Graphic Era

Deemed to be University

Accredited by NAAC with Grade A

NBA Accredited Program in CSE, ECE & ME

Approved by AICTE, Ministry of HRD, Govt. of India

Department of Electronics and Communication Engineering

Bachelor of Technology

Electronics and Communication Engineering

Curriculum

University Vision

We visualize Graphic Era (Deemed to be University) as an internationally recognized, enquiry driven, ethically engaged diverse community, whose members work collaboratively for positive transformation in the world, through leadership in teaching, research and social action.

University Mission

The mission of the university is to promote learning in true spirit and offering knowledge and skills in order to succeed as professionals. The university aims to distinguish itself as a diverse, socially responsible learning community with a high-quality scholarship and academic rigor.

Department Vision

The Department visualizes itself to become leading centre of learning in the field of Electronics & Communication Engineering with academic excellence in research to produce self-motivated, creative, and socially responsible engineers and specialists, ready to take up challenges of industrial development with ethics and societal commitment.

Department Mission

M1: To provide high quality contemporary education in the field of Electronics & Communication Engineering and professional ethics to its learners.

M2: To provide creative learning environment for the students to equip them with strong foundation for continuing higher education.

M3: To pursue research and develop insight knowledge of current and emerging technologies in Electronics & Communication Engineering to serve the needs of the society, industry, and scientific community.

M4: To prepare students to have creative and innovative thinking to develop them into socially responsible professionals

Program Educational Objectives (PEOs):

PEO1	**Inculcation of an ability to realize and apply the subject-related knowledge to the real-world problems in the areas of electronics and communication engineering.**
PEO2	**Motivating individuals for team-led effort to investigate and provide ecologically sustainable, and cost-effective solutions to the problems in the subject area.**
PEO3	**Encouragement of competence in engineering computational and experimental capabilities to pursue research oriented higher education.**
PEO4	**Establishment of all-round environment for well conversant, socially and ethically responsible individuals with excellent communication skills.**

Program Outcomes (POs):

PO1	**Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**
PO2	**Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**
PO3	**Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.**
PO4	**Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.**
PO5	**Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.**
PO6	**The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.**
PO7	**Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.**
PO8	**Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.**
PO9	**Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.**
PO10	**Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.**
PO11	**Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**
PO12	**Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.**

Program Specific outcomes (PSOs):

PSO1	**Create an ability to understand theoretical and practical concepts of Electronics and Communication Engineering and apply them in designing, fabrication, and testing of various Electronics & Communication system.**
PSO2	**The ECE Graduates will be able to analyze and implement engineering system pertaining to communication, Signal Processing, VLSI, Radio Frequency communication, microprocessor; microcontroller-based system design and embedded systems etc.**
PSO3	**This program enables the student to succeed in competitive exam like GATE, IES etc. and provides foundation for higher education and research.**

Program Course Structure (All Semesters)

B. Tech (Electronics and Communication Engineering)
(Batch 2021 onwards)
Semester I & II

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECT			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 101/201	Basic Electronics Engineering	ESC	3	3	0	0	25	25	50	100
LABORATORY										
PEC 151/251	Basic Electronics Engineering Lab	ESC	1	0	0	2	25	25	50	100
	TOTAL		**4**	**3**	**0**	**2**				**200**

B. Tech (Electronics and Communication Engineering)

(Batch 2021 onwards)

Semester III

COURSE MODULE			CREDITS	TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS										
CODE	TITLE	COMPONENT		L	T	P	CWA	MSE	ESE	TOTAL
TEC 301	Electronic Devices and Circuits	PCC	3	3	0	0	25	25	50	100
TEC 302	Digital Electronics	PCC	3	3	0	0	25	25	50	100
TEC 303	Networks Analysis and Synthesis	PCC	3	3	0	0	25	25	50	100
TEC 304	Signals and Systems	PCC	3	3	0	0	25	25	50	100
TMA 310	Advanced Engineering Mathematics	BSC	3	3	0	0	25	25	50	100
XCS 301	Career Skills	HSMC	2	2	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 301	Electronics Circuit Lab	PCC	1	0	0	2	25	25	50	100
PEC 302	Digital Electronics Lab	PCC	1	0	0	2	25	25	50	100
PEC 303	Networks Lab	PCC	1	0	0	2	25	25	50	100
GP 301	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**21**	**17**	**0**	**06**				**1000**

B. Tech (Electronics and Communication Engineering)

(Batch 2021 onwards)

Semester IV

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 401	Communication Systems I	PCC	3	3	0	0	25	25	50	100
TEC 402	Analog Integrated Circuits	PCC	3	3	0	0	25	25	50	100
TEC 403	Microprocessor and its Applications	PCC	3	3	0	0	25	25	50	100
TEC 404	Electromagnetic Field Theory	PCC	3	3	0	0	25	25	50	100
TOE ___	Open Elective I	OEC	3	3	0	0	25	25	50	100
XCS 401	Career Skills	HSMC	2	2	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 401	Communication Systems I Lab	PCC	1	0	0	2	25	25	50	100
PEC 402	Analog Integrated Circuits Lab	PCC	1	0	0	2	25	25	50	100
PEC 403	Microprocessor Lab	PCC	1	0	0	2	25	25	50	100
POE ___	Open Elective Lab-I	OEC	1	0	0	2	25	25	50	100
GP 401	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**22**	**17**	**0**	**08**				**1100**
Mandatory Non - Credit Course										
MC 401	Constitution of India	MC	0	0	0	0	0	0	0	0

B. Tech (Electronics and Communication Engineering)

(Batch 2021 onwards)

Semester V

COURSE MODULE			CREDITS	TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS										
CODE	TITLE	COMPONENT		L	T	P	CWA	MSE	ESE	TOTAL
TEC 501	Digital Signal Processing	PCC	3	3	0	0	25	25	50	100
TEC 502	Communication Systems II	PCC	3	3	0	0	25	25	50	100
TEC 503	Microcontroller and Embedded Systems	PCC	3	3	0	0	25	25	50	100
TEC 504	Antenna and Wave Propagation	PCC	3	3	0	0	25	25	50	100
TEC ___	Program Elective I	PEC	3	3	0	0	25	25	50	100
XCS 501	Career Skills	HSMC	2	2	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 501	Digital Signal Processing Lab	PCC	1	0	0	2	25	25	50	100
PEC 502	Communication Systems II Lab	PCC	1	0	0	2	25	25	50	100
PEC 503	Microcontroller & Embedded Lab	PCC	1	0	0	2	25	25	50	100
GP 501	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**21**	**17**	**0**	**06**				**1000**

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Semester VI

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 601	Wireless Communication	PCC	3	3	0	0	25	25	50	100
TEC 602	Microwave Engineering	PCC	3	3	0	0	25	25	50	100
TEC 603	VLSI Technology and Design	PCC	3	3	0	0	25	25	50	100
TEC ___	Program Elective II	PEC	3	3	0	0	25	25	50	100
TOE ___	Open Elective II	OEC	3	3	0	0	25	25	50	100
XCS 601	Career Skills	HSMC	2	2	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 601	CAD of Electronics using CADENCE tool Lab	PCC	1	0	0	2	25	25	50	100
PEC 602	Microwave and Antenna Lab	PCC	1	0	0	2	25	25	50	100
PVL 603	Fading Channels and Mobile Communications	PCC	1	0	0	2	25	25	50	100
POE ___	Open Elective Lab-II	OEC	1	0	0	2	25	25	50	100
PMP 604	Mini Project	PROJ	1	0	0	2	25	25	50	100
GP 601	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**23**	**17**	**0**	**10**				**1200**

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Semester VII

COURSE MODULE				TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS			CREDITS	L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TEC 701	Principles of Management	HSMC	3	3	0	0	25	25	50	100
TEC ___	Program Elective III	PEC	3	3	0	0	25	25	50	100
TEC ___	Program Elective IV	PEC	3	3	0	0	25	25	50	100
TEC 731	Disaster Management	ESC	2	2	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 701	Project Phase-I	PROJ	5	0	0	10	100	-	-	100
SEC 701	Seminar on Industrial Training	PROJ	1	0	0	2	100	-	-	100
GP 701	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**18**	**11**	**0**	**12**				**700**

B. Tech (Electronics and Communication Engineering)

(Batch 2021 onwards)

Semester VIII

COURSE MODULE			CREDITS	TEACHING PERIODS			WEIGHTAGE: EVALUATION			
THEORY SUBJECTS				L	T	P	CWA	MSE	ESE	TOTAL
CODE	TITLE	COMPONENT								
TOE ___	Open Elective III	OEC	3	3	0	0	25	25	50	100
TEC ___	Program Elective V	PEC	3	3	0	0	25	25	50	100
TEC ___	Program Elective VI	PEC	3	3	0	0	25	25	50	100
LABORATORY AND OTHERS										
PEC 801	Project Phase-II	PROJ	9	0	0	18	50	-	150	200
GP 801	General Proficiency	GP	1	0	0	0	-	-	-	100
	TOTAL		**19**	**9**	**0**	**18**				**600**

Program Elective Courses		
Course Code	**Course Name**	**Semester**
Program Elective I		
TEC 552	Control Systems	Fifth
TEC 553	Electromagnetic Interference and Compatibility	
TEC 554	High Speed Communication Circuits	
TEC 555	Probability and Stochastic Processes	
Program Elective II		
TEC 651	Data Communication Networks	Sixth
TEC 652	Digital VLSI Circuit Design	
TEC 653	Semiconductor Materials and Devices	
TEC 654	Digital Video Processing	
Program Elective III		
TEC 751	Optical Fiber Communications	Seventh
TEC 752	ASIC Design and FPGA	
TEC 753	Radar and Navigation Aids	
TEC 754	Organic Electronics Devices and Circuits	
Program Elective IV		
TEC 755	Wireless Sensor Network	Seventh
TEC 756	Fundamentals of Nanotechnology	
TEC 757	CMOS Analog Circuit Design	
TEC 758	Speech Processing	
Program Elective V		
TEC 851	Satellite Communications	Eighth
TEC 852	Testing of VLSI circuits	
TEC 853	Digital System using VHDL	
TEC 854	Digital Image Processing	
Program Elective VI		
TEC 855	Telecommunication Switching	Eighth

TEC 856	**Neural Networks & Machine Learning**	
TEC 857	**Mobile Ad hoc Networks**	
TEC 858	**Adaptive Signal Processing**	

Open Elective Courses		
Course Code	**Course Name**	**Semester**
Open Elective-I		
TOE 410	Data Structures with C	Fourth
TOE 411	Electrical Machines-I	
TOE 412	Computer Based Numerical and Statistical Technique	
Open Elective Lab-I		
POE 410	Data Structures with C Lab	Fourth
POE 411	Electrical Machines Lab-1	
POE 412	CBNST Lab	
Open Elective-II		
TOE 610	Object Oriented Programming with C++	Sixth
TOE 611	Power Electronics	
TOE 612	Operating Systems	
Open Elective Lab-II		
POE 610	OOPs with C++ Lab	Sixth
POE 611	Power Electronics Lab	
POE 612	Operating Systems Lab	
Open Elective-III		
TOE 810	Computer Architecture	Eighth
TOE 811	Electrical and Electronics Measuring Instruments	
TOE 812	Biosensors and Bioelectronics	

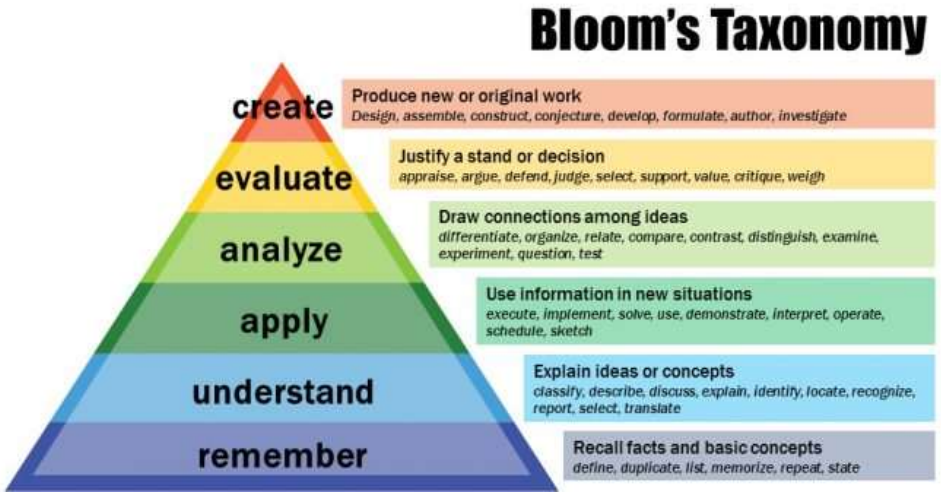
Abbreviations:

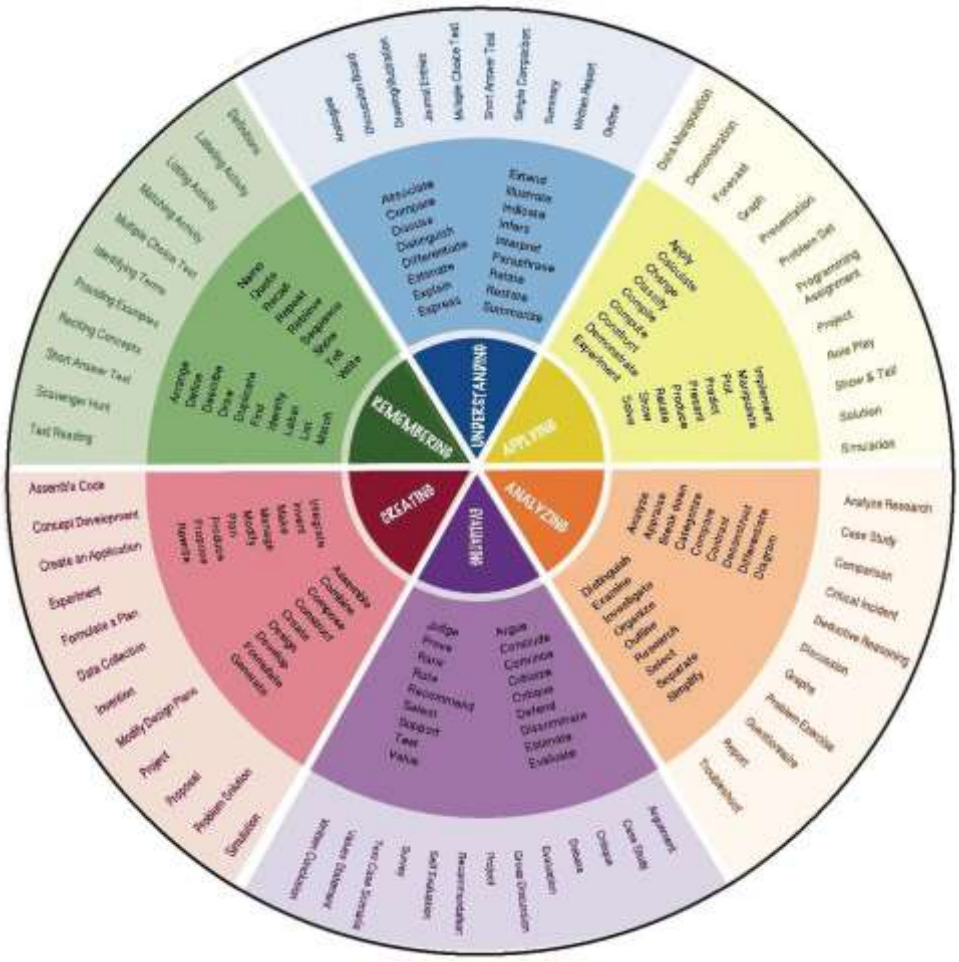
L	**Lecture**
T	**Tutorial**
P	**Practical**
CWA	**Class Work Assessment**
MSE	**Mid Semester Exam**
ESE	**End Semester Exam**
BSC	**Basic Science Course**
ESC	**Engineering Science Course**
HSMC	**Humanities and Social Sciences including Management course**
PCC	**Professional Core Course**
PEC	**Professional Elective Course**
OEC	**Open Elective Course**
MC	**Mandatory Course**
PROJ	**Project**
GP	**General Proficiency**

Bloom's Taxonomy for Curriculum Design and Assessment

Preamble

The design of curriculum and assessment is based on Bloom's Taxonomy. A comprehensive guideline for using Bloom's Taxonomy is given below for reference.





Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	First/Second	***Subject Title***	Basic Electronics Engineering		***Code***	TEC 101/201
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Engineering Science Course (ESC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Semiconductor Physics						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Remember** operations on number systems and understand concepts of digital circuits.
CO 2	**Understand** the basics of semiconductors and PN junction diode.
CO 3	**Apply** the basics of PN junction diode in rectifier circuits and DC power supply.
CO 4	**Analyze** Bipolar Junction Transistor (BJT) from its basic concepts and biasing circuits.
CO 5	**Evaluate** the performance of operational amplifier (OP-amp) from its performance parameters like gain, CMRR, offset values etc.
CO 6	**Design** and **develop** various basic electronic circuits.

Unit No.	***Content***	***Hours***
Unit 1:	**Number Systems & Boolean Algebra**: Number systems and their conversion, Addition & subtraction of binary, Octal and hexadecimal numbers, Multiplication & division of binary numbers, fractional numbers, Logic gates, Boolean algebra, Implementation of basic gates using universal gates, Implementation of logic functions using basic gates & universal gates, SOP & POS form of logic expression, Canonical form, Conversion from SOP & POS form to canonical form, Simplification of Boolean function: Algebraic method, Karnaugh map method (two, three & four variable K-map with don't care condition).	10
Unit 2:	**Basics of Semiconductor Devices and its Applications:** Energy band theory: Classification of solids based on energy band diagram, Semiconductors; Intrinsic semiconductors, Extrinsic semiconductors– P-type and N-type, Electrons and holes in intrinsic and extrinsic semiconductors, Mobility and conductivity, Mass action law, Charge densities in semiconductors, Drift and diffusion current, P-N Junction; Formation of depletion region, V- I characteristics of P-N junction diodes, Diode breakdown mechanism.	8
Unit 3:	**AC to DC Conversion and Voltage Regulation:** Introduction to DC power supply, Rectifiers circuit: Half wave, Center tapped full wave and Bridge rectifier circuits. Rectifier performance parameter analysis, Filter circuits: L, C, and Pi filters, Zener diode, Zener breakdown, Zener diode as a voltage regulator, Analysis and design of regulator circuits using Zener diode, Avalanche diode.	8
Unit 4:	**Transistor and its Biasing Circuits:** Construction of bipolar junction transistors (BJT), NPN and PNP type, Characteristics; Common base, Common emitter, Common collector configuration, Transistor biasing; The operating point, Stability factor, Bias stabilization; Fixed bias, Collector to base bias and Self-bias circuit.	8
Unit 5:	**Introduction to Operational Amplifiers:**	6

	Introduction to integrated circuits; Advantages and limitations, Characteristics of an ideal Op-amp, Introduction of 741 IC. Inverting and non-Inverting Op-amp circuits, Summing amplifier, Difference amplifier, Voltage follower. Op-amp as integrator and differentiator.	
Total Hours		**40**

	Textbooks
1.	Jacob Millmann & Halkias, "***Integrated Electronics***", TMH, 2nd Edition, 2009.
2.	M. Morris Mano, Michael D. Ciletti, "***Digital Design***", Pearson Education, 5th Edition, 2012.
	Reference Books
3.	Boylestad and L. Robert and Nashelsky Louis, "***Electronics Devices and Circuits Theory***", Pearson Education, 10th Edition, 2009.
4.	S. Salivahanan and S. Arivazhagan, "***Digital Circuits and Design***", Oxford University Press, 5th edition, 2018.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	First/Second	***Subject Title***	Basic Electronics Engineering Lab		***Code***	PEC 151/251
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Engineering Science Course (ESC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		*25*	*25*	*50*
Pre-requisite: Basic Semiconductor Physics						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Identify** and **understand** active & passive components along with various measuring instruments.
CO 2	**Verify** truth table of logic gates.
CO 3	**Analyse** the characteristics of diodes and transistors.
CO 4	**Implement** different electronics circuits using operational amplifier and logic gates.

Exp. No.	***Name of the Experiment***
1.	Familiarization of electronics measuring instrument and components.
2.	Measure the voltage and frequency using a CRO.
3.	Study and verification of the truth table for logic gates.
4.	To design and verify the truth table for logic gates using NOR gate.
5.	To design and verify the truth table for logic gates using NAND gate.
6.	Study V-I characteristics of PN junction diode and determine the static and dynamic resistance from the characteristic curve.
7.	Study of a Half wave rectifier circuit with and without capacitor filter.
8.	Study of a Full wave rectifier circuit with and without capacitor filter.
9.	Study V-I characteristics of Zener diode and determine its voltage regulation.
10.	Study the input and output characteristics of common base (CB) transistor.
11.	Study the input and output characteristics of common emitter (CE) transistor.
12.	Design and verification of Inverting and non-inverting amplifier using Op-Amp IC.
Innovative Experiments	
13.	Design and verification of summer and subtractor circuit using Op-Amp IC
14.	Study and verification of the truth table for half adder using logic gates.
15.	As suggested by the concerned faculty/lab in charge.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Third	***Subject Title***	Electronic Devices and Circuits		***Code***	TEC 301
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electronics Engineering						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Understand** the working, bias stabilization and characteristics of BJTs and MOSFETs in different regions.
CO 2	**Analyse** BJT/MOSFET as amplifier in different configuration and its frequency response.
CO 3	**Understand** and **analyse** multi-stage amplifiers and feedback topologies.
CO 4	**Investigate** the basic concepts of oscillators and their classifications.
CO 5	**Analyse** power amplifiers and their classification.
CO 6	**Design** BJT and MOSFET based electronic circuits.

Unit No.	***Content***	***Hours***
Unit 1:	**Bipolar Junction Transistor:** Review of BJT, BJT as an amplifier and switch, Small signal models and analysis (CB, CE, CC), Frequency response of CE amplifier, Calculation of cut off frequencies, RC coupling. **Multistage amplifier:** Cascade amplifier, Darlington pair, Bootstrapping, and Cascode configuration.	9
Unit 2:	**Field Effect Transistors:** Introduction to FET, Junction FET (JFET), Static characteristics of JFET, JFET drain characteristics, Transfer characteristics, Q-point analysis, Small signal JFET parameters, DC biasing of JFET, Common source JFET amplifier, MOSFET or IGFET, DE MOSFET, E-only MOSFET, MOSFET characteristics and Q-point analysis.	10
Unit 3:	**MOSFET as an Amplifier:** MOSFET biasing, MOSFET as an amplifier and switch, Biasing in MOSFET amplifier circuits, Small signal models and analysis (Common Gate, Common Source, Common Drain). Frequency response of CS amplifier, Calculation of cut off frequencies.	9
Unit 4:	**Feedback Circuits and Oscillators:** General feedback structure, Properties of negative feedback, Four basic feedback topologies and their analysis. Principle of sinusoidal oscillators, Types of oscillators: RC phase shift, Wein bridge, Hartley, Colpitts, Clapp and crystal oscillator.	8
Unit 5:	**Power Amplifiers:** Introduction to power amplifier, Classification of power amplifier, Operation and efficiency of: Series fed class A, Transformer coupled class A, Class B push pull, Crossover distortion, Class AB push pull, Class C power amplifier.	6
Total Hours		**42**

	Textbooks
1.	Millman Halkias, "***Integrated electronics***", TMH, 2nd edition, 2001.
2.	Boylestad L Robert, "***Electronic devices and circuit theory***", Pearson, 10th edition, 2005.
	Reference Books
3.	Neaman A Donald, "***Electronics circuits***", TMH, 3rd edition, 2008.
4.	S. Sedra and KC Smith, "***Microelectronic Circuits***", Oxford university press, 5th edition, 2009.
5.	Jacob Millman and Arvin Grabel, "***Microelectronics***", TMH, 2nd edition, 2001.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
Course: - Bachelor of Technology						
Semester	Third	***Subject Title***	Digital Electronics		***Code***	TEC 302
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electronics Engineering						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Describe** minimization techniques for the simplification of Boolean functions and **design** combinational circuits.
CO 2	**Understand** the concepts of sequential circuits and its real time applications.
CO 3	**Apply** the concepts in designing of asynchronous and synchronous sequential circuits.
CO 4	**Analyse** and **study** various semiconducting memories.
CO 5	Gain **knowledge** of various logic families.
CO 6	**Implement** various digital systems.

Unit No.	***Content***	***Hours***
Unit 1:	**Boolean Algebra and Gate Level Minimization:** Basic Boolean algebra concepts, Theorems, and properties. Digital logic gates, K-Map method for minimization up to 6-variables, Quine-McClusky method for minimization, NAND and NOR gate implementation. **Combinational Logic Circuits:** Combinational circuits, Analysis procedure, Design procedure, Binary adder & subtractor, Decimal adder, Binary multiplier, Magnitude comparator, Multiplexer, Demultiplexer, Decoder, Encoder, Parity generator & checker, Programmable ROMs, Code Convertors (BCD, excess-3 code, Gray code, and Seven Segment Code).	10
Unit 2:	**Sequential Logic Circuits:** Triggering, Latches & Flip Flops: RS, JK, D and T (Characteristics table, Equation and excitation table), Flip Flop conversion, Race around condition, JK Master Slave Flip Flop. **Counter:** Asynchronous counter, Decoding gates, Synchronous counters, Changing the counter modulus, Decade counter, Presettable counter, Designing of asynchronous and synchronous counters. **Registers:** Types of register, Serial in-Serial out, Serial in-Parallel out, Parallel in-Parallel out, Parallel in- Serial out, Universal shift register, Bidirectional shift register, Application of shift registers.	8
Unit 3:	**Design of Synchronous and Asynchronous Sequential Circuit:** Model selection, State transition diagram, State synthesis table, Design equations and circuit diagram, State reduction table, Design and analysis of asynchronous sequential circuit, Problems with asynchronous sequential circuit.	8
Unit 4:	**Semiconductor memories:**	8

	Programmable logic array, Programmable array logic, ROM, PROM, EPROM, EEPROM, Bipolar RAM, Static and dynamic RAM. Designing combinational circuits with multiplexer, ROM, PAL and PLA, D-A and A-D converter.	
Unit 5:	**Logic Family:** Introduction, Various characteristics, Register Transistor Logic (RTL), Diode-Transistor Logic (DTL), Transistor-Transistor Logic (TTL), Emitter Coupled Logic (ECL), NMOS and PMOS logic, CMOS logic family, Various properties of logic families, CMOS transmission gate circuits.	8
Total Hours		**42**

Textbooks	
1.	Mano M. Morris and Ciletti M. D., "***Digital Design"***, 4th Edition, Pearson Education, 2006.
2.	Charles H. Roth Jr, "***Fundamentals of Logic Design"***, 5th Edition, Thomson, 2004.
Reference Books	
3.	Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, "***Digital Systems Principles and Applications"***, 10th Edition, Pearson Education, 2007.
4.	Donald P Leach, Albert Paul Malvino & Goutam Saha, "***Digital Principle and Application***", 7th Edition, Tata McGraw Hill, 2010.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Third	***Subject Title***	Networks Analysis and Synthesis		***Code***	TEC 303
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electrical Engineering						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Remember** the basic laws of the network theory including, Ohm's law, Kirchoff's laws, current, and potential divider rules.
CO 2	**Understand** the network theorems in electrical circuits.
CO 3	**Apply** graph theory approach to solve electrical networks.
CO 4	**Analyse** the performance parameters of RLC circuits in context of transient and steady state analysis.
CO 5	**Evaluate** the performance parameters of two port network and coupled circuits.
CO 6	**Design** the electrical networks in Foster and Cauer forms of realization using network functions.

Unit No.	***Content***	***Hours***
Unit 1:	**Network Concepts and Theorems:** Elements and sources, Node and mesh analysis, Kirchhoff's laws, Steady state sinusoidal analysis, Thevenin's, Norton's, Maximum power transfer, Tellegen's, reciprocity, and superposition theorems, Study of basic waveforms.	10
Unit 2:	**Graph Theory:** Concept of graphs, Definitions, Trees, Co-tree, Chords and links, Matrices associated with graphs, Incidence matrix, Circuit matrix, Tie-set matrix, Cut-set matrix and their KVL and KCL analysis.	6
Unit 3:	**Network Transients:** Transient response, Time domain analysis of simple RC, RL and RLC circuits, Network analysis using Laplace transform, Driving point and transfer function, Resonance in electrical circuits.	8
Unit 4:	**Two Port Network and Coupling Circuit:** Different two port parameters, Condition of reciprocity and symmetry for different two port parameters, Inter relationship between different two port parameters, Interconnection of two port networks. Coupled circuits: Self-inductance and mutual inductance, Coefficient of coupling, dot convention, Analysis of magnetic coupling circuits.	10
Unit 5:	**Analysis and Synthesis of Network Functions:** Driving point function, transfer function, Positive real function; Definition and properties, Poles and zeroes of network functions, Hurwitz polynomials, Properties of LC, RC and RL driving point functions, Synthesis of LC, RC and RL Driving point admittance functions using Foster and Cauer first and second forms.	8
Total Hours		**42**

	Textbooks
1.	Kemmerly, Hayt and Durbin, "***Engineering Circuit Analysis***", TMH, 7th Edition, 2010.
2.	Van Valkenburg, M.E., "***Network Analysis & Synthesis***", PHI/ Pearson education, 3rd Edition, 2002.
	Reference Books
3.	Alexander, Charles K., Sadiku, Matthew N. O., "***Fundamentals of Electric Circuits***", TMH, 5th Edition, 2004.
4.	Roy Choudhury D, "***Networks and systems***", New Age International Publications, 2nd Edition.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Third	***Subject Title***	Signals and Systems		***Code***	TEC 304
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electrical Engineering						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Differentiate** between various types of signals and **understand** the implication of operations of signals.
CO 2	**Understand** and **classify** systems based on the impulse response behaviour of both continuous time and discrete-time systems.
CO 3	**Apply** Fourier series for continuous-time signals.
CO 4	**Apply** Fourier Transform for continuous-time signals.
CO 5	**Explain** the Laplace transform and its importance to analyse signals and systems.
CO 6	**Design** and **develop** LTI systems and its response in time and frequency domain.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Continuous-time and Discrete-time Signals:** Introduction to signal, Classification of signals: continuous /discrete-time, Analog/ digital signal, Periodic/ aperiodic, Even/odd, Energy/power, Deterministic/random, Commonly used continuous-time signals and discrete-time signals: Unit step, Unit ramp, Exponential, Rectangular pulse, Unit impulse, Operation on continuous –time and discrete time signals: Addition, Multiplication, Differentiation/difference, Integration/ accumulation, Shifting, Scaling, Folding and convolution.	8
Unit 2:	**Introduction to Continuous-time and Discrete-time Systems**: Classification of systems: Static and dynamic, Linear, and non-linear, Time-variant and time invariant, Causal, and non-causal, Stable and unstable, Continuous time and discrete time LTI system, Impulse response and step response of LTI systems, Convolution integral/ convolution sum, Properties of LTI system.	9
Unit 3:	**Fourier Series Analysis of Continuous-time Signals:** Introduction, Vector space representation by ortho-normal vectors and signal space representation by orthogonal signal set, Fourier series representation of periodic signals, Convergence of Fourier series, Trigonometric Fourier series and exponential Fourier series, Properties of the continuous time Fourier series. Power content of a periodic Signal.	8
Unit 4:	**Continuous Time Fourier Transform:** Deriving Fourier transform from Fourier series, Convergence of the Fourier transforms, Fourier transform of standard signals, Properties of Fourier transforms, Invers Fourier Transform, Convolution, Parseval's theorem: Energy spectral density, Power spectral density.	8
Unit 5:	**Laplace Transform:** Introduction to Laplace transform, Relation between Laplace and Fourier transforms, Region of convergence for Laplace transform, Properties of	9

	ROC, Laplace transform of some common signals, Properties of the Laplace transform, Convolution, Unilateral Laplace transform, Inverse Laplace transform and initial value and final value theorem, Solution of differential equation using Laplace transform.	
Total Hours		**42**

	Textbooks
1.	Alan. V. Oppenheim, Alan. S. Willsk, S. Hamid Nawab, "***Signals and systems***", 2001, 2nd edition- PHI learning Pvt. Ltd.
2.	Simon Haykin and Barry VanVeen, "***Signals and systems***", 2007, 2nd edition, Wiley, India.
3.	P. Rama Krishna Rao and Shankar Prakriya, "***Signals and Systems***", 2013, 2nd edition, McGraw Hill.
	Reference Books
4.	B. P. Lathi, "***Signal processing and linear systems***", 2009, Oxford university press.
5.	R.F. Ziemer, W.H. Tranter and D.R. Fannin, "***Signals and Systems - Continuous and Discrete***", 1998, 4th edition, Prentice Hall.
6.	H. P. Hsu, "***Signal and Systems***", McGraw Hill Publications, 2008, 2nd edition.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Third	***Subject Title***	Advanced Engineering Mathematics		***Code***	TMA 310
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Basic Science Course (BSC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Mathematics and Algebra						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** analytic function and power series expansion.
CO 2	**Analyse** different order of moments.
CO 3	**Understand** different numerical methods and their applications.
CO 4	**Analyse** differential and integral equations.
CO 5	**Understand** conditional probability and Baye's theorem.
CO 6	**Apply** these theorems in electronics and communication engineering problems.

Unit No.	***Content***	***Hours***
Unit 1:	**Complex Variable:** Analytic function, Complex integration, Cauchy integral formula, Cauchy integral formula for derivatives, Power series, Taylor series, and Laurent series, Zeros, Singularities and residues. Conformal mapping, Bilinear transformation.	8
Unit 2:	**Moments:** Kurtosis, Skewness, Curve fitting (all curves), Correlation and regression, Multiple regression. Definition and examples of vector space.	8
Unit 3:	**Solution of Algebraic and Transcendental Equations:** Bisection, Iteration method, Newton Raphson method, Interpolation: Finite differences, Newton's forward and backward formula, Central difference Bessel's formula, Interpolation with unequal intervals Lagrange's interpolation formula.	8
Unit 4:	**Numerical Integration:** Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Weddle's rule and Boole's rule Solution of differential equation: Euler's method and Runge-Kutta method.	10
Unit 5:	**Random variables:** Random variables, Baye's theorem, Function of Random variables, Probability distribution functions, Moments, Mean, Correlation and covariance function: Principles of autocorrelation function, cross – correlation functions, Central limit theorem, Properties of Gaussian process.	8
Total Hours		**42**

Textbooks	
1.	B. S. Grewal, "***Higher Engineering Mathematics***", Khanna Publications, 43rd edition, 2013.
2.	B.V. Ramanna, "***Higher Engineering Mathematics***", Tata-McGraw Hill, 6th edition, 2006.
Reference Books	

3.	Kreyszig, Erwin. "***Advanced Engineering Mathematics***", Wiley Publications, 10th edition, 2010.
4.	A. Mattuck, "***Introduction to Analysis***", Prentice-Hall, 3rd edition, 1999.
5.	R. K. Jain, Iyengar, "***Advanced Engineering Mathematics***", Narosa Publication, 2nd edition, 2002.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Third	***Subject Title***	Career Skills		***Code***	XCS 301
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Humanities and Social Sciences including Management course (HSMC)		02		2	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Skills						
Course Outcomes						
Upon completion of this course, the students will be able to						
CO 1	Have a logical approach to the problems and at the same time they will be able to **differentiate** between the strong and the week arguments and validity of the statement.					
CO 2	**Improve** the reasoning ability of the students by using the different methods.					
CO 3	**Learn** different approaches related to the coding or other complex types of problems which are related to the sequence detection etc.					
CO 4	Get a basic **knowledge** of the data interpretation.					
CO 5	Acquire **knowledge** of puzzles and different methods to **solve** the puzzles in an easier way is also included.					
CO 6	**Develop** the basic skills of aptitude and logical reasoning.					

Unit No.	***Content***	***Hours***
Unit 1:	**Meeting Etiquette:** Introductions - The Handshake– Exchange of visiting cards Personal etiquette – Hygiene, Grooming, and good sense Travel etiquette, Sharing apartments Behavior at work – Formal behavior with seniors and colleagues – Etiquette with women/men – Adherence to office rules – Discipline table Manners and small talk **Group Discussions:** Group discussion techniques/ Do's and Dont's/ body language/mock sessions.	6
Unit 2:	**Logical Reasoning:** Series completion, Coding decoding, direction sense test, logical Venn diagram.	6
Unit 3:	**Logical Reasoning:** Mathematical operation, Number ranking, Time sequence test, Arithmetical reasoning.	6
Unit 4:	**Job Application:** Importance of business communication in today's world, Designing business letters, Types of letters. Writing effective emails, Report writing essential parts - Cover letter and the 'resume', Types of 'resumes' (Curriculum Vitae) Chronological 'resume', functional 'resume'	6
Total Hours		**24**

Textbooks

1.	R. K. Bansal and J.B. Harrison, "***Spoken English for India***", Orient Longman.
2.	Thomson and Martinet, "***A practical English Grammar***", Oxford University Press.
3.	Malti Aggarwal, "***Professional Communication***".
4.	M. A. Pink and A. E. Thomas, "***English grammar, composition and correspondence***", S. Chand and Sons.
5.	"***A Dictionary of Modern Usage***", Oxford University Press.
Reference Books	
6.	R.S Agarwal, "***Quantitative aptitude***".
7.	R.S Agarwal, "***Verbal and Non-Verbal Reasoning***".
8.	Shakuntala Devi "***puzzles***".

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Third	***Subject Title***	Electronics Circuit Lab		***Code***	PEC 301
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Basic Electronics Lab						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Remember** the different electronic components and testing the characteristics of rectifiers in CRO.
CO 2	**Analyse** the characteristics of regulated power supply, amplifiers and oscillator circuits with simulation in OrCAD.
CO 3	**Evaluate** amplifier circuits to compute gain and frequency response.
CO 4	**Design** and **implement** analog circuits on PCB followed by soldering and testing.

Exp. No.	***Name of the Experiment***
1.	Simulation of half wave and full wave center tapped rectifiers through OrCAD software.
2.	Simulation of DC regulated power supply (+5V) through OrCAD software.
3.	To implement the circuits of Half wave and Full wave center tapped rectifiers on the bread board and draw/measure the outputs with and without filter.
4.	Simulation of CE Amplifier using PSPICE OrCAD.
5.	Simulation of two stage RC Coupled Amplifier using PSPICE OrCAD.
6.	To implement the circuit of single stage common emitter (CE) amplifier on the bread board and draw its output and frequency response curve.
7.	Simulation of FET amplifier circuit using OrCAD and compute the gain and bandwidth.
8.	To test the given Hartley oscillator and determine its frequency of oscillation.
9.	To test the given Wein Bridge oscillator and determine its frequency of oscillation.
10.	To test the given RC Phase shift oscillator and determine its frequency of oscillation.
11.	To test the given COLPITTS oscillator and determine its frequency of oscillation.
12.	To develop the negative of full wave center tapped rectifier/DC regulated power supply.
13.	To make the PCB of full wave center tapped rectifier/DC regulated power supply.
14.	To drill and solder the components on the PCB of full wave center Tapped rectifier/DC regulated power supply.
15.	To test the PCB of full wave center tapped rectifier/DC regulated power supply.
Innovative Experiments	
16.	To make the Layout of center tapped full wave rectifier through OrCAD software.
17.	To make the Layout of DC regulated power supply through OrCAD software.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Third	***Subject Title***	Digital Electronics Lab		***Code***	PEC 302
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Basic Electronics Lab						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** various logic gates and digital circuits.
CO 2	**Identify** various digital ICs and understanding its operation.
CO 3	**Design** elementary digital circuits under real and simulated environment.
CO 4	**Simulate** various logic circuits using simulation tool.

Exp. No.	***Name of the Experiment***
1.	To verify the truth table of basic logic gates (AND, OR, NOT, NAND, NOR, XOR). To realize basic two input Boolean AND, OR logic functions using discrete components.
2.	To verify the Consensus Theorem (Boolean algebra functions) using universal digital IC Gates.
3.	To design and test a half/full adder circuit using digital IC gates.
4.	To design and test a half/full subtractor circuit using IC gates.
5.	To design, implement and test the function F(A,B,C,D)=m(1,3,5,7,9,15)+d(4,6,12,13) using a NOR-OR implementation.
6.	To design and test RS, JK, D and T flip flops using logic gates.
7.	To design and test shift registers using flip-flops.
8.	To design and test an asynchronous up/down counter.
9.	To design, implement and test half/full adder/subtractor functions using a multiplexer.
10.	To design and simulate the implementation of BCD TO EXCESS 3-CODE CONVERTER using OrCAD/PSPICE.
11.	To design and simulate the implementation of ring counter using OrCAD/PSPICE.
Innovative	
12.	To design, implement and simulate half & full adders using OrCAD/PSPICE.
13.	To design, implement and simulate half & full subtractors using OrCAD/PSPICE.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Third	***Subject Title***	Networks Lab		***Code***	PEC 303
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Basic Electrical Lab						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** the basic circuit concepts and network theorems.
CO 2	**Analyse** the transient characteristics and frequency response of RLC circuits.
CO 3	**Evaluate** different parameters of two port network in electrical networks.
CO 4	**Design** and **test** series/parallel RLC Circuits (Time/Phasor Domain).

Exp. No.	***Name of the Experiment***
1.	Verification of principle of superposition with dc and ac sources.
2.	Verification of Thevenin theorem in dc and ac circuits.
3.	Verification of Norton theorem in dc and ac circuits.
4.	Verification of Maximum power transfer theorem in dc and ac circuits.
5.	Verification of Tellegen's theorem for two networks of the same topology.
6.	Analysis of the transient response of RL circuits with step voltage input.
7.	Analysis of the transient response of RC circuits with step voltage input.
8.	Analysis of the transient response of RLC circuits with sinusoidal ac input.
9.	Analysis of the frequency response of RLC circuit with sinusoidal ac input.
10.	Determination of the z parameters of a two-port network and computation of Y parameters.
11.	Determination of h parameters of a two-port network and computation of ABCD parameters.
12.	Verification of the two-port parameter in inter-connected two port networks.
Innovative Experiments	
13.	Determination of image impedance and characteristic impedance of T and ∏ networks.
14.	Determination of driving point and transfer functions of a two-port ladder network and verify with theoretical values.
15.	Determination of frequency response of a Twin – T notch filter.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fourth	***Subject Title***	Communication Systems I		***Code***	TEC 401
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Signals and Systems						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Demonstrate** and **understand** analog communication system and representation of signals.
CO 2	**Demonstrate** and **understand** different methods of amplitude modulation and demodulation schemes, their design, operation and applications.
CO 3	**Demonstrate** and **understand** different methods of angle modulation and demodulation schemes, their design, operation and applications.
CO 4	**Demonstrate** and **understand** different methods of pulse modulation, their design, operation and applications.
CO 5	**Evaluate** the performance of analog communication system in the presence of noise.
CO 6	**Demonstrate** and **understand** analog communication system and representation of signals.

Unit No.	***Content***	***Hours***
Unit 1:	**Amplitude Modulation Systems:** Modulation, Need of modulation, Model of communication system, Amplitude Modulation: Equation for AM wave, Modulation index, Power and current relationships, Transmission and power efficiency, Generation and demodulation of DSB-FC, DSB-SC, SSB-SC and VSB signals, Spectral characteristics of amplitude modulated signals, Comparison of amplitude modulation systems; AM receiver and its characteristic.	12
Unit 2:	**Angle Modulation Systems:** Phase and frequency modulation: Narrow band and wideband FM & PM, Spectral characteristics of angle modulated signals, Generation and demodulation of FM Signal, PLL, Communication receiver.	12
Unit 3:	**Noise:** Introduction – internal and external noise, Noise equivalent bandwidth, S/N ratio, Noise figure, Equivalent noise temperature, Cascade connection of two port network.	6
Unit 4:	**Pulse Analog Modulation System:** Sampling process, Pulse amplitude modulation, Pulse duration modulation, Pulse position modulation.	5
Unit 5:	**SNR Performance of Continuous Wave Modulation Systems:** Introduction: Review of probability and random process. Gaussian and white noise characteristics, Analog communication model, SNR calculation in DSB-SC, SSB-SC, DSB-FC & FM systems, FM threshold effect; Pre-emphasis and De-emphasis in FM, Comparison of performances.	8
Total Hours		**43**

	Textbooks
1.	B. P. Lathi, ***"Modern Digital and Analog Communication"***, Oxford Publication, 3rd edition, 2005.
2.	Simon Haykin, ***"Communication Systems"***, John Willey, 4th edition, 2001.
3.	Taub and Schilling, ***"Principles of Communication System"***, Tata McGraw-Hill, 4th edition, 1995.
4.	HWEI HSU, "***Analog and Digital Communications***", Schaum Outline Series, 2nd edition, 2003.
	Reference Books
5.	Roddy and Coolen, ***"Electronic Communication"***, Prentice Hall of India, 4th edition, 1998.
6.	Singh and Sapre, ***"Communication system"***, TMH, 2/e, 2007.
7.	A. Papoulis, "***Probability, Random variables and Stochastic processes***", MGH, 4th edition, 2002.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fourth	***Subject Title***	Analog Integrated Circuits		***Code***	TEC 402
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Electronics Devices and Circuits						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Identify** various configurations of differential amplifier.
CO 2	**Understand** the concepts of ideal and practical operational amplifiers (Op-Amp).
CO 3	**Apply** the concepts of Op-Amp in designing of the linear and non-linear integrated circuits.
CO 4	**Analyse** the performance parameters of active filters using Op-Amp.
CO 5	**Evaluate** the performance parameters of oscillators and multivibrators using Op-Amp.
CO 6	**Design** voltage regulator circuits using Op-Amp.

Unit No.	***Content***	***Hours***
Unit 1:	**Brief review of differential amplifier (DC and AC analysis), OP-AMP Fundamentals:** DC and AC analysis of various configurations of differential amplifier, Input stage, Intermediate stage circuits, Constant current bias circuits, Current mirror, Active load, Level shifter, Output stage.	10
Unit 2:	**Operational Amplifier Applications:** Inverting/Non-inverting amplifier: Calculation of input and output impedance along with gain with feedback for finite open loop gain, Summer, Difference amplifier, Integrators, Differentiators, VCVS, CCVS and VCCS, Instrumentation amplifiers.	8
Unit 3:	**Non-linear Circuits:** Logarithmic amplifiers, Log/Antilog modules, Precision rectifier, OP-AMP as comparator. Oscillators (Hartley, Colpitts, RC phase shift), Multivibrators: Astable, Monostable and Bistable, Triangular wave generator, Multivibrator, 555 timer and applications, PLL & capture range.	10
Unit 4:	**Active Filters:** Butterworth filter: Low pass filter, High pass filter, Band pass filter, Band-reject Filter, Sallen-Key unity gain filter, Sallen-Key equal component filter and its performance parameters: Gain, Cut-off frequency, Frequency response, State variable filter.	8
Unit 5:	**Voltage Regulators:** Series Op-amp regulators, IC voltage regulators, 723 general purpose regulators, Switching regulators, Fixed voltage (78/79, XX) regulators.	6
Total Hours		**42**

Textbooks	
1.	Sedra and Smith, "***Microelectronic Circuits***", Oxford University press, 5th Edition, 2019.

2.	J. Michael Jacob, "***Applications and design with Analog Integrated Circuits***", PHI, 2nd Edition, 2010.
	Reference Books
3.	B. Razavi, "***RF Microelectronics***", Prentice Hall, 2nd Edition, 2011.
4.	B.P. Singh and Rekha Singh, "***Electronic Devices and Integrated Circuits***", Pearson Education, 1st Edition, 2012.
5.	Ramakant A. Gayakwad, "***Op-Amps and Linear Integrated Circuits***", PHI, 3rd Edition, 2009.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fourth	***Subject Title***	Microprocessor and its Applications		***Code***	TEC 403
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Digital Electronics						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Remember** the concept of microcomputer system.
CO 2	**Understand** microprocessor 8085 and 8086 hardware.
CO 3	**Apply** the concepts of assembly language programming of 8085 and 8086 to fulfil different tasks.
CO 4	**Examine** the application of 8085 and 8086 microprocessor with interrupt system, real time timer and counter.
CO 5	**Test** different interfacing ICs and memory for defined tasks with 8085 and 8086 microprocessor.
CO 6	**Integrate** the knowledge of 8085 and 8086 in various embedded systems.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Microprocessors:** Evolution of microprocessors, Microprocessor internal architecture, hardware model of 8085, Pin diagram and function of each pin.	8
Unit 2:	**Programming with 8085:** Instruction set, Programming model of 8085, Addressing modes, Assembly language programming, Peripheral I/O, Memory mapped I/O, 8085 Interrupts, Stack and subroutines.	8
Unit 3:	**16 Bit Processor:** 16-bit microprocessors (8086): Architecture, Pin diagram, Physical address, Segmentation, Memory organization, Addressing modes, Instruction set, Assembly language programming of 8086, Comparison of 8086 & 8088 microprocessor.	10
Unit 4:	**Interfacing (Data Transfer) with Microprocessor:** Data transfer schemes: Introduction, Handshaking signals, Types of transmission, 8255 (PPI), Serial data transfer (USART 8251), Memory interfacing, 8257 (DMA), Programmable interrupt controller (8259).	8
Unit 5:	**Interfacing of Microprocessor with Timing Devices:** Programmable interval timer/ counter (8253/8254): Introduction, Modes, Interfacing of 8253, Applications. Introduction to DAC & ADC, ADC & DAC Interfacing (0808, 0809).	7
Total Hours		**41**

Textbooks	
1.	Ramesh Gaonkar, "***Microprocessor Architecture, Programming, and Applications with the 8085***", Penram International Publication (India) Pvt. Ltd., 6th Edition, 2013.

2.	A. K. Ray & K. M. Bhurchandi, "***Advanced Microprocessors and peripherals***", Tata McGraw Hill, 3rd Edition, 2012.
	Reference Books
3.	Douglas V. Hall, "***Microprocessors and Interfacing***", Tata McGraw Hill, 3rd Edition, 2012.
4.	Barry B. Brey, "***The Intel Microprocessors Architecture Programming and interfacing***", Pearson, 8th edition, 2012.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fourth	***Subject Title***	Electromagnetic Field Theory		***Code***	TEC 404
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Fundamentals of Physics and Engineering Mathematics						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** the concept of vector algebra, gradient, divergence and curl.
CO 2	**Differentiate** among different types of coordinate systems and **apply** them for solving the problems of electromagnetic field theory.
CO 3	**Analyse** the electric field and magnetic field for various structures.
CO 4	**Evaluate** E-M wave parameter in different medium.
CO 5	**Model** Transmission line and its various parameter.
CO 6	**Analyse** the behaviour of E and H field in parallel-plate geometry.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Electromagnetic:** Vector algebra, Co-ordinate systems, Scalar and vector fields, Line integral, Surface integral, Volume integral, Gradient of a scalar field, Divergence of a vector field, Curl of a vector field, Divergence theorem, and Stoke's theorem.	8
Unit 2:	**Static Fields:** Coulomb's law, Electric field intensity, Electric flux density, Gauss' law & its application, Electrostatic potential, Poisson's & laplace equation, Energy density in electrostatics field, Dielectric constant, Continuity equation, Boundary condition in electrostatics, Biot-Savart law, Ampere's law & its application, Magnetic flux density, Force due to magnetic field, Magnetic energy, Boundary condition in magnetostatics.	12
Unit 3:	**Maxwell's Equation and Electromagnetic Wave Propagation:** Uniform plane waves, Poynting theorem, Wave polarization, Reflection & refraction of a plane wave at normal incidence & oblique incidence.	8
Unit 4:	**Introduction to Transmission Lines:** Transmission line parameters, Transmission line equations, Input impedance, Reflection coefficient & Standing wave ratio, Power, Quarter wave transformer and impedance matching through single stub using smith chart.	8
Unit 5:	**Parallel Plate Waveguide:** Analysis of Transverse Electric (TE) mode, Transverse Magnetic (TM) Mode and Transverse Electromagnetic (TEM) waves.	6
Total Hours		**42**

Textbooks	
1.	Mathew N.O. Sadiku, "***Elements of Electromagnetics***", Oxford University Press, 3rd Edition, 2011.

2.	Hyatt, William, "***Engineering Electromagnetics***", McGraw Hill 7th Edition, 2011.
	Reference Books
3.	Griffiths D.J., "***Introduction to Electrodynamics***", Prentice Hall of India LTD, 3rd Edition, 2010.
4.	Krauss, J.D., "***Electromagnetics with Applications***", TMH, 5th edition, 2012.
5.	Jordan & Balmain, "***Electromagnetic Wave & Radiating Systems***", Prentice Hall of India LTD, 2nd edition, 2010.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fourth	***Subject Title***	Career Skills		***Code***	XCS 401
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Humanities and Social Sciences including Management course (HSMC)		02		2	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Skills						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	Have a logical approach to the problems and at the same time they will be able to **differentiate** between the strong and the week arguments and validity of the statement.
CO 2	**Improve** the reasoning ability of the students by using the different methods.
CO 3	**Learn** different approaches related to the coding or other complex types of problems which are related to the sequence detection etc.
CO 4	Get a basic **knowledge** of the data interpretation.
CO 5	Acquire **knowledge** of puzzles and different methods to **solve** the puzzles in an easier way is also included.
CO 6	**Develop** the basic skills of aptitude and logical reasoning.

Unit No.	***Content***	***Hours***
Unit 1:	**Functional Grammar:** Parts of speech, Articles, Parallel construction, Subject verb agreement.	6
Unit 2:	**Logical Reasoning:** Blood relation, Puzzle test, syllogism, Classification, Seating/placing arrangements,	6
Unit 3:	**Logical Reasoning:** Ranking and comparison, Sequential order and things, Selection based on conditions, Data interpretation	6
Unit 4:	**Building Vocabulary:** Analogy, Para jumbles, Antonyms and synonyms.	6
Total Hours		**24**

Textbooks	
1.	R. K. Bansal and J.B. Harrison, "***Spoken English for India***", Orient Longman.
2.	Thomson and Martinet, "***A practical English Grammar***", Oxford University Press.
3.	Malti Aggarwal, "***Professional Communication***".
4.	M. A. Pink and A. E. Thomas, "***English grammar, composition and correspondence***", S. Chand and Sons.
5.	"***A Dictionary of Modern Usage***", Oxford University Press.
Reference Books	
6.	R.S Agarwal, "***Quantitative aptitude***".
7.	R.S Agarwal, "***Verbal and Non-Verbal Reasoning***".

8.	Shakuntala Devi "***puzzles***".

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fourth	***Subject Title***	Communication Systems I Lab		***Code***	PEC 401
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Basics of CRO and MATLAB						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** and **analyse** the waveforms of DSB-FC, DSB-SC, SSB-SC.
CO 2	**Analyse** the waveforms of different angle modulation techniques (FM & PM).
CO 3	**Compare** and **evaluate** the performances of different analog modulation techniques.
CO 4	**Investigate** pulse analog modulation system and **analyse** their system performance.

Exp. No.	***Name of the Experiment***
1.	Generation of amplitude modulated (DSB-FC) waveform and determines its modulation indices.
2.	Generation of Double sideband suppressed carrier (DSB-SC) waveform using balanced modulator.
3.	Generation of single sideband suppressed carrier (SSB-SC) signal.
4.	Generation of frequency modulated (FM) signal using voltage-controlled oscillator.
5.	Demodulation of FM signal using phase locked loop (PLL).
6.	Generation and detection of PAM.
7.	Generation and detection of PWM & PPM.
8.	Simulation of Double sideband suppressed carrier (DSB-SC) signal using MATLAB.
9.	Simulation of amplitude modulated (DSB-FC) signal using MATLAB.
10.	Simulation of Single sideband suppressed carrier (SSB-SC) signal using MATLAB.
11.	Simulation of frequency modulated (FM) signal using MATLAB.
12.	Simulation of phase modulated (PM) signal using MATLAB.
13.	Simulation of Frequency division Multiplexing (FDM) using MATLAB.
Innovative Experiments	
14.	To analyse the radiation pattern of Yagi-Uda antenna.
15.	Getting familiar with the features and basic operations of the spectrum analyzer and investigating signals in frequency domain.
16.	To plot the frequency domain representation of DSB-FC, DSB-SC and SSB-SC using MATLAB.
17.	To plot the frequency domain representation of FM, and PM using MATLAB.
18.	To demonstrate the effect of AWGN in DSB-FC, DSB-SC and SSB-SC using MATLAB.
19.	Simulation of frequency modulation and demodulation in noisy condition using MATLAB.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fourth	***Subject Title***	Analog Integrated Circuits Lab		***Code***	PEC 402
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Electronics Circuits Lab						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** the concepts of open loop/closed loop Op-Amp configurations.
CO 2	**Analyse** the performance parameters of Active Filters using Op-Amp.
CO 3	**Evaluate** the performance characteristics of comparator and multi-vibrator circuits using OP-AMP.
CO 4	**Design** various linear and non-linear circuits using Op-Amp.

Exp. No.	***Name of the Experiment***
1.	Design and Test open loop inverting and non-inverting op-amp.
2.	Design and Test closed loop inverting and non-inverting op-amp.
3.	Design and Test op-amp based adder and subtractor circuits.
4.	Design and Test op-amp based integrator circuits.
5.	Design and Test op-amp based differentiator circuits.
6.	Design and Test op-amp based active RC low pass filters.
7.	Design and Test op-amp based active RC high pass filters.
8.	Design and Test op-amp based active Band pass filter.
9.	Design and Test op-amp based comparator circuits.
10.	Realize op-amp based triangular wave generator.
11.	Analyze CMRR and slew rate of Op-Amp.
12.	Design and test astable and monostable multivibrator circuits using 555 timer.
Innovative Experiments	
13.	Design and test unity gain sallen key low pass filter.
14.	Design band reject filter.
15.	Design and test Op-amp based PLL.
16.	Self-motivated experiments or suggested by the lab incharge.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fourth	***Subject Title***	Microprocessor Lab		***Code***	PEC 403
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Digital Electronics Lab						
Course Outcomes						
Upon completion of this course, the students will be able to						
CO 1	**Remember** 8085 and 8086 instruction set.					
CO 2	**Understand** different assembly language programs on microprocessor-based microcomputer kit.					
CO 3	**Apply** the programming concepts to test and debug assembly language programs in the laboratory.					
CO 4	**Assemble** various devices and memories with microprocessor for any defined task.					

Exp. No.	***Name of the Experiment***
1.	Write program in 8085 to swap two 8-bit numbers.
2.	Write a program in 8085 to move a block of data bytes from one location to another location.
3.	Write programs in 8085 to perform addition & subtraction of 8-bit number with carry / borrow.
4.	Write a program in 8085 for addition of 16 bits numbers with carry.
5.	(a) Write an ALP in 8085 to find one's complement of 8 /16bit data. (b) Write an ALP in 8085 to find two's complement of 8/16 bit data.
6.	Write an ALP in 8085 to add two 8-bit BCD data.
7.	(a) Write an ALP in 8085 to find larger number between two numbers. (b) Write an ALP in 8085 to find smaller number between two numbers.
8.	Write an ALP in 8085 to find largest /smallest in a series of n number.
9.	Write an ALP in 8085 to find multiplication of 8-bit number.
10.	(a) Write a program in 8086 to add two 16-bit numbers given by the user. (b) Write a program in 8086 to subtract two 16-bit numbers given by the user.
11.	(a) Write a program in 8086 to multiply two 16-bit data. (b) Write a program in 8086 to divide: 32-bit data by 16-bit data.
12.	(a) Write a program in 8086 to find the largest no. from an array of n numbers stored in an array. (b) Write a program in 8086 to perform sorting of given set of numbers.
13.	Write a program in 8086 to add and subtract two 8-bit BCD numbers.
14.	(a) Write a program in 8086 to convert a BCD number to its ASCII code equivalent. (b) Write a program in 8086 to convert a BCD number to its grey code equivalent.
Innovative Experiments	
15.	Write an ALP for traffic light controller using 8085.
16.	Write an ALP for interfacing of PPI 8255 with microprocessor 8085.
17.	A data string of no. of bytes is converted to its equivalent 2's complement using 8086 string instruction.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Digital Signal Processing		***Code***	TEC 501
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Signals and Systems						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** discrete time signals & systems and various transforms.
CO 2	**Analyse** and **evaluate** the DFT and FFT algorithm.
CO 3	**Evaluate** the implementation of digital filter structures.
CO 4	**Apply** the design methods of IIR digital filter.
CO 5	**Analyse** and **apply** design techniques of FIR digital filters.
CO 6	**Integrate** the knowledge in **designing** of various digital signal processing-based systems.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction of Discrete –Time Signals and Systems and other Transforms:** Elements of Digital Signal Processor, Discrete time sinusoids, Discrete time signals and systems, Correlation (Cross and auto correlation). Z transform and its properties, ROC properties, Inverse Z transform. Introduction to Discrete time Fourier series (DTFS) and Discrete time Fourier transform (DTFT) and their properties.	8
Unit 2:	**DFT and FFT Algorithms:** Discrete Fourier Transform (DFT), DFT as linear transformation, DFT properties, Circular convolution, Fast Fourier Transform (FFT): Decimation –in- Time Fast Fourier Transform (DITFFT), Decimation –in- Frequency Fast Fourier Transform (DIFFFT), Applications of FFT, Goertzel algorithm.	9
Unit 3:	**Structures of Digital Filters:** Structure for realization of digital filters: Direct form I, Direct form II, Cascade and parallel Form, Transversal structure linear phase FIR filter structure, Lattice structure, Signal flow graph and transposed structure.	9
Unit 4:	**Design of Infinite Impulse Response (IIR) Digital Filters:** Design of IIR digital filters using impulse invariance technique, Bilinear transformation technique, Approximation of derivatives technique, Design of low pass Butterworth filter and Chebyshev filter.	9
Unit 5:	**Design of Finite Impulse Response (FIR) Digital Filters:** Symmetric and anti-symmetric FIR filters, Linear phase FIR filters, Design using frequency sampling technique , Design of FIR filter using window techniques- Hamming, Hanning and Blackman, Rectangle, Bartlett and Kaiser windows, Concept of optimum equi-ripple approximations, Effect of finite word length, Fixed point and binary floating point number representations, Comparison, Overflow error, Truncation error.	7
Total Hours		**42**

	Textbooks
1.	J. G. Proakis, D.G. Manolakis and D. Sharma, "***Digital Signal Processing Principles, Algorithms and Applications***", Pearson Education, 4th edition, 2012.
2.	Oppenhiem V.A.V and Schaffer R.W, "***Discrete – time Signal Processing***", Prentice Hall, New Jersey, US., 3rd edition, 2013.
	Reference Books
3.	S.K.Mitra, "***Digital Signal Processing***", TMH, New Delhi, India, 4th edition, 2013.
4.	Emmanuel C. Ifeachor, "***Digital Signal Processing A Practical Approach***", Prentice Hall, New Jersey, US, 2nd edition reprint, 2011.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Communication Systems II		***Code***	TEC 502
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Signals and Systems, Communication systems I						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Demonstrate** the concepts of sampling, Quantization and various waveform coding schemes.
CO 2	**Analyse** the effect of ISI and their mitigation.
CO 3	**Design** and **develop** different digital modulation systems.
CO 4	**Describe** the mathematical model of a digital modulation technique, characterize the effect of AWGN channel and determine its bit error rate performance.
CO 5	**Apply** the concepts of information theory for digital communication systems.
CO 6	**Apply** the concepts of digital communications for reliable communication with high data rate.

Unit No.	***Content***	***Hours***
Unit 1:	**Sampling and Baseband Transmission:** Model of digital communication system, Sampling of low pass and band pass signals, Distortion due to sampling, Uniform and non-uniform quantization, Quantization error, Companding (A law and μ law), Pulse code modulation, Differential PCM and delta modulation, Adaptive delta modulation, Linear prediction filters.	10
Unit 2:	**Digital Transmission through Band Limited AWGN Channels:** Representation of line codes – Properties and applications of line codes, Power spectral density of NRZ & RZ unipolar format, NRZ & RZ polar format, NRZ &RZ bipolar format, and Manchester format, Intersymbol interference, Nyquist criterion for Distortion-less baseband binary Transmission, Raised cosine filter, Introduction to equalization techniques and Zero forcing equalizer.	8
Unit 3:	**Digital Modulation Techniques:** Represent of bandpass signals and systems, Gram Schmidt procedures, Representation of digitally modulated signals; Amplitude shift keying, Phase shift keying, Differential PSK, Quadrature PSK, Frequency shift keying, Minimum shift keying, Quadrature Amplitude Modulation (QAM).	10
Unit 4:	**Optimum Receivers for AWGN Channel:** Model for received signal passed through an AWGN channel, Matched filter receiver and correlation receiver, Detector, Probability of error calculation for BASK, BPSK, QPSK, BFSK, and QAM.	7
Unit 5:	**Information Theory and Error Control Coding:** Information measure; Entropy and information rate, Discrete memory less source, Mutual information, Binary symmetric channel, Discrete channel capacity, Continuous information source, Continuous channel capacity, Source coding theorem, Shannon-Fano coding, Huffman coding, Channel	10

	capacity theorem, Linear block codes, Coding Gain, Hamming codes, Convolution coding.	
Total Hours		**45**

	Textbooks
1.	Simon Haykin, "***Digital Communications***", 2001, 4th edition, John Wiley, India.
2.	Herbert Taub and Donald L Schilling, "***Principles of Communication Systems***", 2012, 4th edition, Tata McGraw Hill, New Delhi.
	Reference Books
3.	John.G. Proakis, "***Digital Communication***, 2014, 5th edition, Pearson Education, Noida, India.
4.	Bernard Sklar, "***Digital Communications: Fundamentals and Applications***", 2016, 2nd edition, Prentice Hall, New Jersey, US.
5.	B. P. Lathi and Z. Ding, "***Modern Digital and Analog Communication Systems***",2009, 4th edition, Oxford University Press.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Microcontroller and Embedded Systems		***Code***	TEC 503
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Microprocessor and its applications						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Remember** the concept of microcontroller.
CO 2	**Understand** the concepts of embedded systems using 8051 and Arduino IDE.
CO 3	**Apply** the concepts of interfacing of 8051 and Arduino to peripheral device, sensors and motors.
CO 4	**Examine** the applications of 8051 microcontroller and Arduino as I/O, timer and counter.
CO 5	**Evaluate** different tasks using assembly language programming for 8051 and C programming for Arduino.
CO 6	**Develop** foundation for the designing of Advanced embedded systems.

Unit No.	***Content***	***Hours***
Unit 1:	**Microcontroller**: Difference between microprocessors and microcontrollers, Types of Micro-controllers, ARM processor, Memory structure of 8051, Processor architecture – Harvard v/s Von Neumann, CISC v/s RISC, 8051 architecture, control storage, Variable area, Stack, Hardware register space, SFR, 8051 pin diagram.	9
Unit 2:	**8051 Instruction Set:** Addressing modes, External addressing, Instruction execution, Instruction set – data movement, Arithmetic, Bit operators, Branch, Software development tools like assemblers, Simulators, O/P file formats. Assembling and running an 8051 program, 8051 data types, 8051 flag bits and the PSW register, 8051 register banks and stack	9
Unit 3:	**Programming of 8051 and Interrupts:** Programming of 8051, I/O bit manipulation. Timer, Counter, Programming of timer, 8051 interrupts, Interrupts priority in the 8051, and interrupts programming.	8
Unit 4:	**Introduction to Arduino IDE Platform** Introduction to ATMEGA328 microcontroller and to Arduino IDE, Instruction set, Hardware, characteristics, Interfacing with different peripheral devices, Debugging hardware errors, Using PWM I/O pins, Interfacing Arduino hardware with internet of things	8
Unit 5:	**Interfacing**: Interfacing with 8051: LCD, Keyboard, ADC, DAC interfacing, Sensor interfacing and signal conditioning, Stepper motor and DC motor, Basics of serial communications, 8051 connection to RS-232, 8051 serial port programming assembly.	8
Total Hours		**42**

	Textbooks
1.	Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, "***The 8051 Microcontrollers & Embedded Systems***", Pearson Education, 2nd Edition, 2007.
2.	V Udayashankara, M S Mallikarjunaswamy, "***8051 Micro-controller, Hardware, Software and Application***", Tata McGraw-Hill education, 2009.
3.	Simon Monk, "***Programming Arduino: Getting Started with Sketches***", McGraw-Hill education, 2nd Edition, 2016.
	Reference Books
4.	Kenneth Ayala, "***The 8051 Microcontroller***", West Publishing Company, 3rd edition, 2007.
5.	Julien Bayle, "***C-Programming for Arduino***", Packt Publishing, 2013.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Antenna and Wave Propagation		***Code***	TEC 504
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Systems I, Communication Systems II, and Electromagnetic Field Theory						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** the concept of radiation.
CO 2	**Compute** fundamental parameters of antenna and different antenna characteristics.
CO 3	**Analyse** uniform and non-uniform antenna array.
CO 4	**Evaluate** fundamental parameters for designing of microstrip patch antenna.
CO 5	**Develop** the concepts of wave propagation through free space.
CO 6	**Design** antenna for different application.

Unit No.	***Content***	***Hours***
Unit 1:	**Radiation Fundamentals:** Potential theory, Helmholtz integrals, Radiation from a current element, Basic antenna parameters, Radiation field of an arbitrary current distribution, small loop antennas.	8
Unit 2:	**Receiving Antenna:** Reciprocity relations, receiving cross section, and its relation to gain, Reception of completely polarized waves, Linear antennas, Current distribution, Radiation field of a thin dipole, Folded dipole, Feeding methods, Radiation from helical antenna.	10
Unit 3:	**Antenna Arrays:** Array factorization. Array parameters. Broad side and end fire arrays. Yagi-Uda arrays Log-Periodic arrays, Broadband antennas, Helical antenna, Spiral antenna.	8
Unit 4:	**Aperture Antennas:** Fields as sources of radiation, Horn antennas, Babinet's principle, Parabolic reflector antenna, Feeding systems, Microstrip antennas, Metamaterial antenna.	8
Unit 5:	**Wave Propagation:** Propagation in free space, Propagation around the earth, Surface wave propagation, Structure of the ionosphere, Propagation of plane waves in ionized medium, Determination of critical frequency, MUF, Fading, Troposphere propagation, Super refraction.	8
Total Hours		**42**

Textbooks	
1.	J. D. Kraus, R. Marhefka, A. Khan, "***Antennas and Wave Propagation***", McGraw Hill Education, Publication, 4th edition, 2017.

2.	C. A. Balanis "***Antenna analysis & Design***", John Wiley, 3rd edition, 2016.
3.	R. E. Collin, "***Antennas and Radio Wave Propagation***", McGraw–Hill, 1st edition, 2013.
	Reference Books
4.	A. R. Harish and M. Sachidananda "***Antennas and Wave Propagation***", Oxford Publication, 1st edition, 2017.
5.	Joe Myers, "***Structure and Applications of Microstrip Antennas***", Clanrye International Publication, 1st edition, 2015.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Career Skills		***Code***	XCS 501
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Humanities and Social Sciences including Management course (HSMC)		02		2	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Skills						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	Have a logical approach to the problems and at the same time they will be able to **differentiate** between the strong and the week arguments and validity of the statement.
CO 2	**Improve** the reasoning ability of the students by using the different methods.
CO 3	**Learn** different approaches related to the coding or other complex types of problems which are related to the sequence detection etc.
CO 4	Get a basic **knowledge** of the data interpretation.
CO 5	Acquire **knowledge** of puzzles and different methods to **solve** the puzzles in an easier way is also included.
CO 6	**Develop** the basic skills of aptitude and logical reasoning.

Unit No.	***Content***	***Hours***
Unit 1:	**Effective Reading Skills:** Reading comprehension, Purpose of reading, Skimming and scanning. Tips for improving comprehension skills. (For effective reading skills practice papers on Reading Comprehension will be provided to students).	4
Unit 2:	**Aptitude section:** Clocks, Calendar, Profit/loss, Percentage, Average.	4
Unit 3:	**Aptitude Section:** Ages, Trains & Boats, Simplification, Ratio & proportion, Partnership.	12
Unit 4:	**Critical Reasoning:** Analyze logical arguments.	4
Total Hours		**24**

Textbooks	
1.	R.K.Bansal and J.B. Harrison, "***Spoken English for India***", Orient Longman.
2.	Thomson and Martinet, "***A practical English Grammar***", Oxford University Press.
3.	Malti Aggarwal, "***Professional Communication***".
4.	M. A. Pink and A. E. Thomas, "***English grammar, composition and correspondence***", S.Chand and Sons.
5.	"***A Dictionary of Modern Usage***", Oxford University Press.
Reference Books	
6.	R.S Agarwal, "***Quantitative aptitude***".
7.	R.S Agarwal, "***Verbal and Non Verbal Reasoning***".

8.	Shakuntala Devi "***puzzles***".

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Digital Signal Processing Lab		***Code***	PEC 501
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Fundamentals of MATLAB						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand**, **implement**, and **analyse** various basic signal convolution and correlation functions.
CO 2	**analyse** and **evaluate** DFT and IDFT functions through MATLAB software.
CO 3	**analyse** and **evaluate** FFT algorithm through MATLAB software.
CO 4	**analyse** and **evaluate** FIR and IIR digital filter through MATLAB software.

Exp. No.	***Name of the Experiment***
1.	Generation of various signals functions (Unit impulse, Unit step, Unit ramp signals, Sinc & Signum) through MATLAB.
2.	Sampling theorem verification by generating and plot of the continuous time sinusoid signal into discrete time signal and reconstruction of the continuous time signal from its sampled signals.
3.	Write a MATLAB program to plot the power spectral density (PSD) of given signal.
4.	Write a MATLAB program to plot the energy spectral density (ESD) of given signal.
5.	Write a MATLAB program to generate and plot the real, imaginary, magnitude and phase part of given imaginary exponential function.
6.	To convolve sequence (i) linear (ii) circular, and their characteristics using MATLAB. (By given problems, verify it by mathematically as well as experimental ways).
7.	To correlate of sequences using MATLAB. (By given problems, verify it by mathematically as well as experimental ways and plot them).
8.	DFT and IDFT computation for a sequence N points using MATLAB.
9.	Development of FFT algorithm using MATLAB, validate the result through mathematically as well as experimentally.
10.	Generation of Gaussian distributed numbers using MATLAB.
11.	To simulate 2nd order IIR Filter using MATLAB.
12.	To simulate and design FIR filter using MATLAB.
Innovative Experiments	
13.	Circular Convolution of two Sequences by using FFT method.
14.	Write a MATLAB Program to implement Radix2 Decimation in Time (DIT) FFT algorithm.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Communication Systems II Lab		***Code***	PEC 502
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Basics of CRO and fundamentals of MATLAB						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Develop** and **understand** the signal sampling, quantization, and its reconstruction.
CO 2	**Develop** an ability to **understand** and **design** various waveform coding techniques.
CO 3	**Develop** an ability to **evaluate** and **design** various digital modulation techniques.
CO 4	**Develop** an ability to **evaluate** and **design** Time Division Multiplexing technique.

Exp. No.	***Name of the Experiment***
1.	Sampling of the signal using different sampling techniques and reconstruction of the sampled signals.
2.	Generation and detection of pulse code modulation technique.
3.	Generation and detection of Delta demodulator technique.
4.	To demonstrate Time division multiplexing & de-multiplexing process.
5.	Mapping of binary data into baseband pulses using different data formatting techniques.
6.	Mapping of binary data into passband signal using binary amplitude shift keying (BASK).
7.	Mapping of binary data into passband signal using binary frequency shift keying (BFSK).
8.	Mapping of binary data into passband signal using binary phase shift keying (BPSK).
9.	Simulation of binary amplitude shift keying (BASK) modulated Signal using MATLAB.
10.	Simulation of binary frequency shift keying (BFSK) modulated signal using MATLAB.
11.	Simulation of binary phase shift keying (BPSK) modulated signal using MATLAB.
12.	Simulation of differential phase shift keying (DPSK) using MATLAB.
Innovative Experiments	
13.	To plot and analyze the waveform for Quadrature Phase Shift Keying (QPSK) signal using MATLAB for a given bit stream.
14.	Simulation of QAM modulation and demodulation using MATLAB.
15.	Simulation of MSK modulation and demodulation using MATLAB.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Microcontroller & Embedded Lab		***Code***	PEC 503
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Microprocessor Lab						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Remember** 8051 microcontroller instruction set.
CO 2	**Understand** different assembly language programs on microcontroller-based microcomputer kit.
CO 3	**Apply** the programming concepts to test and debug assembly language programs in the laboratory.
CO 4	**Assemble** various devices and memory with microcontroller for any defined task.

Exp. No.	***Name of the Experiment***
1.	a) Write a program in 8051 to add two 8-bit numbers. b) Write a program in 8051 to subtract two 8-bit numbers.
2.	a) Write a program in 8051 to add two 16-bit numbers. b) Write a program in 8051 to subtract two 16-bit numbers.
3.	a) Write a program in 8051 to find the largest no. from an array of n numbers stored in an array. b) Write a program in 8051 to perform smallest no. from an array of n numbers stored
4.	Write a program in 8051 to add two 8-bit BCD numbers.
5.	a) Write a program in 8051 to multiply two 8-bit data. b) Write a program in 8051 to divide two 8-bit data.
6.	Write a program in 8051 to convert a BCD number to its ASCII code equivalent.
7.	Write a program in 8051 which move a block of data.
8.	Write a program in 8051 which sort a block of data.
9.	Write a program in 8051 which convert a binary number to its grey code equivalent
10.	Write a program in 8051 which determines average of n numbers.
11.	Write a program in 8051 to convert a BCD number to its binary code equivalent
12.	Write a program in Arduino to use PWM pin to increase and decrease the intensity of brightness in an LED.
13.	Write a program in Arduino to interface LED and create a burglar alarm.
14.	Write a program in Arduino to interface with a dc motor.
Innovative Experiments	
15.	8255 Interface to 8051.
16.	Traffic Light Controller interface to 8051.
17.	Interfacing Arduino IDE to create an IOT data log.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	Wireless Communication		***Code***	TEC 601
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Systems II						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Demonstrate** an understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.
CO 2	**Demonstrate** an understanding on cellular concepts, cellular architecture, and evolution of different generations and standards for mobile cellular communication.
CO 3	**Analyse** and **design** of mobile radio propagation models.
CO 4	**Analyse** different channel parameters, causes of impairments in signal propagation and impairment removal techniques.
CO 5	**Analyse** different diversity combining techniques.
CO 6	**Apply** the concepts of spread spectrum for designing wireless Communication Systems.

Unit No.	***Content***	***Hours***
Unit 1:	**Wireless Communication System, Standards & Cellular Concept:** An overview of wireless communication, Basic elements in wireless communication systems, Wireless communication system, and standards. Evolution of mobile cellular communication (1G, 2G. 2.5G, 3G and beyond), Typical cellular standards (AMPS, GSM, GPRS, WCDMA, LTE, LTE-A). Cellular concept – Frequency reuse – Channel assignment strategies – Handoff strategies – Interference & system capacity, Trunking & grade of service – Improving coverage and capacity in cellular system.	10
Unit 2:	**Evolution of Mobile Radio Propagation Fundamentals: Large Scale Path Loss:** Introduction to radio wave propagation, Free space propagation model, Basic propagation mechanisms, Ground reflection (Two-Ray) Model, Indoor propagation models, path loss model.	7
Unit 3:	**Small Scale Fading & Multipath:** Small-scale multipath propagation, Impulse response model of multipath channel, Parameters influencing small scale fading, Types of small-scale fading, Diversity mechanisms.	9
Unit 4:	**Diversity Combining Techniques:** Rayleigh & Rician fading models, Selection Combining (SC), Equal Gain Combining (EGC), and Maximal Ratio Combining (MRC), Derivation of SC, EGC, and MRC improvement, RAKE receiver.	7
Unit 5:	**Spread spectrum:** Multiple access techniques, Pseudo-noise sequence, Direct sequence spread spectrum (DS-SS), Frequency hopped spread spectrum (FHSS). Time hopping.	7
Total Hours		**40**

	Textbooks
1.	Sanjay Kumar, "***Wireless Communication: The Fundamental and Advanced Concepts***", 2015 (Indian reprint), 1st edition, River Publishers Series.
2.	Rappaport, T.S., "***Wireless communications***", 2012 (Reprint), 2nd edition, Pearson Education, Noida, India.
3.	David Tse, Pramod Viswanath, "***Fundamentals of Wireless Communication***", Cambridge University Press, 2005.
	Reference Books
4.	T L Singal, "***Wireless Communications***", 2014 (Reprint), 1st edition, Tata McGraw Hill Education, New Delhi, India.
5.	Simon Haykin and Michael Moher, "***Modern Wireless Communications***", 2005, 2nd edition, Parson Education, Delhi.
6.	Andrea Goldsmith, "***Wireless Communications***", 2005, Cambridge University Press.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	Microwave Engineering		***Code***	TEC 602
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Systems I, Communication Systems II, and Electromagnetic Field Theory.						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Remember** the basic concepts of waveguides and understanding of waveguides characteristics and cavity resonators.
CO 2	**Apply** the basics of the waveguide to different microwave components based on network parameters.
CO 3	**Analyse** various microwave sources and their characteristics.
CO 4	**Understand** various parameters measurement for evaluating the performance of the microwave components.
CO 5	**Implement** Microstrip filters used in RF transmitter and receiver.
CO 6	**Design** RF components, transmitter, receiver, and RF communication links.

Unit No.	***Content***	***Hours***
Unit 1:	**Waveguides and Transmission Line:** Rectangular and circular waveguide, Excitation of waveguides, Rectangular cavity resonators, Introduction to microstrip line.	10
Unit 2:	**Passive Microwave Devices:** Network parameter of microwave circuit, Scattering matrix, Microwave T junctions, E plane TEE, H plane TEE, Magic TEE, Hybrid TEE, Hybrid ring, Terminations, Attenuators & phase changers, Isolator & circulators, Directional couplers and power divider.	8
Unit 3:	**Microwave Sources:** Klystron, Reflex Klystron, Magnetron (Conventional, linear), TWT, Gunn diode, IMPATT, TRAPATT, Tunnel diode –Operation & characteristics, Basics of GaAs FET.	8
Unit 4:	**Microwave Measurements:** Measurement of frequency, Wavelength, Power, VSWR, Impedance determination, S-Parameter measurements, Spectrum analyzer, Network analyzer.	6
Unit 5:	**Microwave Systems:** Types of filter designing, Low-pass prototype filter design, Filter transformations, Filter implementation, Richard transformation, Kuroda identities, Stepped-Impedance low pass filters. Introduction to RFID, MMIC, RFMEMS, and Effect of microwave on human body.	8
Total Hours		**40**

Textbooks	
1.	Liao, Samuel, "***Microwave Devices & Circuits***", PHI, 3rd edition, 2003.

2.	Pozar, D M, "***Microwave Engineering***", John Wiley & sons, 4th edition, 2013.
	Reference Books
3.	Collins, R E, "***Foundations for Microwave Engineering***", John Wiley & sons, 2nd edition, 2007.
4.	I J Bhal & P. Bharti, "***Microwave Solid state Circuit Design***", John Wiley & sons, 2nd Edition, 2003.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	VLSI Technology and Design		***Code***	TEC 603
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Electronic Devices and Circuits						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Develop** basic understanding of VLSI fabrication Technology.
CO 2	**Illustrate** different kind of diffusion and deposition techniques in VLSI.
CO 3	**Discuss** VLSI design concepts, MOS structure, and MOSFET equation in terms of current and voltage.
CO 4	**Examine** the properties and characteristics of MOS structures.
CO 5	**Understand** various layout and stick design of CMOS circuits.
CO 6	**Propose** the characteristic differences in MOS structures and device-based projects.

Unit No.	***Content***	***Hours***
Unit 1:	**VLSI Technology:** Clean room technology, Crystal growth and wafer preparation, Electronic grade silicon, CZ crystal growth technique, Silicon shaping. Epitaxy: Vapor-phase epitaxy, Doping and auto-doping, Buried layers. Oxidation: Importance, Deal and Grove's model.	8
Unit 2:	**Diffusion:** Models of diffusion in solids, Fick's law. Ion implantation: Range theory, Ion stopping, Implantation equipment, Annealing. Lithography: Types, Photoresist. Etching: Wet etching, Ion milling, Liftoff. Metallization: Applications, Choices, Deposition.	8
Unit 3:	**Era of VLSI Design:** Introduction to VLSI design, Front end and Back end design, Computer aided design technology. **MOS Transistor:** MOS structure, MOS system under external Bias, Threshold voltage, Structure and operation of MOS transistor, MOSFET device design equation, MOSFET scaling, MOSFET capacitances.	8
Unit 4:	**MOS Inverters:** Static characteristics, Resistive – load inverter, Inverters with n-type MOSFET load, CMOS inverter, Switching characteristics of MOS inverters, Delay-time definitions, Switching power dissipation of CMOS inverters.	10
Unit 5:	**Layout Design:** Design rules, Stick diagram, Parasitic effects, Layout design prospects, CMOS basic circuits layout design: NAND, NOR, AND, OR, AOI circuits.	8
Total Hours		**42**

Textbooks

1.	S. Kang and Y. Leblebici, "***CMOS Digital Integrated Circuits, Analysis and Design***", 3rd Edition, Tata McGraw-Hill, 2003.
2.	S. M. Sze, ***"VLSI Technology"*** 2nd edition, McGraw Hill, 1988.
3.	James D. Plummer, Michael Deal, Peter D. Griffin, "***Silicon VLSI Technology: Fundamentals, Practice, and Modeling"***, 1st edition, Pearson, 2003.
4.	Sorab K.Ghandi, ***"VLSI Fabrication Principles Silicon And Gallium Arsenide",*** 2nd edition, A Wiley Inderscience Publications, 1994.
	Reference Books
5.	D. A. Pucknell and K. Eshraghian, "***Basic VLSI Design"***, 3rd Edition, Prentice-Hall of India, 1994.
6.	Stephen A. Campbell, "***The Science and Engineering of Microelectronic Fabrication"***, 2nd Edition, Oxford University Press, 2008.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	Career Skills		***Code***	XCS 601
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Humanities and Social Sciences including Management course (HSMC)		02		2	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Skills						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	Have a logical approach to the problems and at the same time they will be able to **differentiate** between the strong and the week arguments and validity of the statement.
CO 2	**Improve** the reasoning ability of the students by using the different methods.
CO 3	**Learn** different approaches related to the coding or other complex types of problems which are related to the sequence detection etc.
CO 4	Get a basic **knowledge** of the data interpretation.
CO 5	Acquire **knowledge** of puzzles and different methods to **solve** the puzzles in an easier way is also included.
CO 6	**Develop** the basic skills of aptitude and logical reasoning.

Unit No.	***Content***	***Hours***
Unit 1:	**Building Advanced Vocabulary:** Sentence completion: Single and double vocabulary **Job Application:** Personal interviews and C.V Writing essential parts - Cover letter and the 'resume'. Types of 'resumes' (Curriculum Vitae) Chronological 'resume', functional 'resume'.	5
Unit 2:	**Aptitude Section:** Number system, P& C, Probability, Log,	8
Unit 3:	**Aptitude Section:** Time & work, S.I & C.I, Time & distance, Mixture, Chain rule, Pipes & cisterns	6
Unit 4:	**Advanced Grammar:** Spotting errors, Subject verb agreement-based errors.	5
Total Hours		**24**

Textbooks	
1.	R.K. Bansal and J.B. Harrison, "***Spoken English for India***", Orient Longman.
2.	Thomson and Martinet, "***A practical English Grammar***", Oxford University Press.
3.	Malti Aggarwal, "***Professional Communication***".
4.	M. A. Pink and A. E. Thomas, "***English grammar, composition and correspondence***", S. Chand and Sons.
5.	"***A Dictionary of Modern Usage***", Oxford University Press.

Reference Books	
6.	R.S Agarwal, "***Quantitative aptitude***".
7.	R.S Agarwal, "***Verbal and Non-Verbal Reasoning***".
8.	Shakuntala Devi "***puzzles***".

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	CAD of Electronics using CADENCE Tool Lab		***Code***	PEC 601
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Digital Electronics lab						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** the concepts associated with different analog and digital electronics devices like MOSFETs, CMOS, logic gates etc.
CO 2	**Apply** the basics of these devices to analyse various electronic circuits like amplifier, inverter, adder, subtractor etc.
CO 3	**Analyse (**both DC and transient) different circuits using simulation tools.
CO 4	**Design** various analog and digital electronics circuit.

Exp. No.	***Name of the Experiment***
PART – A (using Cadence Tool)	
1.	Design and simulation of various gates.
2.	Design and simulation of XOR gate using NAND gate only.
3.	Design and simulation of comparator.
4.	Design and simulation of full adder and full subtractor.
5.	Design and simulation of multiplexer and demultiplexer.
6.	Design and analysis (DC and Transient) of CMOS inverter using 0.18 µm technology.
7.	Design, simulation and analysis of common source amplifier using 0.18 µm technology.
8.	Design, simulation and analysis of common drain amplifier using 0.18 µm technology.
9.	Design and comparison of DC and transient output characteristics of CMOS inverter at different aspect ratio.
10.	Layout design of CMOS inverter using 0.18 µm technology
PART – B (using Xilinx Tool)	
11.	Design, simulation and synthesis of various logic gates using Verilog HDL.
12.	Design, simulation and synthesis of full adder and full subtractor using Verilog HDL.
13.	Design, simulation and synthesis of multiplexer and de-multiplexer.
Innovative Experiment:	
14.	Design, simulation and synthesis of Flip-Flops.
15.	Design and simulation of MOS differential amplifier using Cadence tool.
16.	Design and simulation of current mirror circuit using Cadence tool.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	Microwave and Antenna Lab		***Code***	PEC 602
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Professional Core Course (PCC)		01		0	0	2
Examination Duration (Hrs)		***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		02		25	25	50
Pre-requisite: Electromagnetic Field Theory, Antenna and Wave Propagation						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** microwave bench and related component.
CO 2	**Apply** the fundamentals to measure the parameters of microwaves and analyse S-parameters for various microwave devices.
CO 3	**Evaluate** and measure the necessary antenna performance parameters.
CO 4	**Develop** basic skills to learn some CAD tool and apply in the **design** of various antennas.

Exp. No.	***Name of the Experiment***
1.	To measure the guide wavelength and frequency of the signal in a rectangular waveguide, working on TE_{10} mode.
2.	To draw the mode characteristic of reflex klystron.
3.	To measure the characteristics of given E plane, H plane and Magic TEE.
4.	To measure the characteristics of given circulator and directional coupler.
5.	Analyze the change is frequency and output power with the change in bias voltage of Gunn diode.
6.	To verify the characteristic of low pass filter using power sensor.
7.	To draw the polar pattern and measure the gain of waveguide Horn antenna.
8.	To study the characteristics of a patch antenna.
9.	To design and simulate a rectangular shape microstrip patch antenna with the given input parameters.
10.	To design and simulate a triangular shape microstrip patch antenna with the given input parameters.
11.	To design and simulate a circular shape microstrip patch antenna with the given input parameters.
12.	To implement optimization for the design of a patch antenna.
Innovative Experiments	
13.	Measure the characteristic of power divider and power combiner (S-Band and C-Band).
14.	To design and simulate a low pass filter with the given input parameters.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	Principles of Management		***Code***	TEC 701
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Humanities and Social Sciences including Management course (HSMC)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Knowledge of Ethical Science						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Understand** definition and keywords related to principle of management.
CO 2	**Analyse** the elements and steps of planning.
CO 3	**Investigate** the structure, design, and principle of organising.
CO 4	**Interpret** principles and elements of directing.
CO 5	**Understand** the process and functions of controlling
CO 6	**Apply** practical concepts of scientific management in their respective work domain.

Unit No.	***Content***	***Hours***
Unit 1:	**Overview of Management:** Definition - Management - Role of managers - Evolution of management thought - Organization and the environmental factors – Trends and challenges of Management in global scenario.	10
Unit 2:	**Function of Planning:** Nature and purpose of planning - Planning process - Types of plans – Objectives - - Managing by objective (MBO) strategies - Types of strategies - Policies - Decision making - Types of decision - Decision making process - Rational decision-making process - Decision making under different conditions.	8
Unit 3:	**Function of Organizing:** Nature and purpose of organizing - Organization structure - Formal and informal groups organization - Line and Staff authority - Departmentation - Span of control - Centralization and decentralization - Delegation of authority - Staffing – Human resource development, Selection and recruitment - Orientation - Career development - Career stages – Training - -Performance appraisal.	8
Unit 4:	**Function of Directing:** Creativity and Innovation - Motivation and satisfaction - Motivation theories - Leadership styles - Leadership theories - Communication - Barriers to effective communication - Organization culture - Elements and types of culture - Managing cultural diversity.	8
Unit 5:	**Function of Controlling:** Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing productivity - Cost control - Purchase control - Maintenance control - Quality control - Planning operations.	8

Total Hours	**42**

	Textbooks
1.	L. M. Prasad, "***Priciples and Practice of Management***", S. Chand & Sons, 3rd edition, 2008.
2.	P. C. Tripathi and P. N. Reddy, "***Principles of Management***", Tata Mcgraw Hill, 4th edition, 2008.
	Reference Books
3.	Heinz Weihrich, Mark V. Cannice and Harold Koontz, "***Management: A Global Perspective***", Tata Mcgraw Hill, 12/e, 2009.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	Disaster Management		***Code***	TEC 731
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Engineering Science Course (ESC)		02		2	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic knowledge of History and Geography						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Describe** the concepts of disasters and its types.
CO 2	**Explain** the relationship between disasters and development.
CO 3	**Apply** the approaches of Disaster Risk Reduction (DRR) and the relationship between vulnerability, disasters, disaster prevention and risk reduction.
CO 4	**Discuss** disasters around the world and the unequal social consequences stemming from disaster events.
CO 5	**Build** skills to respond to disasters.
CO 6	**Understand** the strengths and weaknesses of disaster management approaches through case studies.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction, Definitions and Classification:** **Concepts and Definitions:** Disaster, Hazard, Vulnerability, Resilience, Risks Natural disasters: Cloud bursts, Earthquakes, Tsunami, snow, Avalanches, landslides, Forest fires, Diversion of river routes (ex. Kosi river), Floods, Drought, Cyclones, Volcanic hazards/ disasters (Mud volcanoes): Causes and distribution, Hazardous effects and environmental impacts of natural disasters, Mitigation measures, Natural disaster prone areas in India, Major natural disasters in India with special reference to Uttarakhand. **Man-Induced Disasters:** Water logging, Subsidence, Ground water depletion, Soil Erosion, Release of toxic gases and hazardous chemicals into environment, Nuclear explosions	10
Unit 2:	**Inter-Relationship between Disasters and Development:** Factors affecting vulnerabilities, Differential impacts, Impacts of development projects such as dams, Embankments, Changes in land use etc., Climate change adaption, Relevance of indigenous knowledge, Appropriate technology and local resources, Sustainable development and its role in disaster mitigation, Roles and responsibilities of — community, Panchayat raj institutions/urban local bodies, State, Centre and other stake holders in disaster mitigation.	6
Unit 3:	**Disaster Management (Pre-disaster stage, Emergency stage and Post disaster stage):** Pre-disaster stage (preparedness): Preparing hazard zonation maps, Predictability/forecasting and warning, Preparing disaster preparedness plans, Land use zoning, Preparedness through information, Education and communication (IEC), Disaster resistant house construction, Population reduction in vulnerable areas, Awareness.	8

	Emergency stage: Rescue training for search & operation at national & regional level, Immediate relief, Assessment surveys Post Disaster stage-Rehabilitation and reconstruction of disaster affected areas; Urban disaster mitigation: Political and administrative aspects, Social aspects, Economic aspects, Environmental aspects.	
Unit 4:	**Disaster Management Laws and Policies in India:** Environmental legislations related to disaster management in India: Disaster management Act, 2005; Environmental policies & programmes in India-Institutions & national centres for natural disaster mitigation: National Disaster Management Authority (NDMA): Structure and functional responsibilities, National Disaster Response Force (NDRF): Role and responsibilities, National Institute of Disaster Management (NIDM): Role and responsibilities.	6
Unit 5:	**Case studies: Natural and Man-Made Disasters in India:** **A. Natural Disasters in India with Special Reference to Uttarakhand: (4 lectures)** 1. Earthquakes: Uttarkashi (1991), Kutch (2001), Sikkim (2011) 2. Cloud Bursts: Uttarkashi (2012) 3. Landslides along Himalayan and other regions: Malpa (Pithoragarh) (1998), Varunavrat hill landslide at Uttarkashi (2003) 4. Floods: Orissa floods (2011) 5. Tsunami: Indian Ocean earthquake and Tsunami (2004) 6. Cyclones: Thane (2011) 7. Droughts: Karnataka (2011) 8. Snow avalanche **B. Man-Induced Disasters in India:** 1. Forest fires: Forest fires in Uttarakhand, 2004, 2012 and deforestation 2. Industrial disasters: Bhopal gas tragedy, 1984 3. Mining: Chasnala (Bihar) mining disaster, 1975 4. Oil spills: Mumbai oil spill, 2010. 5. Nuclear disaster accidents: Narora atomic power station, Blandshahar (1993); Kalpakkam atomic power station (2002); Kota atomic power station, Rajasthan (1995) **C. Disasters Relevant to the Area Specific to the Discipline of the Students.** Mock shows: Mock shows will be organized and conducted by expert agencies for understanding the vulnerability of areas in and around campus along with adopting the preventive measures.	10
Total Hours		**40**

Textbooks and Reference Books	
1.	K.J. Anandha Kumar, Ajinder Walia, Shekher Chaturvedi, ***"India Disaster Report"***, 2011, National Institute of Disaster Management, June 2012.
2.	R.B.Singh (Ed), ***"Environmental Geography"***, Heritage Publishers New Delhi, 1990.
3.	Savinder Singh, ***"Environmental Geography"***, Prayag Pustak Bhawan, 1997.
4.	Kates,B.I & White, G.F, ***"The Environment as Hazards"***, oxford, New York, 1978.
5.	R.B. Singh (Ed), ***"Disaster Management"***, Rawat Publication, New Delhi, 2000.
6.	R.B. Singh, ***"Space Technology for Disaster Mitigation in India (1NCED)"***, University of Tokyo, 1994.

7.	Dr. Satender, ***"Disaster Management in Hills"***, Concept Publishing Co., New Delhi, 2000.
8.	H.K. Gupta (Ed), ***"Disaster Management"***, Universities Press, India, 2003.
9.	A.S. Arya Action Plan for Earthquake, Disaster, Mitigation in V.K. Sharma (Ed), ***"Disaster Management"*** IIPA Publication New Delhi, 1994.
10.	R.K. Bhandani, ***"An overview on Natural & Manmade Disaster & their Reduction"***, CSIR, New Delhi.
11.	M.C. Gupta, ***"Manuals on Natural Disaster management in India, National Centre for Disaster Management"***, IIPA, New Delhi, 2001.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Control Systems		***Code***	TEC 552
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (I)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electrical Engineering, Network Analysis and Synthesis						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Remember** basic concepts of network systems, Laplace transform to understand mathematical modeling of physical system.
CO 2	**Understand** the concepts of time domain analysis of first and second order systems.
CO 3	**Apply** open and close loop pole zero concepts for stability of a system by various analytical and graphical frequency response techniques.
CO 4	**Analyse** the system performance different compensation techniques.
CO 5	**Evaluate** controllability and observability by state space approach concepts.
CO 6	**Formulate** a system model for a given set of desired specification.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction:** Introduction to open loop and closed loop control systems, Feedback characteristics of control systems, Mathematical representation of physical systems, Control hardware and their models: dc and ac servomotors, Electrical and mechanical analogy, Block diagram algebra and signal flow graphs, Mason's gain formula.	8
Unit 2:	**Time Domain Analysis:** Standard test signals, Time response of first and second systems, Performance indices. Error analysis: Static and dynamic Error coefficients, Effect of adding poles and zeroes to the system, Response of P, PI, and PID controllers.	8
Unit 3:	**Concept of Stability:** Concept of stability, Asymptotic and conditional stability, Routh Hurwitz criterion, Root locus technique (Concept and construction). **Frequency Response Analysis:** Correlation between time and frequency response, Polar and inverse polar plots, Nyquist stability criterion, Bode plots, M and N circle.	10
Unit 4:	**Design through Compensation Techniques:** Realization of lag, lead and lag-lead compensators, Design of closed loop control system using root locus and Bode plot compensation.	8
Unit 5:	**State Variable Analysis:** Introduction, State space representation, State modes of linear systems, State equations, Transfer matrices, Diagonalization solution of state equations, Controllability, and observability. Introduction to non-linear systems.	8
Total Hours		**42**

Textbooks

1.	Nagrath I. J. & Gopal M., "***Control System Engineering***", New Age International Publishers, 5th Edition, 2007.
2.	Manke. B. S., "***Linear control systems***", Khanna Publishers, 11th Edition, 2012.
	Reference Books
3.	Kuo B. C., "***Automatic Control Systems***", PHI, 7th Edition, 2010.
4.	Ogata K., "***Modern Control Engineering***", PHI, 5th Edition, 2010.
5.	Nise S. Norman., "***Control Systems Engineering***" Wiley India Pvt. Ltd., 5th Edition, 2009.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Electromagnetic Interference and Compatibility		***Code***	TEC 553
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (I)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Electromagnetic Field Theory						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** the concepts of electromagnetic interference.
CO 2	**Analyse** the measurement techniques of electromagnetic interference.
CO 3	**Differentiate** among various EMC standards.
CO 4	**Examine** EMI control and filtering.
CO 5	**Investigate** EMC design and interconnection.
CO 6	**Design** and **develop** different EMC techniques.

Unit No.	***Content***	***Hours***
Unit 1:	**Basic Concept:** Definition of EMI and EMC, Classification of EMI/EMC - CE, RE, CS, RS, Units of parameters, Sources of EMI, EMI coupling modes - CM and DM, ESD phenomena and effects, Transient phenomena and suppression.	8
Unit 2:	**EMI Measurement**: Basic principles of RE, CE, RS and CS measurements, EMI measuring instruments- Antennas, LISN, Feed through capacitor, Current probe, EMC Analyzer and detection Technique open area site, Shielded anechoic chamber, TEM cell.	8
Unit 3:	**EMC Standard and Regularization:** National and intentional standardizing organizations, FCC, CISPR, ANSI, DOD, IEC, CENEEC, FCC CE And RE standards, CISPR, CE and RE standards, IEC/EN, CS standards, Frequency assignment - Spectrum conversation.	8
Unit 4:	**EMI Control and Method Fixes:** Shielding, Grounding, Bonding, Filtering, EMI gasket, Isolation transformer, Opto-isolator.	8
Unit 5:	**EMC Design and Interconnection Technique:** Cable routing and connection, Component selection and mounting, PCB Design- Trace routing, Impedance control, Decoupling, Zoning and grounding	8
Total Hours		**40**

Textbooks	
1.	H. W. Ott, "***Electromagnetic Compatibility Engineering***", Wiley, 1st edition, 2009.
2.	C. R. Paul, "***Introduction to Electromagnetic compatibility***" Wiley, 2nd edition, 2010.
Reference Books	

3.	D. G. Baker, "***Electromagnetic Compatibility: Analysis and Case Studies in Transportation***", Wiley, 1st edition, 2017.
4.	D. A. Weston, "***Electromagnetic Compatibility: Principles and Applications***", Marcel Dekker Inc, 1st edition, 1991.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	High Speed Communication Circuits		***Code***	TEC 554
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (I)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Electronics Devices and Circuits, Analog Integrated Circuits, and Communication Systems I						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Identify** the concepts of RF design and different communication transceiver modules.
CO 2	**Understand** LNA and mixer implementation.
CO 3	**Discuss** power amplifiers and efficiency of power amplifiers.
CO 4	**Implement** circuits for phase locked loop.
CO 5	**Analyse** the application of frequency synthesizers.
CO 6	**Design** various high-speed communication systems for wireless applications.

Unit No.	***Content***	***Hours***
Unit 1:	**Noise in Communication Subsystems:** Internal and external noise, Noise in resistors, Noise sources in a CMOS amplifier, Broadband amplifier design Considerations for noise, Narrowband amplifier Noise requirements, Cascaded amplifiers noise performance.	8
Unit 2:	**LNA Design:** LNA topologies, LNA noise factor and noise figure, Narrowband LNA Design for wireless systems, Direct input termination of CS Amplifier, Noise Factor analysis of CS amplifier, Noise factor Analysis of CG amplifier, Inductor degenerated CS amplifier, Derive noise factor for inductor degenerated amplifier.	10
Unit 3:	**Power Amplifiers:** Resistor loaded class A amplifier, Class A RF power amplifier, Class B power amplifier, Push-Pull amplifier, Class C amplifier, Class D power amplifier, Class D Push-Pull power amplifier, Class B vs. D Push-Pull amplifier waveforms.	10
Unit 4:	**VCO and Mixers:** Voltage Controlled Oscillators (VCO's), Model for voltage to frequency mapping of VCO, Model for voltage to phase mapping of VCO, frequency domain model of VCO, Recently popular approach – The MOS varactor, Method to increase Q of MOS varactor, Boosted VCO, Very high frequency VCO, Mixer design for wireless systems, Ideal mixer behaviour, Issue of image aliasing.	8
Unit 5:	**Overview of Phase-Locked Loops and Integer-N Frequency Synthesizers:** Phase-locked loop, Method of phase detection, Impact of changes in phase error, Integer-N frequency synthesizer, Integer-N frequency synthesizers in wireless systems, Key limitation of integer-N synthesizers, Fractional-N frequency synthesis, Classical fractional-N synthesizer architecture, Accumulator operation, Phase interpolation technique.	10

Total Hours	46

	Textbooks
1.	J. Smith, "***Modern Communication Circuits***", McGraw – Hill, 2nd Edition, 1997
2.	Lee, Thomas H. "***The Design of CMOS Radio-Frequency Integrated Circuits****"*, Cambridge, UK: Cambridge University Press, 1997.
	Reference Books
3.	T. H. Lee, "***The Design of CMOS Radio – Frequency Integrated Circuits***" 2nd Edition, Cambridge 2004.
4.	J. S. Beasley & G. M. Miller, "***Modern Electronic Communication***" 9th Edition, Pearson. 2004
5.	T.L. Floyd, "***Electronic Devices***", 7th Edition, Pearson, 2007.
6.	Razavi, Behzad, **"*RF Microelectronics",*** Upper Saddle River, NJ: Prentice Hall, 1997.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Fifth	***Subject Title***	Probability and Stochastic Processes		***Code***	TEC 555
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (I)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Engineering Mathematics						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Demonstrate** an understanding of the basic concepts of random variable & random processes.
CO 2	**Describe** random vectors and their characterization.
CO 3	**Analyse** the operation of two random variables.
CO 4	**Analyse** the stochastic processes with the help of probability models and their characterization.
CO 5	**Evaluate** the spectral characteristics of random process.
CO 6	**Determine** the PDF and CDF for different models.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Theory of Probability:** Axioms of probability, Review of set theory, Joint & conditional probability, Independent events, Combined experiments.	6
Unit 2:	**Random Variables and Random Vectors:** Distributions and densities. Some useful probability distributions (Uniform, Gaussian, Exponential, Gamma, Rayleigh, Rician, Binomial, Poisson), Conditional distribution & density function, Functions of one RV, Statistical independence. Operations on one random variable - Expectations, Moments, Chebycheff inequality, Characteristic functions and moment generating functions.	10
Unit 3:	**Functions of Two Random Variables:** Operation on two random variables, Correlation, Covariance, Vector space of random variables, Multiple random variables, Operation on multiple random variables, Central limit theorem, Infinite sequences of random variables. Convergence concepts. Laws of large numbers, Tchebycheff inequality and estimation of unknown parameters.	10
Unit 4:	**Stochastic Processes:** Stationarity& independence, Stationarity in the strict and wide senses, Ergodicity, Widesense stationary processes. Correlation functions & their properties, Gaussian random process, Covariance functions and their properties, Measurement of correlation functions.	10
Unit 5:	**Spectral characteristic of random process:** Power spectral density &their properties, Relation between PSD & autocorrelation function, Wiener-Khintchine relations, Cross power spectrum density and its properties.	6
Total Hours		**42**

	Textbooks
1.	Peyton Z. Peebles, Probability, random variable, and random signal principle, 4th Edition, McGraw-Hill, 2001.
2.	Athanasios Papoulis, S. Unnikrishna Pillai, ***"Probability, Random Variables and Stochastic Processes***", 4th Edition, McGraw-Hill, 2002.
	Reference Books
3.	R.B. Ash &C. Doleans Dade, ***"Probability and Measure Theory"*** (2/e), Elsevier, 2005.
4.	E. Wong & B. Hajek, ***"Stochastic Processes in Engineering systems"***, Springer, 1985.
5.	R.B. Ash and W.A. Gardner, ***"Topics in stochastic processes"***, Academic Press, 1975.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	Data Communication Networks		***Code***	TEC 651
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (II)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Systems II						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Remember** data communication and networks with an overview of OSI and TCP/IP network models and different protocols associated.
CO 2	**Understand** data transmission over physical layer.
CO 3	**Explain** various data link layer design issues and services.
CO 4	**Classify** different Multiple Access protocols and IEEE standards applied for medium access.
CO 5	**Analyse** Network Layer design issues and evaluate transport layer services.
CO 6	**Learn** and **integrate** the functions of presentation, session and application layer.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Data Communication:** Goals and Applications of Networks, LAN, MAN, WAN, Wireless network, Protocols and standards. Reference model: OSI, TCP/IP. Basics of physical layer, Digital transmission, Circuit and packet switching.	6
Unit 2:	**Data Link Layer:** Data link layer design issues, Services provided to network layers, Framing, Error control, Flow control, Error detection and correction, Elementary data link protocols, an unrestricted simplex protocol, A simplex stop-and-wait protocol, Simplex protocol for a noisy channel, Sliding window protocols, A protocol using go-back-N, A protocol using selective repeat, Example data link protocol-HDLC and PPP.	8
Unit 3:	**Medium Access Sub layer:** Channel allocations, Static and dynamic allocation in LAN, Multiple access protocols, ALOHA, Carrier sense multiple access protocols, Collision free protocols, Limited contention protocols, Ethernet, IEEE standard and protocols.	8
Unit 4:	**Network and Transport Layer:** Network layer design issues, Concept of virtual circuit and datagram subnet, Routing algorithms, Internetworking, IP protocol and addressing. Transport services, Design issues, Elements of transport protocols, Simple transport protocols, Connection management, UDP, TCP, Congestion control and quality of service.	12
Unit 5:	**Presentation and Application Layer & Security:** **Presentation Layer:** Design issues, Data compression techniques, Cryptography. Application layer: Domain name system (DNS), File transfer (FTP), Access and management, Electronic mail (SMTP), Virtual terminals. **Network Security:** Security services, Message confidentiality, Integrity and authentication.	8

Total Hours	42

	Textbooks
1.	Andrew S. Tanenbaum and David J. Wetherall, "***Computer Networks***", Prentice Hall, 5th edition, 2011.
2.	Behrouz A. Forouzan, "***Data Communications and Networking***", McGraw-Hill, 4th edition, 2007.
	Reference Books
3.	James F. Kurose, Keith W. Ross, "***Computer Networking: A Top-Down Approach***", Pearson, 6th edition, 2013.
4.	William Stallings, "***Data and Computer Communication***", Pearson Education, 8th edition, 2007.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	Digital VLSI Circuit Design		***Code***	TEC 652
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (II)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electronics Engineering and Digital Electronics						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Describe** the basic MOS structure and layout design.
CO 2	**Understand** the static and dynamic characteristics of MOS inverters.
CO 3	**Apply** the MOS concepts to design combinational and sequential MOS logic circuits.
CO 4	**Analyse** different digital MOS logic circuits.
CO 5	**Estimate** power consumption of CMOS logic circuits.
CO 6	**Integrate** various concepts of digital VLSI circuit design and apply them in **designing** of MOS based digital circuits.

Unit No.	***Content***	***Hours***
Unit 1:	**Review of MOS Technology:** MOS structure, MOS under external bias, MOSFET, Scaling of MOS circuits, Small geometry effects, MOSFET capacitances. MOS circuit design processes: MOS layers, Design rule: Stick diagram and layout.	10
Unit 2:	**MOS Inverters:** Static characteristics: Introduction, Resistive-load inverter, Inverters with N-Type MOSFET load, CMOS inverter. Switching characteristics and interconnect effects: Introduction, Delay –time, Inverter design with delay constraints, Estimation of interconnect parasitic, Calculation of interconnect delay, Switching power dissipation of CMOS inverters.	10
Unit 3:	**MOS Logic Circuits:** Combinational MOS logic circuits: MOS logic circuit with depletion NMOS loads, CMOS logic circuits, Complex logic circuits, CMOS transmission gates. Sequential MOS logic circuits: Behaviour of bistable elements, SR latch, Clocked latch and Flip-flop, CMOS D latch and Flip-flop.	10
Unit 4:	**Dynamic Logic Circuits:** Basic principles of pass transistor circuits, Voltage bootstrapping, Synchronous dynamic circuit techniques, Dynamic CMOS circuit, High performance dynamic CMOS circuits.	6
Unit 5:	**Low Power CMOS Logic Circuits:** Overview of power consumption, Low power design through voltage scaling, Estimation and optimization of switching activity, Reduction of switched capacitance, Adiabatic logic circuits.	6
Total Hours		**42**

Textbooks	
1.	S. Kang and Y. Leblebici, "***CMOS Digital Integrated Circuits, Analysis and Design***", Tata McGraw-Hill, 3rd Edition, 2003.

2.	J. M. Rabaey, A. Chandrakasan and B. Nikolic, "***Digital Integrated Circuits: A Design Perspective***", Prentice-Hall of India, 2nd Edition, 2006.
	Reference Books
3.	D. A. Pucknell and K. Eshraghian, "***Basic VLSI Design***", Prentice-Hall of India, 3rd Edition, 1994.
4.	K. Eshraghian, D. A. Pucknell and S. Eshraghian, "***Essentials of VLSI Circuit and System***", Prentice-Hall of India, 2nd edition, 2005.
5.	N. H. E. Weste et. al., "***CMOS VLSI Design***", Pearson, 3rd edition, 2005.
6.	R. Jacob Baker, "***CMOS: circuit design, layout, and simulation***", John Wiley & Sons, 3rd edition, 2010.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	Semiconductor Materials and Devices		***Code***	TEC 653
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (II)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electronics Engineering, Electronic Devices and Circuits						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Create** basic understanding of semiconductor device physics.
CO 2	**Evaluate** the two terminal MOS structure in terms of its electrical parameters.
CO 3	**Analyse** the three terminal MOS structure in terms of electrical potential and charge.
CO 4	**Apply** surface potential and charges in different regions of MOSFET operation.
CO 5	**Understand** the short channel and narrow channel effects.
CO 6	**Implement** the concepts of semiconductor device physics in developing real life applications.

Unit No.	***Content***	***Hours***
Unit 1:	**Basics of Semiconductors:** Semiconductor materials, Energy levels, Intrinsic and extrinsic semiconductor, Equilibrium in absence/presence of electric field.	8
Unit 2:	**PN Junction Diode:** Junction diode: p-n junction, Tunnel diode, Quasi-Fermi levels, Depletion width capacitance and its application in doping profile determination, I-V characteristics of narrow and wide base diodes and their equivalent circuits, Breakdown mechanisms, Small signal ac impedance.	8
Unit 3:	**Two Terminal MOS Structure:** Flat band voltage, Potential balance and charge balance, Effect of gate body voltage on surface condition, Accumulation, Depletion, Inversion, General analysis, Small signal capacitance.	10
Unit 4:	**Three Terminal MOS Structure:** Contacting the inversion layer, Body effect, Different regions of operation, Pinch-off voltage.	10
Unit 5:	**Four Terminal MOS Structure:** Transistors regions of operation, Complete all-region model, Simplified all-region model, Models based on quasi fermi potential, Regions of inversion in terms of terminal voltage, Temperature effects, Breakdown, Enhancement mode, Depletion mode transistors.	6
Total Hours		**42**

Textbooks	
5.	Tsividis, Yannis, and Colin McAndrew, "***Operation and Modelling of the MOS Transistor***", Oxford: Oxford university press, Vol. 2, 2003.
6.	S. Kang and Y. Leblebici, "***CMOS Digital Integrated Circuits, Analysis and Design***", 3rd Edition, Tata McGraw-Hill, 2003.

Reference Books	
7.	Robert L. Boylestad and Louis Nashelsky, "***Electronic Devices and Circuit Theory***", 9th Edition, Prentice Hall of India (PHI), 2006.
8.	Ben g. Streetman and Sanjay Kumar Banerjee, "***Solid State Electronic Devices***", 6th Edition, Prentice Hall of India (PHI), 2013.
9.	Takayasu Sakurai, Akira Matsuwawa and Takakuni Douseki, "***Fully-Depleted SOI CMOS Circuits and Technology for Ultralow power applications***", Springer, 2006.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Sixth	***Subject Title***	Digital Video Processing		***Code***	TEC 654
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (II)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Digital Signal Processing						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Recall** the concept of colour video system.
CO 2	**Understand** motion estimation technique and various block matching algorithm.
CO 3	**Analyse** various video coding schemes.
CO 4	**Apply** content dependent video coding.
CO 5	**Assess** the object-based video coding.
CO 6	**Understand** video compression standards.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Video Processing**: Principles of color video system, Video display, Composite versus component video, Progressive and interlaced scan, Sampling of video signals, DVI technology.	8
Unit 2:	**Motion Estimation Techniques**: General methodologies, Pixel based motion estimation, Block matching algorithm, Deformable block matching algorithm, Mesh based motion estimation, Global motion estimation, Region based motion estimation, Multi-resolution motion estimation, and feature based motion estimation.	8
Unit 3:	**Basic of Video Coding**: Categorization of video coding schemes, Information theory for source coding, Binary encoding, Scalar quantization, Vector quantization, Wave form-based coding, Block-based transform coding, Predictive coding, Temporal prediction and transform coding.	8
Unit 4:	**Content dependent Video Coding**: Two-dimensional shape coding, Texture coding for arbitrarily shaped region, Joint shape and texture coding, Region based video coding.	8
Unit 5:	**Object based Video Coding:** Knowledge based video coding, Semantic video coding, Layered coding system **Video Compression Standard:** Standards, H.261 family of standards.	8
Total Hours		**40**

Textbooks

1. Y. Wang, J. Ostermann, and Y.Q.Zhang, "***Video Processing and Communications***", Prentice Hall, 1st Edition,2001.
2. Ed. Al Bovik, "***Handbook of Image and Video Processing***", Academic Press, 2nd Edition, 2000.

Reference Books

3.	A. M. Tekalp, "***Digital video Processing***", Prentice Hall, 2nd Edition, 2001.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	Optical Fiber Communications		***Code***	TEC 751
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (III)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Systems I, Communication Systems II, and Microwave Engineering						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Remember** the concepts of light and understanding of different types of optical waveguides and propagation mechanisms.
CO 2	**Understand** attenuation, losses, and polarization for different types of optical fiber.
CO 3	**Apply** the concepts of optics to analyze different optical transmitter sources.
CO 4	**Analyse** the genesis of optical detectors with noise considerations.
CO 5	**Evaluate** the optical fiber systems in terms of modulation, demodulation, multiplexing, and optical networking.
CO 6	**Apply** the concepts of optical communication to design optical networks.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction:** The general system, Advantages of optical fiber communication. **Optical Fiber Waveguides:** Ray theory transmission; Total internal reflection, Acceptance angle, Numerical aperture, Skew rays. Mode theory for optical propagation; Modes in planar guide, Phase and group velocity. Cylindrical fiber; Modes, Step indexed fiber, Graded index fiber. Single mode fibers; Cutoff wavelength, Mode-field diameter and spot size, Effective refractive index, Group delay and mode delay factor.	10
Unit 2:	**Attenuation in Optical Fibers:** Material absorption losses; Intrinsic and extrinsic absorption. Linear and non-linear scattering losses. Fibers bend loss. Dispersion; Intramodal and intermodal dispersion, Modal noise. Polarization; Modal birefringence, Polarization maintaining fibers.	8
Unit 3:	**Optical Sources:** Basic Concept; Absorption and emission of radiation, Population inversion, Optical feedback and laser oscillation, Threshold condition for laser oscillation. Optical emission from semiconductor; The PN junction, Spontaneous emission, Carrier recombination, Stimulated emission and lasing, Heterojunctions, Semiconductor materials. The Semiconductor injection laser, Injection laser characteristics. LED power and efficiency, The double heterojunction LED, LED structures and characteristics.	10
Unit 4:	**Optical Detectors:** Optical detection principles, Absorption, Quantum efficiency, Responsivity, Long wavelength cutoff, Semiconductor photodiode without internal gain; P-N Photodiode and P-I-N Photodiode, Semiconductor photodiode with internal gain; Avalanche photodiode, Benefits and drawbacks of avalanche	6

	photodiode. Phototransistors & photoconductive detectors, Receiver performance considerations.	
Unit 5:	**Optical Fiber Systems:** Modulation format; Amplitude shift keying, Frequency shift keying, Phase shift keying, Polarization shift keying. Demodulation schemes; Heterodyne synchronous detection, Heterodyne nonsynchronous Detection, Homodyne Detection, Phase diversity reception. Advanced multiplexing strategies; Optical Time Division Multiplexing (OTDM), Wavelength Division Multiplexing (WDM). **Introduction to Optical Network:** Optical network concepts, Network topologies; Bus, Ring, Star and mesh, Local Area Network (LAN), Synchronous Optical Network (SONET), Synchronous Digital Hierarchy (SDH).	8
Total Hours		**42**

	Textbooks
1.	John M S Senior, "***Optical Fiber Communication***", PHI, 3rd Ed, 2009.
	Reference Books
2.	Joseph C Palais, "***Fiber Optic Communications***", 5th Ed., 2005.
3.	G E Keiser, "***Optical Fiber Communication***", McGraw-Hill, 5th Ed, 2013.
4.	Govind P Agrawal, "***Fiber-Optic Communication Systems***", Wiley, 3rd Ed, 2015.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	ASIC Design and FPGA		***Code***	TEC 752
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (III)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: VLSI Technology and Design						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Describe** the concepts of ASICs, CMOS logic and ASIC library design.
CO 2	**Understand** different optimization techniques and their relative interaction of FPGA implementation.
CO 3	**Apply** the concepts of ASIC and FPGA interconnection in designing various electronic circuits.
CO 4	**Analyse** CMOS based Application Specific Integrated Circuit (ASIC) systems design.
CO 5	**Evaluate** ASIC family using Xilinx tool to optimize the device performance.
CO 6	**Design** SOC based integrated circuits for various FPGA applications.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction**: Introduction to ASICs, CMOS logic and ASIC library design, Types of ASICs, Design flow, CMOS transistors CMOS design rules, Combinational logic cell, Sequential logic cell, Data path logic cell, Transistors as resistors, Transistor parasitic capacitance, Logical effort, Library cell design, Library architecture. Review of VHDL/Verilog: Entities and architectures.	10
Unit 2:	**ASIC and FPGA Families:** Programmable asics, Programmable ASIC logic cells and programmable ASIC I/O cells anti fuse, Static RAM, EPROM and EEPROM technology, PREP benchmarks, ACTEL ACT, Xilinx LCA Altera FLEX, Altera MAX DC & AC inputs and outputs, Clock & power inputs, Xilinx I/O blocks.	8
Unit 3:	**ASIC and FPGA Interconnect:** ASIC design software and low-level design entry, ACTEL ACT, Xilinx LCA, Xilinx EPLD, Altera MAX 5000 and 7000, Altera MAX 9000, Altera FLEX, Design systems, Logic synthesis, Half gate ASIC, Schematic entry, Low level design language, PLA tools, EDIF, CFI design representation.	10
Unit 4:	**FPGA Implementation:** FPGA partitioning, partitioning methods, Floor planning, Placement, Physical design flow, Global routing, Detailed routing, Special routing, Circuit extraction, DRC.	8
Unit 5:	**FPGA Applications:** Design using Xilinx family, FPGA and advance Silicon on Chip (SOC) class FPGA, SOC design flow, Platform-based and IP based SOC designs, Basic concepts of bus-based communication architectures.	6
Total Hours		**42**

Textbooks

1.	M.J.S .Smith, "***Application - Specific Integrated Circuits***", Addison –Wesley Longman Inc., 1st Edition, 2002.
2.	Skahill, Kevin, "***VHDL for Programmable Logic***", Pearson Education", 1st Edition, 2006.
	Reference Books
3.	John F. Wakherly, "***Digital Design: Principles and Practices***", Prentice Hall, 4th Edition, 2008.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	Radar and Navigation Aids		***Code***	TEC 753
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (III)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Microwave Engineering						

Course Outcomes

Upon completion of this course, the students will be able to	
CO 1	**Understand** the concept Radar and its application.
CO 2	**Analyse** MTI and Pulsed Doppler radar.
CO 3	**Investigate** detection of signal and noise in it.
CO 4	**Understand** the concepts of navigation.
CO 5	**Formulate** Doppler navigation system and its accuracy.
CO 6	**Design** various radar and navigation-based systems.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Radar Basics:** The simple form of the radar Equation, Radar block diagram, Radar frequencies, Applications of radar, Detection of signals in noise, Receiver noise and the signal-to-noise ratio, Probability density functions, Probabilities of detection and false alarm, Integration of radar pulses, Radar cross section of targets, Radar cross section fluctuations, Transmitter power, Pulse repetition frequency, Antenna parameters, System losses.	8
Unit 2:	**MTI and Pulse Doppler Radar:** Introduction to doppler and mti radar, Delay line cancelers, Staggered pulse repetition frequencies, Moving target detector, Limitations to MTI performance, Pulse doppler radar, Doppler filters, Tracking with radar, Monopulse tracking, Conical scan, Sequential lobing, Tracking in range.	9
Unit 3:	**Radar Transmission and Detection of Signals in Noise:** Radar transmitters, Linear beam power tubes, Solid state RF power sources, Magnetron, Crossed field amplifiers. The radar receiver, Receiver noise figure, Super heterodyne receiver, Duplexers and receiver protectors, Matched filter receiver, Detection criteria, Detectors, Automatic detector, Constant false alarm rate receivers, Propagation of waves, atmospheric refraction, Standard propagation, Nonstandard propagation, Radar clutter, land and sea clutter, Detection of target in precipitation, The Radar antenna, Reflector antennas, Electronically steered phased array antennas, Phase shifters, Frequency-scan Arrays.	8
Unit 4:	**Introduction to Navigation:** Radio direction finding, The Loop antenna, Loop Input/output circuits, An aural null direction finder, The goniometer, Errors in direction finding, Adcock direction finder, Automatic direction finders, The Commutated aerial direction finder, Range and accuracy of direction finders, The LF/MF four course radio range, VHF Omni Directional Range Finder (VOR), VOR receive ring equipment, Range and accuracy of VOR.	8

Unit 5:	**Distance Measuring Equipment (DME) and Tactical Air Navigation (TACAN):** Operation of DME and TACAN, Instrument landing system, Ground controlled approach system, Microwave Landing System(MLS), Doppler navigation, Beam configurations, Track stabilization, Doppler spectrum, Components of the doppler navigation system, Accuracy of doppler navigation systems, Inertial navigation, Principles of operation, Navigation over the earth, Components of an inertial navigation system, Earth coordinate mechanization, Strapped-down systems, Accuracy of inertial navigation systems, Global Positioning System (GPS).	9
Total Hours		**42**

Textbooks	
1.	M. I. Skolnik, "***Introduction to Radar Systems***", Tata McGraw-Hill, 3rd edition, 2017.
2.	N. S. Nagaraja, "***Elements of Electronics Navigation***", Tata McGraw-Hill, 2nd Edition, 2017.
Reference Books	
3.	P. Z. Peebles, "***Radar Principles***", Wile, 1st edition, 2007.
4.	J.C Toomay, "***Principles of Radar***", PHI 2nd edition, 2004.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	Organic Electronics Devices and Circuits		***Code***	TEC 754
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (III)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Electronics Engineering, Electronics Devices and Circuits.						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Remember** the basics and limitations of conventional silicon-based semiconductor devices.
CO 2	**Understand** the basic concepts and classification of organic materials.
CO 3	**Apply** the basic concepts of charge transport in organic materials for different organic electronic devices.
CO 4	**Analyse** the different properties of OLED.
CO 5	**Evaluate** the performance of organic solar cells.
CO 6	**Design** and **develop** innovative organic electronic devices.

Unit No.	***Content***	***Hours***
Unit 1:	**Organic Materials and Device Physics:** Introduction; Organic materials: Conducting polymers and small molecules, Organic semiconductors: p-type and n-type semiconductors, Source, Drain and Gate electrodes, Gate dielectrics, Substrate. Energy band diagram and concept of charge transport in organic semiconductors; Comparison between organic and inorganic semiconductors including the merits, Demerits and limitations.	9
Unit 2:	**Organic Thin Film Transistors (OTFTs):** Introduction; Operating principle; Output and transfer characteristics; Classification of various organic thin film transistors (OTFT) structures; Performance parameters; Impact of structural parameters on behaviour of OTFT; Concept of contact resistance; Single Gate (SG) and Dual Gate (DG) TFT performance comparison; Merits, Demerits, Limitations and future scope. Applications: - Organic complementary inverter circuits; Organic memory - Organic static random-access memory (OSRAM).	10
Unit 3:	**Organic Light Emitting Diodes (OLEDs)** Introduction; Organic materials for OLEDs; Classification of OLEDs, Operating principle; Output and transfer characteristics; Analysis of OLED performance: Optical, Electrical and thermal properties, Merits and demerits; Stability issues; OLEDs as display applications.	8
Unit 4:	**Organic Solar Cell:** Introduction; Operating principle; Characteristics; Materials for organic solar cells; Classification of organic solar cell- Single layer, Bi-layer and bulk hetero junction organic solar cell; Merits and demerits; Applications and future scope.	7
Unit 5:	**Organic Sensors:** Introduction; Working principle and organic sensing materials for pressure sensors (Piezoresistive, Piezoelectric, and Capacitive sensor), Temperature	8

	sensors, Humidity sensors and pH sensor; comparison between organic and conventional sensors including merits, demerits and limitations; Applications of organic sensors; Basics of ionic polymer–metal composites (IPMC) and its applications.	
Total Hours		**42**

	Textbooks
1.	Hagen Klauk, "***Organic Electronics: Materials, Manufacturing and Applications***", Wiley-VCH Verlag Gmbh & Co. KGaA, Germany, 1st edition, 2006.
2.	Klaus Mullen, Ullrich Scherf, "***Organic Light Emitting Devices: Synthesis, Properties and Applications***", Wiley-VCH Verlag Gmbh & Co. KGaA, Germany, 1st edition, 2005.
3.	Johannes Karl Fink, "***Polymeric Sensors and Actuators***", John Wiley & Sons, 1st edition, 2012.
	Reference Books
4.	Hagen Klauk, "Organic Electronics II: More Materials and Applications", Wiley-VCH VerlagGmbh& Co. KGaA, Weinheim, Germany, 1st edition, 2012
5.	Flora Li, Arokia Nathan, Yiliang Wu, Beng S. Ong, "***Organic Thin Film Transistor Integration: A Hybrid Approach***", Wiley-VCH, Germany; 1st edition, 2011.
6.	Wolfgang Brutting, "***Physics of Organic Semiconductors***", Wiley-VCH Verlag Gmbh & Co. KGaA, Germany, 2nd edition, 2005.
7.	Daniel A. Bernards, Róisín M. Owens, George G. Malliaras, "***Organic Semiconductors in Sensor Applications***", Springer Science & Business Media, 1st edition, 2008.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	Wireless Sensor Network		***Code***	TEC 755
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (IV)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Wireless Communication						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Understand** the basic concepts, constraints, and applications of wireless sensor networks (WSN).
CO 2	**Understand** the enabling technologies for WSN.
CO 3	**Understand** and **analyse** the different MAC (Medium Access Control) protocols of WSN.
CO 4	**Understand** routing protocols of WSN.
CO 5	**Understand** and **analyse** the design principles of wireless sensor network.
CO 6	**Develop** various real-life applications using wireless sensor network.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction of Wireless Sensor Networks (WSNs):** Introduction to sensor networks, Unique constraints and challenges, Advantage of sensor networks, Applications of sensor networks	7
Unit 2:	**WSNs enabling technologies, challenges:** Classification of WSNs Mobile Ad-hoc Networks (MANETs) and wireless sensor networks, Enabling technologies for wireless sensor networks. Issues and challenges in wireless sensor networks	8
Unit 3:	**Physical and Data Link Layer:** Design constraints and requirements - Physical layer and transceiver design, Link layer fundamentals and requirements – Link management - MAC protocols — S-MAC, Low duty cycle and wakeup concepts – Contention based – Schedule based, IEEE 802.15.4 Standard – PHY/MAC slotted - unslotted CSMA/CA- GTS mechanism	9
Unit 4:	**Routing and Transport Controls Protocol:** Routing challenges and design issues in WSNs, Wireless network routing protocols, Energy efficient unicast routing, Energy efficient broadcast /multicast routing, Geographical routing, Traditional transport control protocols, Design issues of transport control protocols, CODA, ESRT, RMST, PSFQ, GRAUDA and Ad hoc Transport Protocols (ATP)	8
Unit 5:	**WSNs Design Principles:** Design principles for WSNs, Gateway concepts & need for gateway, WSN to internet communication, and internet to WSN communication. Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, Introduction to TinyOS and nesC.	10
Total Hours		**42**

	Textbooks
1.	Feng Zhao & Leonidas J. Guibas, "***Wireless Sensor Networks- An Information Processing Approach***", Elsevier, India, 1st edition, 2014.
2.	Mohammad Ilyas, Imad Mahgoub, "***Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems***", CRC Press, 1st edition, 2004.
3.	Holger Karl and Andreas Wiilig, "***Protocols and Architectures for Wireless Sensor Networks***", John Wiley and Sons Limited, New Delhi, India, 1st edition, 2017.
	Reference Books
4.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, "***Wireless Sensor Networks-Technology, Protocols, and Applications***", John Wiley and Sons Limited, New Delhi, India, 1st edition, 2016.
5.	Jun Zheng and Abbas Jamalipour, "***Wireless Sensor Networks- A Networking Perspective***", John Wiley and Sons Limited, New Delhi, India, 1st edition, 2014.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	Fundamentals of Nanotechnology		***Code***	TEC 756
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (IV)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Physics and Basic Electronics Engineering						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Remember** the concepts of emerging world of nanoscience, knowledge of single-electron devices and carbon based nanoelectronics devices.
CO 2	**Understand** the various top-down and bottom-up approaches for nanomaterial synthesis.
CO 3	**Apply** the acquired knowledge to develop novel nanomaterials.
CO 4	**Analyse** the properties of nanomaterials using various scanning probe techniques and spectroscopic techniques for material characterization.
CO 5	**Evaluate** the performance of nanotechnology related devices for various industrial applications.
CO 6	**Apply** the knowledge in developing analytical tools for nanoscale engineering.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Nanotechnology:** Overview, Historical background, Importance of nanoscale, Bottom-Up approaches, Top-Down approaches, Functional approaches.	8
Unit 2:	**Nano Materials:** Fundamental concepts of nanomaterials, Allotropes of carbon, Graphene, Graphene nanoribbons, Fullerenes, Fullerites, Carbon Nanotubes (CNTs), Bucky paper.	8
Unit 3:	**Nano Electronics:** Approaches to nanoelectronics, Fabrication of integrated circuits, Introduction to Microelectromechanical Systems (MEMS), Nanoelectromechanical Systems (NEMS), Nanowires, Nano-circuits, Quantum wire, Quantum well.	10
Unit 4:	**Nano-Engineering Devices and Nano- Medicine:** Lab on chip, Micromachinery, Nanomotor, Nanopore, Nano sensor, Quantum point contact, Synthetic molecular motors, Medical applications of nanomaterials.	8
Unit 5:	**Analytical Tools in Nanoscale Engineering and Nanolithography:** Atomic Force Microscopy (AFM), Scanning Tunnelling Microscope (STM), Nanolithography: Dip-pen, Electron beam, Ion-beam Sculpting, Nanoimprint Lithograph, Photolithography.	10
Total Hours		**42**

Textbooks	
1.	Shunri Oda, David Ferry, "***Nanoscale Silicon Devices***", CRC Press, Taylor & Francis Group, 1st Edition, 2016

2.	Robert Puers, "***Nanoelectronics: Materials, Devices, Applications***", Wiley, 2017.
	Reference Books
3.	Suprio Datta, "***Lessons from nanoelectronics***", World Scientific publisher, 1st Edition, 2012.
4.	Gabriel M. Rebeiz, "***RF MEMS: Theory, Design, and Technology***", Wiley, 2003.
5.	Julian W. Gardner, "***Microsensors, MEMS and Smart Devices***", Wiley, 2002.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	CMOS Analog Circuit Design		***Code***	TEC 757
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (IV)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Electronics Devices and Circuits, Analog Integrated Circuits						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Recall** the knowledge of analog IC design in CMOS technologies.
CO 2	**Understand** MOS transistors with different configurations.
CO 3	**Apply** multistage and differential MOS amplifiers in different electronic circuits.
CO 4	**Analyse** current mirror circuits.
CO 5	**Assess** and **evaluate** feedback amplifiers and phase locked loop.
CO 6	**Design** and **develop** various CMOS analog circuits.

Unit No.	***Content***	***Hours***
Unit 1:	**Models for Integrated Circuit Active Devices:** The depletion region of a P-N junction, Depletion region capacitance and junction breakdown, Basics of MOS transistor, Derivation of current-voltage relationship, Analysis of MOS as an amplifier, Small signal models of MOS transistor, MOS transistor frequency response.	8
Unit 2:	**Singlestage Amplifier:** Common source stage with resistive load, CS stage with diode connected load, CS stage with current source load, CS stage with triode load, CS stage with source generation, Source follower and common gate configuration	9
Unit 3:	**Multistage Amplifier and Operational amplifier:** Cascode current source, Cascode amplifier, Differential pair, Small and large signal analysis of differential amplifier, Differential amplifier with MOS loads, OPAMP Design: General consideration, One stage Op Amp.	9
Unit 4:	**Current Mirrors, Active Loads and References:** Simple current mirror, Cascode current mirror, Wilson current mirror, Common source amplifier with complementary load, Voltage and current references: Widlar and peaking current sources, Supply insensitive biasing.	9
Unit 5:	**Feedback and Non-Linear Analog Circuits:** General consideration, Properties of feedback circuits, Feedback configuration, Nonlinear analog circuits: LC oscillators, Simple phase locked loop.	9
Total Hours		**44**

Textbooks	
1.	B. Razavi, "***Design of analog CMOS Integrated Circuits***", McGraw-Hill, 1st Edition, 2002.
2.	Mohammed Ismail and Terri Faiz, "***Analog VLSI Signal and Information Process***", McGraw-Hill, 1st Edition, 1994.
Reference Books	

3.	Paul R. Gray and R. G. Meyer, "***Analysis and Design of Analog Integrated Circuits***" John Wiley and Sons", 4th Edition, 2001.
4.	R. Jacob Baker, H. W. Li, and D.E. Boyce, "***CMOS: Circuit Design, Layout and Simulation***", Prentice-Hall of India, 3rd edition, 2010.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Seventh	***Subject Title***	Speech Processing		***Code***	TEC 758
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (IV)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Digital Signal Processing						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Understand** basic concepts of speech production.
CO 2	**Analyse** the predictive coding.
CO 3	**Understand** the homomorphic systems.
CO 4	**Analyse** speech enhancement techniques.
CO 5	**Understand** the analysis of several statistical model for speech recognition.
CO 6	**Develop** real-life applications in the area of voice communications.

Unit No.	***Content***	***Hours***
Unit 1:	**Fundamentals of the Speech Production mechanism and Digital Speech Processing:** Anatomy & physiology of speech organs, The process of speech production, Acoustic phonetics, The acoustic theory of speech production, Lossless tube models, Digital models for speech signals. Time domain models for speech processing: Introduction, Window considerations, Short time energy and average magnitude short time average zero crossing rate, Speech Vs. silence discrimination using energy and zero crossing, Pitch period estimation using a parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.	10
Unit 2:	**Linear Predictive Coding (LPC):** Basic principles of linear predictive analysis: The autocorrelation method, The covariance method, Solution of LPC equations: Cholesky decomposition solution for covariance method, Durbin's recursive solution for the autocorrelation equations, Pitch detection and using LPC parameters.	8
Unit 3:	**Homomorphic Speech Processing:** Introduction, Homomorphic systems for convolution: Properties of the complex cepstrum, Computational considerations, The complex cepstrum of speech, Pitch detection, Formant estimation, Mel frequency cepstrum computation, Mel frequency cepstral co-efficients (MFCC) feature extraction.	8
Unit 4:	**Speech Enhancement:** Nature of interfering sounds, Speech enhancement techniques: Spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter.	6
Unit 5:	**Statistical Models for Speech Recognition:** Introduction to speaker recognition and speech recognition. Vector quantization model and gaussian mixture model for speaker and speech	10

	recognition. Discrete and continuous hidden Markov modeling for isolated word and continuous speech recognition.	
Total Hours		**42**

	Textbooks
1.	Lawrence R. Rabiner, Ronald W. Schafer, "***Introduction to Digital Speech Processing***" Now Publishers Inc., 1st Edition, 2007.
2.	Thomas F. Quatieri, "***Discrete-Time Speech Signal Processing: Principles and Practice***", Pearson, 1st Edition, 2008.
	Reference Books
3.	Sadaoki Furui, "***Digital Speech Processing: Synthesis, and Recognition***", CRC Press, 2nd Edition Revised and Expanded, 2000.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Eighth	***Subject Title***	Satellite Communications		***Code***	TEC 851
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (V)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Wireless Communication and Microwave Engineering						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** basic concepts of orbital mechanism and launch vehicle.
CO 2	**Apply** the technologies for satellite & earth station architecture, and applications.
CO 3	**Analyse** the satellite link for the optimum link performance.
CO 4	**Evaluate** the modulation and coding schemes for a given satellite communication link.
CO 5	**Understand** various satellite systems - worldwide and Indian scenario.
CO 6	**Design** prototype satellite communication link for given specifications.

Unit No.	***Content***	***Hours***
Unit 1:	**Overview of Satellite Systems, Orbits and Launching Methods:** General features, Frequency allocation, Properties of satellite communication systems, LEO, MEO and GEO Orbits, Kepler's laws, Orbital dynamics, Orbital elements, Sub-satellite point, Orbital perturbations, Orbital effects on communication system performance. Launching and positioning of satellite. Antenna look angle determination, Sub-satellite point, Limits of visibility.	8
Unit 2:	**Space Segment (Satellite Subsystems) and Earth Station:** Attitude and orbit control system; Telemetry, Tracking, Command and monitoring (TTC & M); Communication subsystems, Antenna subsystem, Power system, Equipment reliability and space qualification. Different types of earth stations.	8
Unit 3:	**Satellite Link Design:** Basic transmission theory, General link design equation, System noise temperature, Uplink/Down Link design, C/N ratio, Saturation flux density, Input/Output back off, Effect of rain: Attenuation and depolarization.	8
Unit 4:	**Satellite Multiple Access Techniques:** Multiplexing and multiple access, Preassigned, Demand assigned multiple access, FDMA- Bandwidth limited and power limited TWT amplifier operation; TDMA- TDMA frame structure, Frame efficiency, Comparison of uplink power requirements for FDMA and TDMA. CDMA- Direct-sequence spread spectrum, M-sequence codes, Spectrum spreading and dispreading	8
Unit 5:	**Introduction of Various Satellite Systems:** VSAT Systems, DBS, DTH; LEO and non-Geosystems- RADARSAT, IRIDIUM, INMARSAT, ORBCOMM, Global Positioning System (GPS), IRNSS (NavIC).	8
Total Hours		**40**

Textbooks	
1.	Pratt and Bostian, "***Satellite Communications***", John Wiley & Sons. 3rd Edition, 2019.

2.	Dennis Roddy, "***Satellite Communications***", McGraw-Hill, 4th Edition, 2017.
3.	Tri T. Ha, "***Digital Satellite Communications***", McGraw Hill, 2nd edition, 2009.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Eighth	***Subject Title***	Testing of VLSI circuits		***Code***	TEC 852
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (V)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: VLSI Technology and Design						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Recall** the knowledge of fault modeling and fault simulation.
CO 2	**Understand** ATPG algorithm for combinational and sequential circuits
CO 3	**Apply** the knowledge in **understanding** high-level testability Measures, SCOAP controllability and observability.
CO 4	**Analyse** different memory testing algorithms.
CO 5	**Assess** and **evaluate** scan architecture.
CO 6	**Design** testing algorithms for VLSI components.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction:** Role of testing, Digital and analog VLSI testing, VLSI technology trends affecting testing. **Fault Modeling:** Defects, Errors, and Faults, Functional versus structural testing, Levels of fault models, A glossary of fault models, Single stuck-at fault. **Logic and Fault Simulation:** Simulation for design verification, Simulation for test evaluation, Modeling circuits for simulation	9
Unit 2:	**Testability Measures:** SCOAP controllability and observability, High-level testability measures. **Combinational Circuit Test Generation:** Algorithms and representations, Redundancy Identification (RID), Testing as a global problem, Definitions, Test generation systems, Test compaction, Significant combinational ATPG algorithms and sequential circuit test generation.	8
Unit 3:	**Memory Test:** Memory density and defect trends, Faults, Memory test levels, March test notation, Fault modelling, Memory testing. Analog and mixed signal test, Delay test and IDDQ test.	9
Unit 4:	**Fundamental Techniques for Logic Testing:** Design for test fundamentals, ATPQ fundamental, Scan architecture and technique.	8
Unit 5:	**Embedded Core Test Fundamentals:** Introduction to embedded core testing, Core-based design, Core DFT development, Chip design with a core, Scan testing the isolated core, Scan testing the non-core logic, Memory testing with BIST.	8
Total Hours		**42**

	Textbooks
1.	Viswani D. Agarval Michael L. Bushnell, "***Essentials of electronic testing for digital memory & mixed signal VLSI circuit***", Kluwer Academic Publications, 1999.
2.	Alfred L. Crouch, "***Design for test for digital IC's and embedded core systems***", PHI, 1999.
	Reference Books
3.	Parag. K. Lala, "***Digital circuit testing and testability***", Academic Press, 1997.
4.	Ashok K. Sharma, "***Semiconductor memories technology, testing and reliability***", Prentice-Hall of India Private Limited, New Delhi, 1st edition, 1997.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Eighth	***Subject Title***	Digital System using VHDL		***Code***	TEC 853
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (V)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Digital Electronics						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** VHDL including code structure.
CO 2	**Describe** data type operators and attributes for arithmetic's operations, digital design with SM chart, data type, operation and component
CO 3	**Analyse** current code, sequential code, packages and components.
CO 4	**Design** network for mathematics operations, digital design with SM chart
CO 5	**Analyse** floating-point arithmetic and design examples.
CO 6	**Apply** concepts of Digital system design using VHDL.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction To VHDL**: Design Flow, EDA Tools, and Translation of VHDL code into a circuit. **Code Structure:** Fundamental VHDL Units, LIBRARY Declarations, ENTITY, ARCHITECTURE, VHDL Design Methodology.	10
Unit 2:	**Data Types:** Pre-Defined Data Types, User-Defined Data Types, Subtypes, Arrays, Port Array, Records, Signed and Unsigned Data Types, Data Conversion. **Operators and Attributes:** Operators, Attributes, User-Defined Attributes, Operator Overloading, GENERIC	8
Unit 3:	**Concurrent Code**: Concurrent versus Sequential, Using Operators, WHEN, GENERATE, BLOCK, **Sequential Code:** PROCESS, Signals and Variables, IF, WAIT, CASE, LOOP, CASE versus IF, CASE versus WHEN, Using Sequential Code to Design Combinational Circuits, Signals and Variables: CONSTANT, SIGNAL, VARIABLE, Number of Registers. **Packages and Components:** Introduction, PACKAGE, COMPONENT, PORT MAP, GENERIC MAP. Functions and Procedures: FUNCTION, Function Location, PROCEDURE, Procedure Location, FUNCTION versus PROCEDURE, ASSERT.	8
Unit 4:	**Design Of Networks For Arithmetic Operations:** Design of serial adder with accumulator, state graph for control networks design of Binary Multiplier, multiplication of signed binary numbers, design of binary divider. **Digital Design With SM Chart:** State machine charts, derivation of SM charts, realizations of SM charts, implementation of dice game.	8
Unit 5:	**Floating Point Arithmetic:** Representation of floating point numbers, floating point multiplication, and other floating point operations.	7

	Design Examples: UART design, description of MC68HC05 microcontroller, design of microcontroller CPU, and complete microcontroller design.	
Total Hours		**41**

	Textbooks
1.	Volnei A. Pedroni, "***Circuit Design With VHDL***", MIT Press, 2004.
2.	Charles H Roth Jr, "***Digital System Design using VHDL***", Thomson Learning, 2002.
3.	Jayaram Bhasker, "***A VHDL Primer***", III edition, Prentice Hall, 2007.
	Reference Books
4.	Stephen Brown & Zvonko Vranesic, "***Fundamentals of digital logic design with VHDL***", TMH, 2nd Ed., 2007
5.	Douglas L. Perry, "***VHDL: Programming by Example***", 4th edition, Tata Mcgraw-hill, July 2002.
6.	Jhon F Wakerly, "***Digital design***", PHI, 4th Edition.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Eighth	***Subject Title***	Digital Image Processing		***Code***	TEC 854
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (V)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Signals and Systems, Digital Signal Processing						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Recall** the basics of images formation.
CO 2	**Understand** the different image transformation technique.
CO 3	**Apply** image restoration and reconstruction.
CO 4	**Analyse** morphological operation.
CO 5	**Assess** and **evaluate** different image segmentation techniques.
CO 6	**Design** and **implement** algorithms for image processing.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to the Digital Image Processing**: Areas and applications, Elements of visual perception, Image sensing and acquisition, Image sampling and quantization, Basic relationships between pixels: Neighbourhoods, Adjacency and distances.	8
Unit 2:	**Image Enhancement**: Intensity Transformations, Histogram modeling; Equalization and modification, Spatial filtering: Smoothing spatial filters and sharpening spatial filters, Image smoothing using frequency domain filters.	8
Unit 3:	**Image Restoration and Reconstruction**: Model of the image degradation/restoration process, Noise models, Restoration by spatial filtering, Periodic noise reduction by frequency domain filtering, Inverse filtering, Minimum mean square error (Wiener) filtering.	8
Unit 4:	**Morphological Image Processing**: Erosion and dilation, Duality, Opening and closing, the Hit-or-Miss transformation, Boundary extraction, Hole filling, Extraction of connected components.	8
Unit 5:	**Image Segmentation, Representation and Description**: Detection of isolated points, Line detection, Edge models, Edge detection, Thresholding, Region-based segmentation, Chain codes, Shape numbers, Fourier descriptors, and Statistical moments.	8
Total Hours		**40**

Textbooks	
1.	Rafael C. Gonzalez, Richard E. Woods, "***Digital Image Processing***", 3rd Edition, Prentice Hall; ISBN: 013168728X, 2007.
2.	Al Bovik editor, "***Handbook of Image & Video Processing***", ISBN 0-12-119790-5, Academic Press, San Diego., 2000.
Reference Books	

3.	Rafael C. Gonzalez, Richard E. Woods, and S. L. Eddins, "***Digital Image Processing Using MATLAB***", Prentice Hall, ISBN 0130085197, 2004.
4.	Anil K. Jain, "***Fundamentals of digital image processing***", Englewood Cliffs, NJ: Prentice Hall, 1989.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Eighth	***Subject Title***	Telecommunication Switching		***Code***	TEC 855
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (VI)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Communication Systems I and Communication Systems II						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** modern telecommunication network and its heterogeneous switching.
CO 2	**Apply** the concepts of traffic engineering to telecommunication network.
CO 3	**Analyse** Single stage and Multistage switch networks & single and dual processor systems.
CO 4	**Estimate** the performance of telecommunication networks.
CO 5	**Design** circuit switched networks with packet switched networks.
CO 6	**Apply** the concepts of network and traffic engineering in telecommunication and switching networks.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction:** Evolution of public switched telecommunication, Simple telephone communication, Basic of switching system, Concept of Strowger and crossbar switching.	8
Unit 2:	**Electronic Space Division Switching:** Stored program control, Centralized and distributed SPC, Software architecture, Application software, Enhanced software, Two and three stage networks. **Time Division Switching:** Sampling, Quantization, Encoding, Basic time division space switching, Basic time division time switching, Time multiplexed space and time switching, Combination switching.	8
Unit 3:	**Traffic Engineering:** Network traffic load and parameters, Grade of service, Modeling switching, Incoming traffic, Common channel signalling, SS7 signalling protocols. **Telephone Networks:** Subscriber loop system, Switching hierarchy and routing, Transmission plan, Transmission system, Signaling techniques.	8
Unit 4:	**Integrated Digital Network:** Digital multiplexing techniques-(Time division multiplexing, Frequency division multiplexing), TDMA, FDMA and CDMA, Concept of ISDN, ISDN standards, Cellular mobile communication.	8
Unit 5:	**Data Networks**: Data transmission in PSTN, Switching techniques, Data communication architecture, Link to link layers, End to end layers, OSI Architecture, satellite-based data networks, LAN, MAN standards, TCP/IP, Internet, Principle of ATM networks.	8
Total Hours		**40**

Textbooks	
1.	Thiagarajan Viswanathan, ***"Telecommunication switching systems and Networks"***, Prentice Hall of India LTD, 2000.
2.	Forouzen, "***Data Communications and Networking***", 3rd Edition, TMH, 2004.
Reference Books	
3.	J. E. Flood, "***Telecommunications Switching, Traffic and Networks***" , Pearson Education, 2006

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Eighth	***Subject Title***	Neural Networks & Machine Learning		***Code***	TEC 856
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (VI)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Basic Probability Theory and Basic Linear Algebra						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Understand** the basics of neural network and its parameters.
CO 2	**Examine** the feed forward network and its implementation.
CO 3	**Analyse** the concepts of pattern analysis and implementation of support vector machine.
CO 4	**Investigate** self-organizing map and pattern clustering.
CO 5	**Evaluate** different feedback network, such as Hopfield, Boltzmann machine.
CO 6	**Develop** neural network for specific applications.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction to Artificial Neural Networks**: Biological neural networks, ANN application overview, Pattern analysis tasks: Classification, Regression and clustering, Computational models of neurons, Structures of neural networks, Learning principles, Supervised, Unsupervised and reinforcement learning. **Linear Models of Learning and Classification**: Polynomial curve fitting, Bayesian curve fitting, Linear basis function models, Bias-variance decomposition, Bayesian linear regression, Least squares for classification, Logistic regression for classification, Bayesian logistic regression for classification.	12
Unit 2:	**Feed Forward Neural Networks**: Pattern classification using perceptron, Multilayer feed forward neural networks (MLFNNs), Pattern classification using MLFNNs, error and back propagation learning, Fast learning methods: Conjugate gradient method, Auto-associative neural networks, Bayesian neural networks.	8
Unit 3:	**Radial Basis Function Networks**: Regularization theory, RBF networks for function approximation, RBF networks for pattern classification. **Kernel Methods for Pattern Analysis**: Statistical learning theory, Support vector machines for pattern classification, Support vector regression for function approximation, Relevance vector machines for classification and regression.	8
Unit 4:	**Self-Organizing Maps**: Pattern clustering, Topological mapping, Kohonen's self organizing map, Competitive learning, Learning vector quantizers, Counter propagation networks, Adaptive Resonance Theory (ART).	6
Unit 5:	**Feedback Neural Networks**:	6

	Pattern storage and retrieval, Hopfield model, Boltzmann machine, Recurrent neural networks. **Applications of Neural Networks and Machine Learning**: Case studies.	
Total Hours		**42**

	Textbooks
1.	S. Haykin, "***Neural Networks – A Comprehensive Foundation***", Prentice Hall of India, 2ed edition, 2003
2.	Satish Kumar, "***Neural Networks – A Classroom Approach***', McGraw Hill Education, 2nd edition, 2017.
	Reference Books
3.	S. Haykin "***Neural Networks & Learning Machines***", Pearson Education India, 3rd edition, 2016.
4.	L. Fausett, "***Fundamentals of Neural Networks: Architectures, Algorithms and Applications***", Pearson Education India, 1st edition, 2004.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Eighth	***Subject Title***	Mobile Ad hoc Networks		***Code***	TEC 857
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (VI)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Wireless Communication						

Course Outcomes

Upon completion of this course, the students will be able to

CO 1	**Understand** the concept of ad hoc wireless networking, IEEE 802.11, IEEE 802.16 (Wi-Max), Bluetooth, IrDA, RF home, design and operation of ad hoc network, their design issues and available solution.
CO 2	**Understand** MAC layer protocols and design issues of MAC protocols.
CO 3	**Understand** and **remember** proactive, reactive and hybrid routing protocols and routing mechanism.
CO 4	**Understand** energy management in ad hoc network.
CO 5	**Understand** Security attacks and QoS provisioning in ad hoc network.
CO 6	**Develop** and **design** efficient wireless mobile ad hoc networks.

Unit No.	***Content***	***Hours***
Unit 1:	**Introduction:** Ad hoc networking: An introduction. Model of operation, Symmetric links, Fundamental of wireless networks, Bluetooth, IrDA, Comparison of bluetooth and IrDA, Home RF, 802.11, 802.16(Wi-Max), Hotspot, Difference between cellular and ad hoc networks, Technical and research challenges. DoD perspective.	8
Unit 2:	**MAC Layer Protocols for Ad hoc wireless Networks:** Need for Medium Access Control(MAC) Protocols, Issues and design goals of MAC protocols, Classification of MAC protocols: Contention based MAC protocols, Contention based MAC protocols with reservation mechanism, Multiple Access Collision Avoidance (MACA), Media Access Protocol for wireless (MACAW), Floor Acquisition Multiple Access Protocols (FAMA), Busy Tone Multiple Access Protocols (BTMA), Multiple Access Collision Avoidance – by Invitation(MACA-BI), Dual Busy Tone Multiple Access Protocols (DBTMA), Multichannel Carrier sense Multiple access (CSMA) MAC Protocol.	10
Unit 3:	**Routing Protocols:** Design issues of routing protocols, Ideal characteristics of routing, Classification of routing protocols: Proactive, Reactive, Hybrid. Overview of DSDV (Destination sequenced distance vector) Routing protocol, Link state, Distance vector, DSDV properties and its merits demerits, Damping fluctuations. Clustering, Hierarchical routing. Overview of DSR (Dynamic Source Routing) protocols: DSR properties, Additional route discovery and maintenance features. Overview of AODV (Ad Hoc On Demand Distance vector) Protocols, Unicasting, Multicasting, Unicast route establishment, Multicasting route establishment, Expanding ring search. Overview of ZRP (Zone Routing Protocol), Reconfigurable	12

	wireless networks, Intrazone, Interzone routing protocols. Overview of OLSR (Optimized Link State Routing) Protocol, Multipoint relays (MPRs), Protocol functioning, Core functioning.	
Unit 4:	**Energy management** Energy management system in Ad Hoc networks, Power issues, Smart batteries, and Associatively based routing, Effects of beaconing of battery life, Maximum lifetime routing.	5
Unit 5:	**Network Security Attacks and Quality of Service** Security in Ad Hoc wireless networks, Network security requirements, Issues and challenges in security provisioning, Network security attacks. QoS in Ad Hoc wireless networks, Issues and challenges, Classification of QoS solutions. Wireless sensor networks, Issues and challenges, Sensor network architecture, Flooding gossiping, Rumor routing, Quality of sensor networks, Evolving standards.	7
Total Hours		**42**

Textbooks	
1.	C. Perkins, "***Ad Hoc Networking***", Addison-Wesley Professional,1st Edition, 2008.
2.	C. Siva Ram Murthy, and B. S.Manoj, "***Ad Hoc Wireless Networks Architecture and Protocols***", Pearson Education 2nd Edition, 2004.
Reference Books	
3.	S. Basagni, And M. Conti, "***Mobile Ad Hoc Networking: Cutting Edge Directions***", John Wiley & Sons, 2nd Edition, 2013.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.

Department of Electronics and Communication Engineering						
B. Tech in Electronics and Communication Engineering						
Semester	Eighth	***Subject Title***	Adaptive Signal Processing		***Code***	TEC 858
Course Component		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective Course (PEC) (VI)		03		3	0	0
Examination Duration (Hrs)		***Theory***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***
		03		25	25	50
Pre-requisite: Digital Signal Processing						

Course Outcomes	
Upon completion of this course, the students will be able to	
CO 1	**Create** and visualize the domain of adaptive signal processing.
CO 2	**Identify** a random process and **formulate** to extract desired information.
CO 3	**Develop** algorithms meeting application specific performance criteria.
CO 4	**Implement** the adaptive algorithms in software/Hardware.
CO 5	**Analyse** convergence and stability issues associated with adaptive filter design and come up with optimum solutions for real life applications.
CO 6	**Design** and **implement** filtering solutions for applications, such as channel equalisation, interference cancelling and prediction considering present day challenges.

Unit No.	***Content***	***Hours***
Unit 1:	**Adaptive Systems:** Definitions and characteristics - Applications – Properties-Examples - Adaptive linear combiner input signal and weight vectors - Performance function-Gradient and minimum mean square error - Introduction to filtering-Smoothing and prediction - Linear optimum filtering-Orthogonality - Wiener – Hopf equation-Performance surface	8
Unit 2:	**Searching Performance Surface-Stability and Rate Of Convergence:** Learning curve-Gradient search - Newton's method - Method of steepest descent - Comparison - Gradient estimation - Performance penalty - Variance - Excess MSE and time constants – Mis-adjustments	8
Unit 3:	**LMS algorithm convergence of weight vector:** LMS/Newton algorithm - Properties - Sequential regression algorithm - Adaptive Recursive filters - Random-search algorithms - Lattice structure - Adaptive filters with orthogonal signals	8
Unit 4:	**Applications-adaptive modeling and system identification:** Multipath communication channel, Geophysical exploration, FIR digital filter synthesis	8
Unit 5:	**Inverse adaptive modeling:** Equalization, and deconvolution adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis	8
Total Hours		**40**

Textbooks	
1.	Simon Haykins, "***Adaptive Filter Theory***", Pearson Education, 5th Edition, 2013.
2.	D. G. Manolakis, V.K. Ingle, S.M. Kogon, "***Adaptive Signal Processing***", McGraw-Hill, 2000.
Reference Books	

3.	Todd K. Moon, Wynn C. Stirling, "***Mathematical Methods and Algorithms for Signal Processing***" Prentice Hall, 1st edition, 1999.
4.	John. R. Triechler, C. Richard Johnson (Jr), Michael. G. Larimore, "***Theory and Design of Adaptive Filters***", Prentice Hall India Private Limited, 2004.

Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam.