	N	S	N	M
CO2	S	S	S	S	S	M	M	M	N	N	S	N	M
CO3	S	M	W	M	M	W	W	N	W	N	M	N	M
CO4	S	M	M	S	S	W	M	S	W	W	S	N	M
CO5	S	M	S	S	W	N	N	N	N	N	N	M	M

Unit-I — **12 hrs**

Introduction: Circuit design, MOSFET modelling, and model parameters, interconnects

Unit-II — **16 hrs**

MOS transistor structure and its operation: Characteristics, scaling theory, hot carrier effects, parasitic elements, MOSFET circuit models, modelling of hot carrier and short channel effects.

Unit-III — **14 hrs**

MOS capacitor: MOS capacitor with zero and nonzero basic-V curves, anomalous C-V curves, non-uniform doped substrate.

Unit-IV — **14 hrs**

SPICE MOSFET models: Introduction, basic concept LEVEL 1 model equations, LEVEL 2 model equations, LEVEL 3 model equations and LEVEL 4 models equations.

RECOMMENDED BOOKS

Title	Author	Publisher
1. Fundamental of Modern VLSI Design	Yuan Taur, Tak H Ning	Cambridge University Press, 2011
2. CMOS Digital Integrated Circuits	Sung-Mo Kang	Tata McGraw Hill
3. Operation and Modelling of the MOS Transistor	Yannis Tsividis	Oxford University Press

ECT-722C
Wireless Sensor Networks

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives	This course is introduced to learn the architecture of wireless sensor networks and various routing protocols. The emphasis is also given to study the tools required in wireless sensor networks.
Course Outcomes	1. Explain, simulate and analyze different routing protocols. 2. Understand architecture and networking of sensors. 3. Understand different topology of wireless sensor network. 4. Simulate network in software tools.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	N	N	W	N	N	W	N	N	S	N	S
CO2	S	S	S	S	W	N	N	S	W	M	M	N	M
CO3	S	M	W	M	M	N	W	S	W	W	M	N	M
CO4	M	M	N	N	W	N	N	W	N	N	S	N	S

Unit-I — **12 hrs**

Overview of wireless sensor networks: Introduction to wireless sensor networks, adhoc networks, difference between adhoc networks and wireless sensor networks, challenges for wireless sensor networks, enabling technologies for wireless sensor networks.

Unit-II — **14 hrs**

Architectures and networking sensors: Single-node architecture - hardware components, energy consumption of sensor nodes, network architecture - sensor network scenarios, optimization goals and figures of merit, mac protocols for wireless sensor networks.

Unit-III — **12 hrs**

Routing protocols: Issues in designing routing protocols, classification of routing protocols, energy-efficient routing, unicast, broadcast and multicast.

Unit-IV — **14 hrs**

Sensor network platforms and applications: applications of sensor networks, sensor node hardware – Berkeley Motes, programming challenges, execution environments like NS2, MATLAB.

RECOMMENDED BOOKS

Title	Author	Publisher
1. Protocols And Architectures for Wireless Sensor Networks	Holger Karl & Andreas Willig	John Wiley,2005
2. Wireless Sensor Networks- An Information Processing Approach"	Feng Zhao & Leonidas J. Guibas	Elsevier,2007
3. Wireless Sensor Networks Technology, Protocols, And Applications", John Wiley, 2007.	Kazem Sohraby, Daniel Minoli, &TaiebZnati,	John Wiley, 2007.

EC-722D
Analog VLSI Design

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives	The aim of this course is to study the basics of CMOS analog building blocks, subsystem design and challenges in deep sub-micron technologies. The course emphasis on design and analysis of fundamental building blocks and basic analog circuits. Both practical design and layout issues will be emphasized.
Course Outcomes	1. Understand the operation of CMOS devices, familiar with the small- and large-signal models of MOS and BJT transistor. 2. Analyze the basic current mirrors, voltage references. 3. Analyze and design basic operational amplifiers, PLL

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	N	N	W	N	N	W	N	N	S	N	S
CO2	S	S	S	S	W	N	N	S	W	M	M	N	M
CO3	S	M	N	N	W	N	N	W	N	N	S	N	S

Unit-I — **12 hrs**

Introduction: Small signal & large signal models of MOS & BJT transistor
MOS & BJT transistor amplifiers: Single transistor amplifiers stages: common emitter, common base, common drain, common gate & common source amplifiers

Unit-II — **16 hrs**

Multiple transistor amplifier stages: Cascode configuration, active cascode. differential amplifiers: differential pair & DC transfer characteristics.
Current mirrors: Simple current mirror, cascode current mirrors widlar current mirror etc. active loads, voltage & current references.

Unit-III — **14 hrs**

Operational amplifier: Applications of operational amplifier, theory and design; definition of performance characteristics
MOS operational amplifier: Design of two stage MOS operational amplifier, two stage MOS operational amplifier with cascodes, MOS telescopic-cascode operational amplifiers.

Unit-IV — **14 hrs**

Nonlinear analog circuits: Voltage controlled oscillator, comparators, source follower and other structures. phase locked techniques; phase locked loops (PLL), closed loop analysis of PLL.
Switched capacitor filters: Switched capacitor circuits and switched capacitor filters

RECOMMENDED BOOKS		
Title	**Author**	**Publisher**
1. CMOS Anlog circuit Design, 1st edition 2000	B.Razavi	Tata Mc-Graw Hill
2. Fundamental of microelectronics, 2nd edition 2009	B.Razavi	John Wiley
3. Microelectronic circuits, 7th edition 2014	Adel Sedra, Charles C. Smith	Oxford University Press

EC-722E
Telecommunication Switching Systems and Networks

	L	T	P	Credits
	4	0	0	4
	Sessional Marks			50
	End Semester Examination Marks			50

Course Objectives

The aim of this course is to study the basics of switching systems and telecommunication transmission, designing of multistage networks, signaling techniques, different networks, charging and routing plans. The course emphasis on different technologies used for design of switching systems such as electronic space division switching and time division switching.

Course Outcomes

1. Understand the operation of telephone system and assess the need for voice digitization.
2. Explain the working principle of switching systems involved in telecommunication switching.
3. Design multi stage switching structures involving time and space switching stages.
4. Analyze the signalling techniques and develop the numbering and charging plan.
5. Perform quantitative measurement of telecommunication traffic to develop and implement an efficient communication network.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	M	N	N	W	N	N	W	N	N	S	N	S
CO2	S	S	S	S	W	N	N	S	W	M	M	N	M
CO3	S	M	N	N	M	M	N	W	N	N	S	N	M
CO4	S	S	S	S	N	N	N	S	W	M	M	N	M
CO5	S	M	N	N	W	N	N	W	N	N	S	N	M

Unit-I — **14 hrs**

Telecommunications transmission: Basic switching system, simple tele-phone communication.
Switching systems: Stronger switching systems, cross bar switching, electronic switching – space division switching, time division switching –time division space switching, time division time switching, time multiplexed space switching, time multiplexed time switching, combination switching.

Unit-II — **14 hrs**

Speech digitization & transmission: Quantization noise, companding, differential coding, vocodors, pulse transmission.
Coding schemes: Line coding, NRZ and RZ codes, Manchester coding, AMI coding, Walsh codes, TDM.

Unit-III — **16 hrs**

Traffic engineering: Grade of service and blocking probability telephone networks, subscriber loops, switching hierarchy and routing, transmission plans and systems, signalling techniques, in channel, common channel.
Control of switching systems: Call processing functions, common control, and stored program control (For all type of switching systems).

Unit-IV	**12 hrs**
Telephone networks and signalling: Introduction, subscriber loops systems, switching hierarchy, transmission and numbering plans, common channel signalling principles, CCITT signalling systems.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Telecommunications Switching, Traffic and Networks	Flood J E	Pearson education Asia, (2001).
2. Telecommunication Switching Systems and Networks	Viswanathan T	PHI, India, (2003).
3. Signaling in Telecommunication Networks	Bosse J G van, Bosse John G	Wiley, John & Sons, (1997).
4. Switching in IP Networks: IP Switching, Tag Switching, and Related Technologies	Bruce S. Davie, Paul Doolan, Yakov Rekhtor	Elsevier Science & Technology Books, (1998)
5. Switching and Traffic Theory for Integrated Broadband Networks	Joseph Yu Hui	Kluwer Academic Publishers, (1990).

ECT-723
Optical Fibre Communications

	L	T	P	Credits
	3	0	0	3
	Sessional Marks			**50**
	End Semester Examination Marks			**50**

Course Objectives

To be familiar with the operating principles of fibre optics characteristics and optical components for fibre communication systems. Analyzation of various nonlinear effects in optical fibre and performance of Optical sources and detector. Describe the hardware i.e. optical sources, detectors and amplifiers of fibre optic communication systems and familiar with the installation of fibre optics communication network for real time application.

Course Outcomes

1. To learn basics of optical fiber and other components for optical communication system.
2. Ability to analyze the various nonlinearities in optical communication system.
3. Know the long-haul communication achieved by using optical amplifier.
4. Learn to install the optical network topologies.
5. Ability to use the appropriate state-of-the-art engineering references and resources needed to find the best solutions to optical system design problems.

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	M	S	S	S	N	M	M	N	M	S	N	M
CO2	S	S	S	S	S	M	N	S	M	M	S	N	M
CO3	S	S	M	M	S	N	W	S	M	M	S	N	M
CO4	S	S	S	S	M	W	M	S	M	M	S	N	W
CO5	S	S	S	S	S	W	N	S	M	N	S	N	M

Unit-I **12 hrs**

Introduction to fiber optic: Historical of fiber optics, block diagram of fiber optical communication, key elements of optical fiber system. standard for optical communication.
Optical fibers: Basic optical law and definitions, fiber characteristics and transmission, Types of fibers single mode and multimode, step index and graded index, numerical aperture, modes.

Unit-II **12 hrs**

Attenuation and dispersion: Attenuation causes and measurement of attenuation, absorption, bending losses, dispersion (intermodal and intermodal), group velocity dispersion, dispersion induced pulse broadening, higher order dispersion, dispersion slope,
Nonlinear effects: Stimulated Raman scattering, stimulated Brillouin scattering, cross phase and self-phase modulation, four wave mixing

Unit-III **12 hrs**

Optical source: Energy bands, intrinsic and extrinsic material, P-n junction, direct and indirect band gaps, LED, structure, material, quantum efficiency, power and modulation, LASER diodes, principle of operation, laser diode rate equations, quantum efficiency, structure and modulation.
Optical receivers: Principle of PIN photo detector and avalanche photodiode, photo detector noise, detector response time, RAPD, avalanche multiplication noise, temperature effects, comparison of photo detectors.

Unit-IV	**12 hrs**
Optical amplification: Introduction to optical amplifier, characteristics of semiconductor optical amplifiers (SOAs), Erbium doped fiber amplifiers (EDFAs) and Raman amplifier and their gain characteristics and gain saturation. **Optical networking**: Fiber optics topologies, fiber distributed data interface (FDDI) structure, synchronous optical network (SONET) and SDH, SONET Ring, networking components.	

RECOMMENDED BOOKS

Title	Author	Publisher
1. Fiber-Optic Communication Systems	G. P. Aggarwal	J. Wiley & Sons. 2nd Ed., 1997
2. Optic Communication Systems	Mynbaev,	Pearson education, 2001,
3.Optical Fiber Communication	Gerd Keiser	McGraw Hill, 5th edition 2013
4. Optical Fiber Communication	Senior	PHI

ECP-723
Optical Fibre Communications

	L	T	P	Credits
	0	0	2	1

Course Objectives: The aim of optical fiber communication lab is to get the students familiar with different components used in optical fiber communication as well as measurement of different parameters such as attenuation, dispersion, nonlinear loss on which performance of overall system depends. This lab will help to simulate and analyze experimentally the optical elements systems for transmission.

Course Outcomes:
1. Students studied the optical fibre and optical elements by simulation and experimentally.
2. Analyze the effect of non-linearity in optical fibre communication.
3. Design of optical fiber link.
4. Analyze the analog as well as digital OFC on hardware kits as well as on software Optisystem.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	M	S	S	S	M	N	M	M	W	N	S	N	M
CO2	S	S	S	S	S	N	N	S	M	M	M	N	M
CO3	S	M	S	S	S	N	N	M	M	N	S	N	W
CO4	S	M	M	M	M	N	W	S	W	W	S	N	M

List of Experiments:

1. Study the various optical components, devices and fibers in fiber optics communication system
2. Study and measurement of attenuation in various optical fiber.
3. Study and measurement of dispersion in various optical fiber.
4. To perform analog and digital fiber optics link study and compare with using simulation software.
5. To determine BER as a function of laser transmitted power and also evaluate bit length, noise and jitter.
6. To determine the power budgeting of an optical fiber link.
7. Measurement of characterization of EDFA.
8. Study the characteristic of SOA using simulation software.
9. Perform the wavelength conversion by using simulation software.
10. Study the optical amplification in a WDM link.
11. To determine the reflectivity of the Fiber Bragg Grating at four different wavelength and verify its wavelength selectivity.
12. To set up OADM and also determine the efficiencies of OADM

ECP-724 Major Project				
	L	**T**	**P**	**Credits**
	0	**0**	**8**	**8**
Course Objectives	An ability to write technical documents and give oral presentations related to the work completed and improve personality development and communication skills. Train the students to approach ethically any multidisciplinary engineering challenges with economic, environmental and social contexts and to set them for future recruitment by potential employers. Identify and apply appropriate well-rehearsed note-taking interactive and time management strategies to their academic studies. Develop audience-centred presentations meeting concrete professional objectives and integrating ethical and legal visual aids. Identify and critically evaluate the quality of claims, explanation, support, and delivery in public and professional discourse, and understand the factors influencing a speaker's credibility.			
Course Outcomes	1. Refine and complete the selected project making use of the technical and engineering knowledge which meets the expected outcome. 2. Work with the modern tools required for the implementation of the project. 3. Achieve the results within in the stipulated time. 4. Communicate technical and general information by means of oral as well as written presentation skills with professionalism. 5. Acquire problem solving, system integration, project management and documentation skills.			

Mapping of Course Outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	S	S	S	S	S	M	S	M	M	M	S	S	W
CO2	S	S	S	M	M	W	M	S	M	M	S	N	S
CO3	M	M	M	S	M	M	M	S	S	S	S	M	W
CO4	S	S	S	S	S	S	N	S	M	S	M	S	W
CO5	S	S	S	S	S	M	S	M	M	M	S	S	W