Gurugram University Gurugram

Curriculum for UG Degree Course

in

Electronics and Communication Engineering

(Engineering &Technology)

Gurugram University Scheme of Studies and Examination
Bachelor of Technology (Electronics & Communication Engineering)

SEMESTER V

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Computer Networks	3	0	0	3	30	70	100
2	PCC		Digital System Design	3	0	0	3	30	70	100
3	PCC		Digital Signal Processing	3	0	0	3	30	70	100
4	PCC		Wireless & Satellite Communication	3	0	0	3	30	70	100
5	PEC		Program Elective - I	3	0	0	3	30	70	100
6	OEC		Open Elective - I	3	0	0	3	30	70	100
7	LC		Computer Networks Lab	0	0	2	1	50	50	100
8	LC		Digital Signal Processing Lab	0	0	2	1	50	50	100
10	LC		Digital System Design Lab	0	0	2	1	50	50	100
11	LC		Wireless & Satellite Communication lab	0	0	2	1	50	50	100
12	MC		Practical Training-I	0	0	2	-	30	70	100*
Total				28			22	380	620	1000

NOTE:

1. Choose any one from Professional Elective Course-I
2. Choose any one from Open Elective Course-I
3. ***Practical Training-I:** The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

PROFESSIONAL ELECTIVE- I (Semester-V)

Sr. No	Code	Subject	Credit
1.		Information Theory and Coding	3
2.		Antennas and Propagation	3
3.		Bio-Medical Electronics	3
4.		Introduction to MEMS	3
5.		Mobile applications development	3
6.		Analog Integrated Circuits	3

COMPUTER NETWORKS

Course Code					
Category	Professional Core Courses				
Course title	Computer Network				
Scheme	L	T	P	Credits	Semester : V
	3	1	0	3	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. To develop an understanding of modern network architectures from a design and Performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs), and Wireless LANs (WLANs).
3. To provide an opportunity to do Network programming.
4. To provide WLAN measurement ideas.

UNIT – I

Introduction: Data communication, Components, Data Representation, Simplex, Half Duplex, and Full Duplex Transmission, Modulation, Multiplexing, Computer networks, distributed processing, Internet, Topologies, Packet and circuit switching, connectionless and connection-oriented services.

Network Models: OSI model and TCP/IP Model

Physical Layer – LAN: Ethernet.

UNIT – II

Data Link Layer and Medium Access Sub Layer: MAC Addressing, Framing, Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window Protocol.

Medium Access Control: Random access, Controlled Access, and channelization protocols.

Network Layer: Logical addressing, classful and classless addressing, subnetting, Ipv4, ICMPv4, ARP, RARP and BOOTP, Ipv6, Ipv6 addressing.

UNIT – III

Network Devices: Repeater, hub, switch, router, and gateway.

Routing Algorithms: introduction to routing, Shortest Path Algorithm, Flooding, Hierarchical Routing, Link State, and Distance Vector Routing

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), TCP connection management.

UNIT – IV

Congestion Control, Quality of Service, QoS Improving techniques.

Application Layer: Domain Name Space (DNS), EMAIL, File Transfer Protocol (FTP), HTTP, SNMP

Network Security: Firewalls, security goals, types of attack, symmetric and asymmetric key ciphers.

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

1. Explain the functions of the different layers of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs), and Wireless LANs (WLANs) and describe the function of each.
3. Identify and connect various connecting components of a computer network.
4. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, and Firewalls using open-source available software and tools.
5. outline various models, topologies and devices of Computer Networks.
6. Design engineering solutions to complex problems utilizing a systems approach.

TEXT AND REFERENCE BOOKS:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
3. Computer Networks, latest Edition, Andrew S. Tanenbaum, Pearson New International Edition.
4. Internetworking with TCP/IP, Volume 1, latest Edition Douglas Comer, Prentice Hall of India.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

DIGITAL SYSTEM DESIGN

Course Code					
Category	**Professional Core Courses**				
Course title	**Digital System Design**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester : V**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03Hrs				

NOTE: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To know the basic language features of Verilog HDL and the role of HDL in digital logic design.
2. To know the behavioural modeling of combinational and simple sequential circuits.
3. To know the behavioral modeling of algorithmic state machines.
4. To know the synthesis of combinational and sequential descriptions.
5. To know the architectural features of programmable logic devices.

UNIT I

Hardware modeling with the Verilog HDL: Encapsulation, modeling primitives, Types of Modelling. Logic system, Data types and operators.Behavioural descriptions in Verilog HDL.Styles for Synthesis of combinational logic and sequential logic. HDL based Synthesis – Technology Independent design

UNIT II

System Verilog standards, Key System Verilog enhancements for hardware design. Advantages of System Verilog over Verilog, Data Types: Verilog data types, System Verilog data types, 2 - State Data types, Bit, byte, shortint, int, longint. 4 - State data types. Logic, Enumerated data types, User Defined data types, Struct data types, Strings, Packages, Type Conversion: Dynamic casting, Static Casting, Memories: Arrays, Dynamic Arrays, Multidimensional Arrays, Packed Arrays, Associative Arrays, Queues, Array Methods, Tasks and Functions: Verilog Tasks and Functions

UNIT III

Verilog interface signals - Limitations of Verilog interface signals, SystemVerilog interfaces, SystemVerilog port connections, Interface instantiation. Interfaces Arguments, Interface Modports, Interface References, Tasks and functions in interface, Verilog Event Scheduler, SystemVerilog Event Scheduler, Clocking Block, Input and Output Skews, Typical Testbench Environment, Verification plan

UNIT IV

Random Variables - rand and randc, Randomize( ) Method - Pre/Post Randomize( ) methods, Constraints in the class, Rand mode and constraint mode, Constraint and Inheritance, Constraint Overriding, Set Membership, Distribution Constraints, Conditional Constraints - .implication (->), if/else, Inline Constraints

COURSE OUTCOMES: After successful completion of the course, the students are able to

1. Demonstate knowledge on HDL design flow,digital circuits design ,switch de-bouncing, metastability, memory devices applications
2. Can synthesis of combinational and sequential descriptions.
3. Design and develop the combinational and sequential circuits using behavioral modelling
4. Solving algorithmic state machines using hardware description language
5. Analyze the process of synthesizing the combinational and sequential descriptions
6. Memorizing the advantages of programmable logic devices and their description in Verilog

Reference Book

1. Samir Palnitkar "Verilog HDLA Guide to Digital Design Synthesis , " 2nd Edition, Pearson Education 2006.
2. Ashenden - Digital design,Elsevier
3. IEEE Standard VHDL Language Reference Manual latest edition
4. Digital Design and Modelling with VHDL and Synthesis : KC Chang; IEEE Computer Society Press.
5. "A VHDL Primmer" : Bhasker; Prentice Hall latest edition.
6. "Digital System Design using VHDL" : Charles. H.Roth ; PWS latest edition
7. "VHDL-Analysis & Modelling of Digital Systems" : Navabi Z; McGraw Hill.
8. VHDL-IV Edition: Perry; TMH latest edition
9. "Introduction to Digital Systems" : Ercegovac. Lang & Moreno; John Wiley latest edition
10. Fundamentals of Digital Logic with VHDL Design : Brown and Vranesic; TMH latest edition
11. Modern Digital Electronics- III Edition: R.P Jain; TMH latest edition.
12. Grout - Digital system Design using FPGA & CPLD 'S,Elsevier.

DIGITAL SIGNAL PROCESSING

Course Code					
Category	**Professional Core Courses**				
Course title	**Digital Signal Processing**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester : V**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

NOTE: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To describe signals mathematically and understand how to perform mathematical operations on signals.
2. Get familiarized with various structures of IIR and FIR systems.
3. To discuss word length issues , multi rate signal processing and application.
4. Design and realize various digital filters for digital signal processing.

UNIT I

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes, Z-Transform, Analysis of LSI systems, frequency Analysis, Inverse Systems,

UNIT II

Introduction to DFT: Efficient computation of DFT Properties of DFT – FFT algorithms – Radix-2 and Radix-4 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms – Use of FFT algorithms in Linear Filtering and correlation.

UNIT III

Structure of IIR: System Design of Discrete time IIR filter from continuous time filter – IIR filter design by Impulse Invariance. Bilinear transformation – Approximation derivatives – Design of IIR filter in the Frequency domain. : Symmetric & Anti-symmetric FIR filters: Linear phase filter – Windowing techniques – rectangular, triangular, Blackman and Kaiser windows – Frequency sampling techniques – Structure for FIR systems.

UNIT IV

Finite word length effects in FIR and IIR digital filters: Quantization, round off errors and overflow errors. Multi rate digital signal processing: Concepts, design of practical sampling rate converters, Decimators, interpolators. Polyphase decompositions.Application of DSP – Model of Speech Wave Form – Vocoder.

COURSE OUTCOMES: After successful completion of the course, the students are able to

1. Interpret and analyze discrete time signals.
2. Compute Z transform.
3. Compute Discrete Fourier Transform.
4. Appreciate the importance of Fast Fourier Transform.
5. Design IIR and FIR filters.
6. Apply signal processing algorithms for real time applications.

Text Books

1. Digital Signal Processing A. Vallavaraj, C. Gnanapriya, and S. Salivahanan\
2. S.K. Mitra, Digital Signal Processing: A computer based approach.TMH
3. Oppenheim A V, Willsky A S and Young I T, “Signal & Systems”, Prentice Hall, (1983).
4. Ifeachor and Jervis, “Digital Signal Processing”, Pearson Education India.
5. DeFatta D J, Lucas J G and Hodgkiss W S, “Digital Signal Processing”, J Wiley and Sons, Singapore, 1988

WIRELESS & SATELLITE COMMUNICATION

Course Code					
Category	**Professional Core Courses**				
Course title	**Wireless & Satellite Communication**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester : V**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

NOTE: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To introduce the fundamentals of satellite communication .
2. To introduce roles of various sub-systems of a satellite system.
3. The course introduces the concept of Modulation and Multiple Access Schemes.
4. Study the satellite link design.
5. Study the satellite orbits.

UNIT I

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication. IRNSS-NAVIC: Navigation with Indian Constellation

Orbital Mechanics: Orbital equations, Kepler"s laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.

UNIT II

Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc

UNIT III

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Satellite link budget : Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

UNIT IV

Multiple Access Techniques For Wireless Communication: Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, packet ratio, capacity of a cellular systems.

Wireless Networking: Difference between wireless and fixed telephone networks, development of wireless networks, fixed network transmission hierarchy, traffic routing in wireless networks, wireless data services, common channel signaling, ISDN (Integrated Services digital Networks), advanced intelligent networks.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the sub-systems of satellite communication systems and ground stations.
2. Understand the signal power calculation and issues in communication satellite tracking.
3. Compute parameters of orbital motions and understand communication with non-geosynchronous satellite
4. Understand different modulation types and interfacing the modems in satellite receivers.
5. Understand various multiple access technique.
6. Applications and frequency bands used for satellite communication.

Text /Reference Books:

1. Timothy Pratt and Jeremy Allnutt: “Satellite Communications”: Ed 3, 2021.Wiley India.
2. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill, 2001
3. Varsha Agrawal, Anil K. Maini, “Satellite Communications” Wiley India 2010.
4. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill.

DIGITAL SYSTEM DESIGN LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Digital System Design Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	2Hrs					

Note:

1. At least 10 experiments are to be performed by students in the semester
2. At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.
3. Group of students for practical should be 15 to 20 in number.

List of Experiments

Combinational & Sequential Design Exercises using HDL

1. Design a Half-Adder & Full Adder.
2. Design a Half Subtractor, & Full Subtractor
3. Design a parity generator
4. Design a 4 Bit comparator
5. Design a RS & JK Flip flop
6. Design a 4: 1 Multiplexer
7. Design a 4 Bit Up / Down Counter with Loadable Count
8. Design a 3: 8 decoder
9. Design a 8 bit shift register
10. Design a arithmetic unit

FPGA (Spartan 3) & CPLD

11. Implement ADC & DAC interface with FPGA
12. Implement a serial communication interface with FPGA
13. Implement a Telephone keypad interface with FPGA
14. Implement a VGA interface with FPGA
15. Implement a PS2 keypad interface with FPGA
16. Implement a 4-digit seven segment display

Lab outcomes:

1. Identify the various IC fabrication methods.
2. Express the Layout of simple MOS circuit using Lambda based design rules.
3. Apply the Lambda based design rules for subsystem design
4. Differentiate various FPGA architectures.
5. Design an application using Verilog HDL.
6. Concepts of modeling a digital system using Hardware Description Language.

DIGITAL SIGNAL PROCESSING LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Digital Signal Processing Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	2Hrs					

Notes:

1. At least 10 experiments are to be performed by students in the semester.
2. At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.
3. Group of students for practical should be 15 to 20 in number.

List of Experiments

11. Introduction to MATLAB.
12. Represent basic signals (unit step, unit impulse, ramp, exponential, sine and cosine)
2. To develop program for Z-Transform in MATLAB
3. To develop program for Convolution of sequences in MATLAB
4. To develop program for Correlation of sequences in MATLAB
5. To develop program for DFT & IDFT of two sequences
6. To develop program for FFT of two Sequences
7. To develop program for Circular Convolution
8. To design analog filter (low-pass, high pass, band-pass, band-stop).
9. To design digital IIR filters (low-pass, high pass, band-pass, band-stop).
10. To develop program for Interpolation and Decimation of sequences
11. To design FIR filters using windows technique.
12. Detection of Signals buried in Noise
13. Effect of noise on signals in MATLAB

Lab Outcomes:

At the end of this lab, students will be able to

1. Interpret and analyze discrete time signals.
2. Compute Z transform.
3. Compute Discrete Fourier Transform.
4. Appreciate the importance of Fast Fourier Transform.
5. Design IIR and FIR filters.
6. Apply signal processing algorithms for real time applications.

COMPUTER NETWORKS LAB

Course code					
Category	**Laboratory Courses**				
Course title	Computer Networks Lab				
Scheme and Credits	L	T	P	Credits	Semester IV
	0	0	2	2	
Classwork	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	02 Hours				

COURSE OBJECTIVES:

1. To understand the functionalities of various layers of OSI model.
2. Understand fundamental underlying principles of computer networking.

CONTENTS:

1. Study of Socket Programming and Client – Server model
2. Write a code simulating ARP /RARP protocols.
3. Write a code simulating PING and TRACEROUTE commands
4. Create a socket for HTTP for web page upload and download.
5. Write a program to implement RPC (Remote Procedure Call)
6. Implementation of Sub netting .
7. Applications using TCP Sockets like a. Echo client and echo server b. Chat c. File Transfer
8. Applications using TCP and UDP Sockets like. DNS e. SNMP f. File Transfer
9. Study of Network simulator (NS).and Simulation of Congestion Control Algorithms using NS
10. Perform a case study about the different routing algorithms to select the network path with its optimum and economical during data transfer. i. Link State routing ii. Flooding iii. Distance vector
11. To learn handling and configuration of networking hardware like RJ, 45 connector, CAT,6 cable, crimping tool, etc.
12. Configuration of router, hub, switch etc. (using real devices or simulators)
13. Running and using services/commands like ping, traceroute, nslookuparp, telnet, ftp, etc.
14. Network packet analysis using tools like Wireshark, tcpdump, etc.

COURSE OUTCOMES: At the end of course , the student will be able to :

1. Develop Client , Server architectures and prototypes by the means of correct standards and technology
2. .Analyze data flow between peer to peer in an IP network using Application, Transport and Network Layer Protocols.
3. Analyse & Implement various framing methods of Data Link Layer.
4. Demonstrate basic configuration of switches and routers.
5. Analyse & Implement various Error and flow control techniques.
6. Implement network routing and addressing techniques.

WIRELESS & SATELLITE COMMUNICATION LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Wireless & Satellite Communication Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	2Hrs					

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus. Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. To set up a satellite communication link & study of change in uplink & downlink frequency.
2. To Study Transmission of Audio & Video Signals & Data communication over satellite link.
3. To Study Transmission of telemetry data like temperature & light intensity over satellite link
4. To measure the propagation delay of signal in a Satellite communication Link.
5. To study different GPS data like longitude, latitude & different types of dilute of precision using GPS receiver..
6. To study selection of various PN codes like Gold, Barker & MLS in CDMA technology .
7. To study generation (spreading) & demodulation (Despreading) of of DSSS modulated signal
8. To study Voice communication over DSSS.
9. To study Minimum shift keying modulation & de modulation.
10. To study radiation pattern & calculate beam width for Yagi uda & Folded dipole antenna.
11. To study radiation pattern & calculate beam width for Circular & Triangular Patch Antenna.
12. to study FHSS Modulation & demodulation & transfer of numeric data.

Lab Outcomes: After completion of this course, students will be able to :

7. Describe the basic components of satellite communication system.
8. Understand transmission of audio & video signal, telemetry data, GPS data and modulation techniques.
9. Demonstrate radiation pattern and calculate beam width for different antennas.
10. Analyze the propagation delay of signals in satellite communication links.
11. Understand CDMA, spread spectrum techniques.

PRACTICAL TRAINING-I

Course Code					
Category	**PT**				
Course title	**Practical Training-I**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	2	**0**	**0**	**0**	
Class Work	30				
Exam	70				
Total	100				
Duration of Exam	3Hrs				

Note:The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

The students are required to undergo practical training of duration not less than 1.5 months in a reputed organization or concerned institute. The students who wish to undergo practical training, the industry chosen for undergoing the training should be at least a private limited company. The students shall submit and present the midterm progress report at the institute. the presentation will be attended by a committee. alternately the teacher may visit the industry to get the feedback of the student.

The final Viva voice of the practical training will be conducted by an external examiner and one external examiner appointed by the institute. External examiner will be from the panel of examiners submitted by the concerned institute approved by the board of studies in engineering and technology. Assessment of industrial training will be based on seminar, viva-voice, report and certificate of practical training obtained by the student from the industry or institute.

PROFESSIONAL ELECTIVE – I

Information Theory and Coding

Course Code					
Category	**Professional Elective Courses**				
Course title	**Information Theory and Coding**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. Students study the basics of Information theory, techniques of coding and decoding.
2. Study to analyze and compare different coding and decoding schemes.
3. Solve numerical problems on channel capacity and coding.
4. Study broadcast channels for different coding schemes and also multiuser channel coding.

UNIT - I

Basics of information theory: Entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources. Markov sources, Shannon's noisy coding theorem and converse for discrete channels, Calculation of channel capacity and bounds for discrete channels, application to continuous channels.

UNIT - II

Techniques of coding and decoding: Channel Coding, Block and convolutional codes; majority logic decoding; Viterbi decoding algorithm, Coding gains and performance. Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.

UNIT - III

Network Information Theory: Overview of multiple access channel (MAC), Achievable result for MAC using successive decoding technique, Outer bound on the capacity region of MAC and its capacity analysis, Gaussian MAC and its capacity analysis.

Introduction to broadcast channel: Superposition coding scheme and its optimality for the degraded broadcast channel, Relation between the capacity region of Gaussian BC and MAC. Achievable rate for interference limited networks using conventional techniques such as time-sharing and treating interference as noise.

UNIT - IV

Introduction to channel coding for multi users: Introduction, Block codes for the binary adder channel, Trellis codes for the multiple access channel.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. To Study and Derive equations for entropy mutual information and channel capacity for all types of channels.
2. To acquire the knowledge about Fourier series and Fourier transform signal analysis tool.
3. Design a digital communication system by selecting an appropriate error correcting codes for a particular application.
4. To learn about Probability of Random signal theory and process.
5. Formulate the basic equations of linear block codes and a cyclic code.
6. Compare the performance of digital communication system by evaluating the probability of error for different error correcting codes.

Text/Reference Books:

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.
5. A. El Gamal and Y. H. Kim, Network Information Theory, Cambridge University Press, 2011

BIO-MEDICAL ELECTRONICS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Bio-medical Electronics**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: V**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To understand concept of electronic systems design in Bio- medical applications.
2. To understand the biological process.
3. To understand non electrical parameter measurements.
4. To understand various Bio Medical Measuring Instruments and therapeuticequipments.

UNIT-I

Physiology and Transducers

Brief introduction to human physiology: Cell and its structure; Resting and Action Potential; Nervous system: Functional organisation of the nervous system; Structure of nervous system, neurons; synapse; transmitters and neural communication; Cardiovascular system; respiratory system; Basic components of a biomedical system. Biomedical transducers: Transducers selection criteria; Piezoelectric; ultrasonic; displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases; Temperature measurements; Fibre optic temperature sensors

UNIT-II

Electro – Physiological Measurements : Bio-electrodes and Biopotential amplifiers for ECG, EMG, EEG, etc.: Limb electrodes;floating electrodes; pregelled disposable electrodes; Micro, needle and surface electrodes;Preamplifiers, differential amplifiers, chopper amplifiers; Isolation amplifier. ECG; EEG;EMG; ERG; Lead systems and recording methods

UNIT-III

Non-Electrical Parameter Measurements

Measurement of blood temperature, pressure and flow; Cardiac output; Heart rate; Heartsound; Pulmonary function measurements; spirometer; Impedance plethysmography; Photo Plethysmography, Body Plethysmography

Unit-IV

Medical Imaging, Ultrasonic, X-ray and nuclear imaging: Radio graphic and fluoroscopic techniques; Computertomography; MRI; Ultrasonography, Assisting And Therapeutic Equipments, Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped; Safety aspects: safety parameters of biomedical equipments

Course Outcomes:

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

1. Apply the concept of electronic systems design in Bio- medical applications.
2. Examine the practical limitations on the electronic components while handlingbio- substances.
3. Evaluate and analyze the biological processes like other electronic processes.
4. Measure non electrical parameter.
5. Familiar the various Bio Medical Measuring Instruments and the rapeutic equipments.
6. Aware of electrical safety of medical equipments

Text/ reference books:

1. W.F. Ganong, Review of Medical Physiology, latest edition, Medical Publishers
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, latest edition
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall,latest edition
4. R.S.Khander, Handbook of Biomedical Instrumentation‖, TATA Mc Graw-Hill,New Delhi, latest edition
5. Leslie Cromwell, ―Biomedical Instrumentation and Measurement, Prentice Hallof India, New Delhi, latest edition

ANTENNAS AND PROPAGATION

Course code					
Category	Professional Elective Courses				
Course title	Antennas and Propagation				
Scheme and Credits	L	T	P	Credits	Semester :V
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

NOTE: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives: During the course, students will be made to learn to:

1. Understand the working principles of the Antenna.
2. Understand the types of Antenna and their propagation.
3. Understand limitations and application for different networks.

UNIT - I

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.
Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

UNIT-II

Aperture and Reflector Antennas- Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas.
Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas.

UNIT – III

Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.
Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

UNIT - IV

Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, Fixed weight beamforming basics, Adaptive beamforming. Different modes of Radio Wave propagation used in current practice.

Course outcomes: At the end of this course students will demonstrate the ability to

1. Understands Physical concept of radiation, Radiation pattern
2. Understand antenna characteristics for different applications.
3. Analyze and design different types of antennas.
4. Understands basic concept of smart Antennas.
5. Design antenna arrays and understand operation of smart antennas.
6. Investigate different modes of propagation and their suitability for wireless communication

Text/Reference Books:

1. J.D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, Antenna Engineering Handbook,cGraw ill, 1984.
5. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House,1980.
6. R.K. Shevgaonkar, Electromagnetic Waves, TataMcGraw Hill, 2005
7. R.E. Crompton, Adaptive Antennas, John Wiley

Analog Integrated Circuit

Course Code					
Category	**Professional Elective Courses**				
Course title	**Analog Integrated Circuit**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester : V**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03Hrs				

NOTE: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:
1. To understand the functioning of OP-AMP and design OP-AMP based circuits
2. To design and analyze waveform Generators.
3. To design sinusoidal and non-sinusoidal oscillators
4. To understand the concept of filters and regulators.

UNIT I

IC OP-AMP applications: OP-AMP Fundamentals (brief review of differential amplifier, current mirror, active load, level shifter, output stage; ac and dc characteristics) Basic building blocks using OP-AMPS. Inverting/Non-inverting VCVS, Integrators, Differentiators, CCVS and VCCS, Instrumentation Amplifiers.

UNIT II

Waveform Generator: Square wave generators: 555Timer, Crystal controlled Oscillator Ramp Generator: Triangle generator, Sawtooth generator Sine wave generator: Requirement for sinusoidal oscillations, Wien-bridge and twin-T oscillators. Function Generators: Multi op-amp function generators, IC function generators Digitally controlled frequency synthesizer: PLL Fundamentals, PLL synthesizer, Totally digital synthesizer.

UNIT III

Active Filters: Introduction to filtering: Frequency response, Characteristics and terminology, Active versus passive filters Low pass filter: First order low pass active filter, second order active filter model, second order low pass filter characteristics, Sallen-Key unity gain filter, Sallen-Key equal component filter, Higher order filters. High pass active filter. Band pass filter: single op-amp band pass filter, multistage band pass filter State variable filter.

UNIT IV

Non-linear Circuits: Logarithmic Amplifiers, Log/Antilog Modules, Precision Rectifier, Peak Detector, Sample and Hold Circuits. OP-AMP as Comparator,Schmitt Trigger, Square and Triangular Wave Generator, Monostable Multivibrator. IC Analog Multiplier applications OTA
Voltage Regulators: OP-AMP Regulators, IC Regulators, Fixed Voltage Regulators (78/79, XX), SMPS.

Course Outcomes: At the end of this course, students will demonstrate the ability to:
1. Design, analysis, simulations, and testing of analog circuits,
2. Analog electronics, with focus on integrated circuit design
3. DC biasing, op-amp Cadence for Simulation Labs and Homework problems.
4. Understand filters and related terminology.
5. Concept of voltage regulators, SMPS
6.Different form of waves and how they generated.

Text Book:

1. Sedra and Smith, Microelectronic Circuits", Oxford University press, 5th Edition, 2005.
2. J. Michael Jacob, Applications and design with Analog Integrated Circuits", PHI, 2nd Edition, 2004.

Reference Book :

B.P. Singh and Rekha Singh, Electronic Devices an Integrated Circuits; Pearson Education, 1st Edition 2006.

MOBILE APPLICATIONS DEVELOPMENT

Course code					
Category	Professional Elective Courses				
Course title	Mobile applications development				
Scheme and Credits	L	T	P	Credits	Semester: V
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVE:

1. Introduce the students with the various "Next Generation Technologies" in the area of mobile computing
2. Assist students understand the various Mobile operating Systems
3. Explore the findings using Android Technologies

UNIT - I

Introduction: Mobile operating system, Operating system structure, Constraints and Restrictions, Hardware configuration with mobile operating system, Features: Multitasking Scheduling, Memory Allocation, File System Interface, Keypad Interface, I/O Interface, Protection and Security, Multimedia features

UNIT - II

Introduction to Mobile development IDE's, Introduction to Worklight basics, Optimization, pages and fragments , Writing a basic program- in Worklight Studio, Client technologies, Client side debugging, Creating adapters, Invoking adapters from Worklight Client application, Common Controls, Using Java in adapters, Programming exercise with Skins, Understanding Apache Cordova.

UNIT - III

Understanding Apple iOS development, Android development, Shell Development, Creating Java ME application, Exploring the Worklight Server, Working with UI frameworks, Authentication, Push notification, SMS Notifications, Globalization.

UNIT - IV

Android: Introduction to Android, Architecture, memory management, communication protocols, application development methods, deployment. iOS: Introduction to iOS, Architecture, memory management, communication protocols, application development

methods, deployment

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

1. Explain the principles and theories of mobile computing technologies.
2. Describe infrastructures and technologies of mobile computing technologies.
3. List applications in different domains that mobile computing offers to the public, employees, and businesses.
4. Describe the possible future of mobile computing technologies and applications.
5. Effectively communicate course work through written and oral presentations

TEXT AND REFERENCE BOOKS:

1. Anubhav Pradhan, Anil V Deshpande, " Mobile Apps Development" Edition:
2. Jeff McWherter, Scott Gowell "Professional Mobile Application Development", John Wiley & Sons, 2012.
3. Barry Burd, "Android Application Development All in one for Dummies", Edition: I
4. Teach Yourself Android Application Development In 24 Hours, Edition: I, Publication: SAMS
5. Neal Goldstein, Tony Bove, "iPhone Application Development All-In-One For Dummies", John Wiley & Sons
6. Henry Lee, Eugene Chuvyrov, "Beginning Windows Phone App Development", Apress, latest edition.
7. Jochen Schiller,"Mobile Communications", Addison-Wesley, latest edition
8. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002, ISBN 0471419028.

INTRODUCTION TO MEMS

Course code					
Category	Professional Elective Courses				
Course title	Introduction to MEMS				
Scheme and Credits	L	T	P	Credits	Semester :V
	3	0	0	3	
Classwork	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

NOTE: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

COURSE OBJECTIVES: The objectives of this course are as under:

1. To understand concept of Microystems and Microelectronics.
2. To understand the MEMS fabrication modules.
3. To understand Scaling effect,sensors.

UNIT - I

Introduction and Historical Background , Introduction Microsystems vs. MEMS, Microsystems and Microelectronics, the Multidisciplinary Nature of Microsystems design and manufacture, Application of MEMS in various industries. MEMS and Miniaturization: Scaling laws inminiaturization: Scaling Effects. Micro/ Nano Sensors, Actuators and Systems overview: Case studies.

UNIT - II

Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; BulkMicromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding.

UNIT - III

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods,

UNIT - IV

Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems. Electrostatics, coupled electro mechanics.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the multidisciplinary aspects of MEMS and NEMS.
2. MEMS and NEMS applications ,also learn sensors and actuators
2. Understand the methods of fabrication and modeling methods.
3. Appreciate the underlying working principles of MEMS and NEMS devices
4. Design and model these devices.
5. Understand mechanics of solid in MEMS and NEMS

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. . M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. . G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6 . M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes, Elsevier, New York, 2000.

Gurugram University Scheme of Studies and Examination
Bachelor of Technology (Electronics and Communication Engineering)

SEMESTER VI

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		Control System Engineering	3	0	0	3	30	70	100
2	PCC		Microwave & Radar Engineering	3	0	0	3	30	70	100
3	PEC		Program Elective - II	3	0	0	3	30	70	100
4	PEC		Program Elective - III	3	0	0	3	30	70	100
5	OEC		Open Elective - II	3	0	0	3	30	70	100
6	PCC		VLSI System Design	3	0	0	3	30	70	100
7	LC		Control System LAB	0	0	2	1	50	50	100
8	LC		Microwave & Radar Engineering Lab(P)	0	0	2	1	50	50	100
9	PROJ		Project-I	-	-	4	2	50	50	100
10	MC		Economics for Engineers	2	0	0	0	30	70	100*
Total				28			22	330	570	900

NOTE:

1. Economics for Engineers: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.
2. At the end of the 6th semester, each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training center etc. and submit the typed report along with a certificate from the organization and its evaluation shall be carried out in the 7th Semester.
3. Choose any one from each of the Professional Elective Course-II and III
4. Choose any one from Open Elective Course-II

PROFESSIONAL ELECTIVE- II (Semester-VI)

Sr. No	**Code**	**Subject**	**Credit**
1.		Robotics & Automation	3
2.		Wireless and Sensor Networks	3
3.		Mobile Communications	3
4.		Power Electronics	3

PROFESSIONAL ELECTIVE - III (Semester-VI)

Sr. No	Code	Subject	Credit
1.		Nano electronics	3
2.		High Speed Electronics	3
3.		Biosensors	3
4.		Image Processing	3

Control System Engineering

Course Code					
Category	**Professional Core Courses**				
Course title	**Control System Engineering**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester : VI**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To understand concepts of the mathematical modeling, feedback control and stability analysis in Time and Frequency domains
2. To develop skills, to analyze feedback control systems in continuous- and discrete time domains.
3. To learn methods for improving system response transient and steady state behavior (response).
4. The compensator design of linear systems is also introduced.

UNIT-I

Systems Components and Their RepresentationControl System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphsmodels-DC and AC servo Systems-Synchronous -Multivariable control system

UNIT-II

Time Response Analysis and Stability ConceptTransient response-steady state response-Measures of performance of the standard first orderand second order system-effect on an additional zero and an additional pole-steady errorconstant and system- type number-PID control.

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus.

UNIT-III

Frequency Domain AnalysisBode Plot - Polar Plot- Nyquist Plots-Design of compensators using Bode Plots-Cascade leadcompensation-Cascade lag compensation-Cascade lag-lead compensation

UNIT-IV

Control System Analysis Using State Variable MethodsState variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts ofControllability and Observability-Stability of linear systems-Equivalence between transferfunction and state variable representations

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the concepts of control systems and importance of feedback in control systems.
2. Perform signal flow graph and formulate transfer function.
3. Perform computations and solve problems on frequency response analysis.
4. Analyse Polar, Bode and Nyquist's plot.
5. Evaluate different types of state models and time functions.
6. Analyse different types of control systems like linear and non-linear control systems, etc.

Text/Reference Books:

1. **B.S Manke , Linear Control system, Khanna Publication**
2. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997
3. Ambikapathy A., Control Systems, Khanna Book Publications, 2019.
4. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
5. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.
6. Nagrath & Gopal, "Modern Control Engineering", New Age International, New Delhi

MICROWAVE AND RADAR ENGINEERING

Course Code					
Category	**Professional Core Courses**				
Course title	**Microwave and Radar Engineering**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester : VI**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

NOTE: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To build up the concept from basics of microwave communications to modern applications.
2. To analyze and study rectangular and circular wave guides using field theory.
3. To understand the theoretical principles underlying microwave devices and networks.
4. To design microwave components such as power dividers, hybrid junctions, Directional Couplers, microwave filters, Microwave Wave-guides and Components, Ferrite Devices.
5. To study about Microwave Solid-State Microwave Devices and Microwave Tubes. 5.
6. To Study about Microwave Measurement Techniques.

UNIT I

Transmission Line: Transmission line equations & solutions, reflection and transmission coefficient, standing wave, standing wave ratio, line impedance and admittance, Introduction to strip lines, Microstrip Transmission line (TL). Wave Guide: Rectangular Wave guide -Field Components and Parameters, TE, TM Modes, Dominant Mode, Circular Waveguides: TE, TM modes. Wave Velocities, Wave guide Cavities.

UNIT II

Passive microwave devices: Microwave Junctions and Couplers, Scattering Matrix, Passive microwave devices: Microwave Hybrid Circuits, Terminations, Attenuators, Phase Shifters, Microwave Propagation in ferrites, Faraday Rotation, Isolators, Circulators. S parameter analysis of all components.

UNIT III

Microwave tubes : Microwave Tubes: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube, Backward Wave Oscillators: Their Schematic, Principle of Operation, Performance Characteristic and their applications. Microwave Measurements: Measurement of Insertion Loss, Frequency, Cavity Q, Dielectric Constant, Scattering Parameters, Noise Factors, Return Loss, Impendence; VSWR Metering and Measurement, High Power Measurement; Power Meters, Microwave Amplifiers.

UNIT IV

Introduction to RADAR systems: RADAR Block diagram, RADAR Range equation, Probability of detection of false alarm, Integration of RADAR pulses, RADAR cross UNIT I of targets, MTI RADAR, CW RADAR.

Course Outcomes:

1. Analyze various parameters and characteristics of the transmission line and waveguide and also use of wave guide component as per applications.
2. Describe, analyze and design simple microwave circuits and devices e g couplers, Attenuators, Phase Shifter and Isolators.
3. Student will also understand the microwave propagation in ferrites.
4. Analyze the difference between the conventional tubes and the microwave tubes for the transmission of the EM waves.
5. Acquire knowledge about the handling and measurement of microwave equipment.
6. Differentiate different Radars, find applications and use of its supporting systems.

Text Books:

1. Liao, S.Y., " Microwave Devices & Circuits", 3rd Edition, Prentice Hall of India Publication, 1995.
2. Sushrut Das, "Microwave Engineering", 1st Edition, Oxford University Publication, 2015.
3. M.I. Skolnik, "Introduction to Radar Engineering ", 3rd Edition, Tata McGraw Hill Publication, 2001.

Reference Books:

4.. A Das and S.K. Das, "Microwave Engineering", 1st Edition, Tata McGraw Hill Publication, 2000.

VLSI SYSTEM DESIGN

Course Code					
Category	**Professional Core Courses**				
Course title	**VLSI System Design**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester : VI**
	3	**1**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03Hrs				

NOTE: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To learn basic CMOS Circuits
2. To nurture students with CMOS analog circuit designs.
3. To realize importance of testability in logic circuit design.
4. To learn CMOS process technology.
5. To learn the concepts of designing VLSI Subsystems.

UNIT I

Introduction to MOSFETs : MOS Transistor Theory – Introduction MOS Device, Fabrication and Modeling , Body Effect, Noise Margin; Latch-up MOS Inverter :

UNIT II

MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, Design Equations, Static Load MOS Inverters, Transistor Sizing, Static and Switching Characteristics; MOS Capacitor; Resistivity of Various Layers. Symbolic and Physical Layout Systems – MOS Layers Stick/Layout Diagrams; Layout Design Rules, Issues of Scaling, Scaling factor for device parameters.

UNIT III

Combinational MOS Logic Circuits: Pass Transistors/Transmission Gates; Designing with transmission gates, Primitive Logic Gates; Complex Logic Circuits. Sequential MOS Logic Circuits: SR Latch, clocked Latch and flip flop circuits, CMOS D latch and edge triggered flip flop. Dynamic Logic Circuits; Basic principle, non ideal effects, domino CMOS Logic, high performance dynamic CMOSCircuits

UNIT IV

Clocking Issues, Two phase clocking. CMOS Subsystem Design: Semiconductor memories, memory chip organization, RAM Cells, dynamic memory cell.

Course outcomes: At the end of this course students will demonstrate the ability to

1. Understand MOS transistor theory and short channel effects.
2. Calculate Noise Margins & Propagation Delay of CMOS Inverter.
3. Analyze the combinational CMOS circuit for speed, power & area.
4. Implement combinational & sequential CMOS circuit with various topologies like domino logic.
5. Design of memories with efficient architectures to improve access times, power consumption.
6. Design an application using CMOS.

TEXT / REFERENCE BOOKS:

1. S. M. Kang and Y. Leblebici,CMOS Digital Integrated Circuits : Analysis andDesign, Third Edition, MH, 2002.
2. W. Wolf,Modern VLSI Design : System on Chip, Third Edition, PH/Pearson, 2002.
3. N. Weste, K. Eshraghian and M. J. S. Smith,Principles of CMOS VLSI Design : A Systems Perspective, Second Edition (Expanded), AW/Pearson, 2001.
4. J. M. Rabaey, A. P. Chandrakasan and B. Nikolic,Digital Integrated Circuits : A Design Perspective, Second Edition, PH/Pearson, 2003.
5. D. A. Pucknell and K. Eshraghian,Basic VLSI Design : Systems and Circuits, Third Edition, PHI, 1994.

CONTROL SYSTEM LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Control System Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	02Hrs					

Notes:

(iii) At least 10 experiments are to be performed by students in the semester.

(iv) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus. Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS: ANY SIX EXPERIEMENTS

1. To study speed Torque characteristics of
   a) A.C. servo motor
   b) DC servo motor.
2. (a) To demonstrate simple motor driven closed loop DC position control system.
   (b) To study and demonstrate simple closed loop speed control system.
3. To study the lead, lag, lead-lag compensators and to draw their magnitude and phase plots.
4. To study a stepper motor & to execute microprocessor or computer-based control of the same by changing number of steps, direction of rotation & speed.
5. To implement a PID controller for temperature control of a pilot plant.
6. To study behavior of 1st order, 2nd order type 0, type 1 system.
7. To study control action of light control device.
8. To study water level control using a industrial PLC.
9. To study motion control of a conveyor belt using an industrial PLC

SOFTWARE BASED (ANY FOUR EXPT.)

Introduction to SOFTWARE (Control System Toolbox)

10. Different Toolboxes in SOFTWARE, Introduction to Control Systems Toolbox.
11. Determine transpose, inverse values of given matrix.
12. Plot the pole-zero configuration in s-plane for the given transfer function. Plot unitstep response of given transfer function and find peak overshoot, peak time.
13. Plot unit step response and to find rise time and delay time.
14. Plot locus of given transfer function, locate closed loop poles for different values ofk.
15. Plot root locus of given transfer function and to find out S, Wd, Wn at given root & todiscuss stability.
16. Plot bode plot of given transfer function and find gain and phase margins Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands-on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/ disallowed.

Lab Outcomes: At the end of this lab students will demonstrate the ability to

1. Understand the concepts of control systems and importance of feedback in control systems.
2. Perform signal flow graph and formulate transfer function.
3. Perform computations and solve problems on frequency response analysis.
4. Analyse Polar, Bode and Nyquist's plot.
5. Evaluate different types of state models and time functions.
6. Analyse different types of control systems like linear and non-linear control systems, etc

MICROWAVE & RADAR ENGINEERING LABORATORY

Course Code						
Category	**Laboratory Courses**					
Course title	**Microwave & Radar Engineering Laboratory**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**	
	0	**0**	**2**	**1**		
Class Work	50 Marks					
Exam	50 Marks					
Total	100 Marks					
Duration of Exam	02Hrs					

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus. Group of students for practical should be 15 to 20 in number.

COURSE OBJECTIVE:

1. Know about the behavior of microwave components.
2. Understand the radiation pattern of horn antenna.

LIST OF EXPERIMENTS:

1. To study wave guide components.
2. To study the characteristics of Gunn oscillator Gun diode as modulated source.
3. Study of wave guide horn and its radiation pattern and determination of the beam width.
4. To study isolation and coupling coefficient of a magic Tee.
5. To measure coupling coefficient, Insertion loss & Directivity of a Directional coupler.
6. To measure attenuation and insertion loss of a fixed and variable attenuator.
7. To measure isolation and insertion loss of a three port Circulators/Isolator.
8. To measure the standing wave ratio and reflection coefficient in a Microwave Transmission line.
9. To measure the frequency of a microwave source and demonstrate relationship among guide dimensions, free space wavelength and guide wavelength.
10. To measure the impedance of unknown load.
11. Use Doppler RADAR to detect the maximum range.
12. Determine the velocity of the moving objects with the help of RADAR range.
13. Use RADAR system to measure the distance traveled by any object.

Course Outcomes:

1. Demonstrate the characteristics of Microwave sources.
2. Demonstrate the characteristics of directional Couplers
3. To test the characteristics of microwave components
4. To analyze the radiation pattern of antenna
5. To measure antenna gain
6. Practice microwave measurement procedures

ECONOMICS FOR ENGINEERS

Course Code						
Category	**Mandatory Courses**					
Course title	**Economics for Engineers**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**	
	2	**0**	**0**	**0**		
Class Work	30 Marks					
Exam	70 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Note: The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score a minimum of 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of a degree.

Course Objectives:

1. Acquaint the students to basic concepts of economics and their operational significance.
2. Acquaint students with market and its operation.
3. To stimulate the students to think systematically and objectively about contemporary economic problems.

UNIT-I

Definition of Economics- Various definitions, types of economics- Micro and Macro Economics, nature of economic problem, Production Possibility Curve, Economic laws and their nature, Relationship between Science, Engineering, Technology and Economic Development.

Demand- Meaning of Demand, Law of Demand, Elasticity of Demand- meaning, factors effecting it, its practical application and importance.

UNIT-II

Production- Meaning of Production and factors of production, Law of variable proportions, Returns to scale, Internal and external economies and diseconomies of scale.

Various concepts of cost of production- Fixed cost, Variable cost, Money cost,Real cost, accounting cost, Marginal cost, Opportunity cost. Shape of Average cost,Marginal cost, Total cost etc. in short run and long run.

UNIT-III

Market- Meaning of Market, Types of Market- Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly (main features).

Supply- Supply and law of supply, Role of demand & supply in price determinationand effect of changes in demand and supply on prices.

UNIT-IV

Indian Economy- Nature and characteristics of Indian economy as underdeveloped, developing and mixed economy (brief and elementaryintroduction), Privatization - meaning, merits and demerits.Globalization of Indian economy - merits and demerits.Banking- Concept of a Bank, Commercial Bank- functions, CentralBank- functions, Difference between Commercial & Central Bank.

Course outcomes:

1. The students will able to understand the basic concept of economics.
2. The students will able to understand the basic concept of demand.
3. The student will able to understand the concept of production and cost.
4. The student will able to understand the concept of market.
5. The students will able to understand the basic concept of supply.
6. The student will able to understand the concept of privatization, globalization and banks.

References:

1. Jain T.R., Economics for Engineers, VK Publication.
2. Chopra P. N., Principle of Economics, Kalyani Publishers.
3. Dewett K. K., Modern economic theory, S. Chand.
4. H. L. Ahuja., Modern economic theory, S. Chand.
5. Dutt Rudar&Sundhram K. P. M., Indian Economy.
6. Mishra S. K., Modern Micro Economics, Pragati Publications.
7. Singh Jaswinder, Managerial Economics, dreamtech press.
8. A Text Book of Economic Theory Stonier and Hague (Longman's Landon).
9. Micro Economic Theory – M.L. Jhingan (S.Chand).
10. Micro Economic Theory - H.L. Ahuja (S.Chand).
11. Modern Micro Economics: S.K. Mishra (Pragati Publications).

PROJECT-I

Course Code					
Category	**Project**				
Course title	**Project-I**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	0	**0**	**2**	**1**	
Class Work	50 Marks				
Exam	50 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Course objectives:

1. To allow students to demonstrate skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation
2. To encourage research through the integration learned in a number of courses.
3. To allow students to develop problem solvingskills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation and prepare a technical report.

The students are required to undertake institutional project work.

The final Viva voice of the institutional project work will be conducted by an external examiner and one external examiner appointed by the institute. External examiner will be from the panel of examiners submitted by the concerned institute approved by the board of studies in engineering and technology. Assessment of institutional project work will be based on seminar, viva-voice and report of institutional project work obtained by the student from the industry or institute.

The internal marks distribution for the students consists of 50 marks internally and 50 marks by an external examiner.

Course outcomes

On successful completion of the course students will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification and formulation.
3. Design engineering formula to complex problems utilising a systems approach.
4. Researchand engineering project.
5. Communicate with engineers and the community at large in written and oral form.
6. Demonstrate the knowledge, skills and attitudes of a professional engineer.

ROBOTICS & AUTOMATION

Course Code					
Category	**Professional Elective Courses**				
Course title	**Robotics & Automation**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all UNITs, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. To learn about relationship between mechanical structures of industrial robots.
2. To gain understanding of spatial transformation to obtain forward kinematic equation of robot manipulators.
3. To understand inverse kinematics of simple robot manipulators.
4. To learn about Jacobian matrix and use it to identify singularities.

UNIT-I

Introduction: Concept and scope of automation: Socio economic impacts of automation, Types of Automation, Low-Cost Automation

Fluid Power: Fluid power control elements, Standard graphical symbols, Fluid power generators, Hydraulic and pneumatic Cylinders - construction, design and mounting; Hydraulic and pneumatic Valves for pressure, flow and direction control.

UNIT-II

Basic hydraulic and pneumatic circuits: Direct and Indirect Control of Single/Double Acting Cylinders, designing of logic circuits for a given time displacement diagram & sequence of operations, Hydraulic & Pneumatic Circuits using Time Delay Valve & Quick Exhaust Valve, Memory Circuit & Speed Control of a Cylinder, Troubleshooting and "Causes & Effects of Malfunctions" Basics of Control Chain, Circuit Layouts, Designation of specific Elements in a Circuit.

Fluidics: Boolean algebra, Truth Tables, Logic Gates, Coanda effect.

UNIT-III

Electrical and Electronic Controls: Basics of Programmable logic controllers (PLC), Architecture & Components of PLC, Ladder Logic Diagrams

Transfer Devices and feeders: Classification, Constructional details and Applications of Transfer devices, Vibratory bowl feeders, Reciprocating tube, Centrifugal hopper feeders

UNIT-IV

Robotics: Introduction, Classification based on geometry, control and path movement, Robot Specifications, Robot Performance Parameters, Robot Programming, Machine Vision, Teach pendants, Industrial Applications of Robots

Course Outcomes (COs): After studying this course, students will be able:

1. To demonstrate knowledge of the relationship between mechanical structures of industrial robots and
2. To learn robot's operational workspace characteristics.
3. To demonstrate an ability to apply spatial transformation to obtain forward kinematic equation of robot manipulators.
5. To learn PLC
6. To demonstrate an ability to solve inverse kinematics of simple robot manipulators.
7. To demonstrate an ability to obtain the Jacobian matrix and use it to identify singularities.

Text Books:

1. Anthony Esposito, Fluid Power with applications, Pearson
2. S. R Majumdar, Pneumatic Control, McGraw Hill
3. S. R Deb, Robotic Technology and Flexible Automation, Tata Mc Hill
4. Saeed B. Niku Introduction to Robotics, Wiley India
5. Ashitava Ghosal, Robotics, Oxford

WIRELESS SENSOR NETWORKS

Course Code						
Category	**Professional Elective Courses**					
Course title	**Wireless sensor networks**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**	
	3	**0**	**0**	**3**		
Class Work	30 Marks					
Exam	70 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

1. Understand the working principles of the Sensors.
2. Understand the protocols used in sensor networks.
3. Understand design principles of WSN.
4. Understand engineering sensor networks.

UNIT-I

Introduction to Sensor Networks, unique constraints and challenges, Advantage of SensorNetworks, Applications of Sensor Networks, Types of wireless sensor networks, Mobile AdhocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for WirelessSensor Networks. Issues and challenges in wireless sensor networks.

UNIT-II

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, BMACprotocol, IEEE 802.15.4 standard and ZigBee

UNIT-III

Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication

UNIT-IV

Single-node architecture, Hardware components & design constraints, Operating systems andexecution environments, introduction to TinyOS and nesC

Course Outcomes (COs): After studying this course, students will be able:

1. Design wireless sensor networks for a given application
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Understand large sensor network.
5. Understand architecture and hardware components.
6. Explore new protocols for WSN

Text Books:

1. WaltenegusDargie , Christian Poellabauer, " Fundamentals Of Wireless Sensor Networks
2. Theory And Practice", By John Wiley & Sons Publications ,2011
3. SabrieSoloman, "Sensors Handbook" by McGraw Hill publication. 2009
4. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications,2004
5. Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols andApplications, Wiley-Inter science
5. Philip Levis, And David Gay "TinyOS Programming" by Cambridge UniversityPress 2009

MOBILE COMMUNICATION

Course Code						
Category	**Professional Elective Courses**					
Course title	**Mobile Communication**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**	
	3	**0**	**0**	**3**		
Class Work	30 Marks					
Exam	70 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objectives:

During the course, students will be made to learn to:

1. Understand the Cellular concepts.
2. Understand the digital modulation techniques.
3. Understand the mobility in Cellular Systems.
4. Understand GSM.

UNIT-I

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

UNIT-II

Large scale signal propagation. Fading channels-Multipath and small-scale fading- Dopplershift, doppler spread, average and rms delay spread, coherence bandwidth and coherencetime, flat and frequency selective fading, slow and fast fading, average fade duration and
level crossing rate.
Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model,Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor),Partition losses between Floors, Log-distance path loss model.

UNIT-III

Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK,QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM and OFDMA.

UNIT-IV

Mobility in Cellular Systems: The Gateway Concept, Measurement Reports, MobilityProcedures - Mobile IP: Basic Components, Tunneling
GSM: Architecture, – UMTS: Architecture, Basics of CDMA, - Introduction to LTE: History,Architecture - OFDM – Uplink and Downlink Communication in LTE.

Course Outcomes (COs): After studying this course, students will be able:

1. To understand the working principles of the mobile communication systems.
2. To understand the relation between the user features and underlying technology.
3. To analyze mobile communication systems for improved performance.
4. To understand multiple access schemes.
5. To analyze mobility in cellular systems.
6. To discuss GSM.

Text Books:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley,1995.
5. VK Garg & JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall,1996.

POWER ELECTRONICS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Power Electronics**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester : VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

NOTE: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To introduce power semiconductor devices, their switching principles and applications.
2. To explain the operation of AC-DC uncontrolled and controlled rectifier, DC-DC converters and DC-AC inverters.
3. To analyse the power electronic switch based rectifier, converters and inverters.
4. To introduce hardware tools for implementation of power electronic circuits.

UNIT I

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.Standard Driver Circuit Schematics for MoSFETs and IGBTs.

UNIT II

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

UNIT III

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

UNIT IV

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Learn how to analyze inverters and some basic applications.
2. Analyze and design SMPS, controlled rectifiers DC to DC converters. and, DC to AC inverters.
3. Learn and design DC to AC inverters, Charge controllers
4. Analyze typical industrial application requirements and build a solution with commercially available power electronic devices
5. Analyse the operation of DC-DC choppers.
6. Analyse the operation of voltage source inverters

Text /Reference Books:

1) P.S. Bimbhra, Power Electronics, Khanna Book Publishing, 2022.
2) M Singh, K Khanchandani, "Power Electronics" McGraw Hill Education, 2nd Ed., 2017
3) Muhammad H. Rashid, "Power electronics" Prentice Hall of India.
4) Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
5) P.C. Sen., "Modern Power Electronics", edition II, S.Chand & Co.
6) V.R.Moorthi, "Power Electronics", Oxford University Press.
7) Cyril W., Lander," Power Electronics", edition III,McGraw Hill.
8) G K Dubey,S R Doradla,:Thyristorised Power Controllers",New Age International Publishers. SCR manual from GE, USA.

PROFESSIONAL ELECTIVE-III

NANO ELECTRONICS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Nano Electronics**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To understand various aspects of nano-technology and the processes involved inmaking nano components and material.
2. Toleverage advantages of the nano-materials and appropriate use in solvingpractical problems.
3. To understand various aspects of nano-technology.
4. To understand the processes involved inmaking nano components and material.

Unit-I

Introduction to nanotechnology, applications of nano electronics. Basics of QuantumMechanics: Wave nature of particles and wave-particle duality, Pauli Exclusion Principle,wave functions and Schrodinger's equations, Density of States, Band Theory of Solids,Particle in a box Concepts

Unit-II

Shrink-down approaches: CMOS scaling: advantages and limitations. Nanoscale MOSFETs,FINFETs, Vertical MOSFETs, system integration limits (interconnect issues etc.)

Unit-III

Nanostructure materials, classifications of nanostructure materials, zero dimensional, onedimensional, two dimensional and three dimensional, properties and applicationsCharacterization techniques for nanostructured materials: SEM, TEM and AFM

Unit-IV

Nano electronics devices: Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Singleelectron transistors, Carbon nanotube electronics, Band structure and transport, devices,applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Course Outcomes:

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

1. Understand various aspects of nano-technology.
2. Understand processes involved inmaking nano components and material.
3. Leverage advantages of the nano-materials and appropriate use in solvingpractical problems.
4. Understand various aspects of nano-technology and
5. Understand the processes involved inmaking nano components and material.
6. Analyse Nano Electronic devices.

Text/ reference books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, latest edition
2. W. Ranier, Nanoelectronics and Information Technology (AdvancedElectronic Materialand Novel Devices), Wiley-VCH, latest edition
3. K.E. Drexler, Nanosystems, Wiley, latest edition
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, CambridgeUniversity Press, latest edition
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, latest edition

HIGH SPEED ELECTRONICS

Course Code					
Category	**Professional Elective Courses**				
Course title	**High Speed Electronics**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To Study the high-speed electronics system.
2. To Understand Radio frequency amplifiers.
3. To analyse mixers.
4. Learn the fabrication process.

Unit-I

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact ofpackages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery,methodologies for design of high-speed buses; radiated emissions and minimizing system noise.

Unit-II

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Inter -modulation, Cross-modulation, Dynamic range.
Devices: Passive and active, Lumped passive devices (models), Active (models, low vs Highfrequency)

Unit-III

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed)Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-overdistortion Efficiency RF power output stages.
Mixers –Up conversion Down conversion, Conversion gain and spurious response. OscillatorsPrinciples.PLL Transceiver architectures.

Unit-IV

Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication, MicroviaBoards. Board Assembly: Surface Mount Technology, Through Hole Technology, ProcessControl and Design challenges.

Course Outcomes:

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

1. Study the high-speed electronics system.
2. Understand significance and the areas of application of high-speed electronics circuits.
3. Understand the properties of various components used in high-speed electronics.
4. Understand Radio frequency amplifiers.
5. Analyse Mixers.
6. Design High-speed electronic system using appropriate components.

Text/ reference books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: AHandbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press.
2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits",CambridgeUniversity Press, 2004, ISBN 0521835399.
1. Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5.
2. Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall.
3. Kai Chang, "RF and Microwave Wireless systems", Wiley.
4. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

BIOSENSORS

Course Code						
Category	**Professional Elective Courses**					
Course title	**Biosensors**					
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**	
	3	**0**	**0**	**3**		
Class Work	30 Marks					
Exam	70 Marks					
Total	100 Marks					
Duration of Exam	3Hrs					

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To understand the basic principles and classification of sensors and measurands.
2. To know the hardware and software of DAQ system and Electronic Interface systems
3. To understand how to measure various parameters and helps to design simple biomedical sensors.
4. To study about the sensor measurements for biological applications.

UNIT-I

Overview of biosensors and their electrochemistry: Molecular reorganization: Enzymes, Antibodiesand DNA, Modification of bio recognition molecules for Selectivity and sensitivity, Fundamentals ofsurfaces and interfaces

UNIT-II

Bioinstrumentation and bioelectronics devices: Principles of potentiometry and potentiometricbiosensors, Principles of amperometry and amperometric biosensors, Optical Biosensors based onFiber optics, Introduction to Chemometrics, Biosensor arrays; Electronic nose and electronic tongue.

UNIT-III

Iron-Selective Field-Effect Transistor (ISFET), Immunologically Sensitive Field Effect Transistor(IMFET). Fabrication and miniaturization techniques.

UNIT-IV

Sensor-to-Frequency Conversion Data-Acquisition Systems: Hardware and Software of DataAcquisition System (DAS), Electronic Interface, Integrated Sensors, Wireless integration. Smartsensor, Nano sensor.

Course Outcomes:

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

1. Understand the basic principles and classification of sensors and measurands.
2. Understand the hardware and software of DAQ system and Electronic Interface systems.
3. Understand how to measure various parameters and helps to design simple biomedical sensors.
4. Explain the concept of molecular reorganization, fundamentals of surfaces and interfaces.
5. Elucidate the principles of different types of biosensors
6. Understand sensor measurements for biological applications.

Text Books

1. Gardner, J.W., Microsensors, Principles and Applications, John Wiley and Sons(1994).
2. Kovacs, G.T.A., Micromachined Transducer Sourcebook, McGrawHill (2001).
3. Turner, A.P.F., Karube,I., and Wilson G.S., BiosensorsFundamentals and Applications, OxfordUniversity Press (2008)
4. Jon Cooper, Biosensors A Practical Approach, Bellwether Books
5. Manoj Kumar Ram, Venkat R, Bhethanabolta, Sensors for chemical and biological applications,CRC Press

IMAGE PROCESSING

Course Code					
Category	**Professional Elective Courses**				
Course title	**Image Processing**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	3	**0**	**0**	**3**	
Class Work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	3Hrs				

Note: The examiner will set nine questions in total. Question one will be compulsory. Question one will have seven parts of 2 marks each from all units, and the remaining eight questions of 14 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Course Objective: The objectives of this course are as under:

1. To understand need for image transforms different types of image transforms and their properties.
2. Analyse image processing application and Machine vision.
3. Implementing image compression and spatial and frequency domain techniques of image compression.
4. To understand different feature extraction techniques.

UNIT-I

INTRODUCTION: Image Processing Fourier Transform and Z-Transform Causality and stability Toeplit and Circulate Metrics orthogonal and unitary Matrices and Kronecker product, Markov Processes KI Transform Mean square Estimates and Orthogonal Principles.

IMAGE SAMPLING QUANTIZATION: Band Limited Image Sampling Versus Replication, Reconstruction ofImage from samples Sampling Theorem, Sampling Theorem for Random Fields, Optimal Sampling, Nonrectangular Grid Sampling, Sampling Aperture, Display Aperture/ Interpolation Functions, Lagrange Interpolation Moire Effect. Image Quantization Uniform Optimal Quantizer, Properties of Mean Square Quantizer, Commander Design Visual Quantization

UNIT-II

IMAGE TRANSFORMS: Two Dimensional Orthogonal and Unitary Transforms and their properties. One-dimensional and Two Dimensional DFT Cosine and Sine Transforms.Hadamard, Slant, Harr and KL,Transforms and their properties, Approximation to KI Transforms.

IMAGE REPRESENTATION BY STOCHASTIC MODELS: One Dimensional Causal Models, AR and ARMA models, Non Causal Representation Spectral factorization, Image Decomposition.

UNIT-III

IMAGE ENHANCEMENT AND RESTORATION: Point Operation, Histogram Modeling, Spatial Operations, Transform Operations, Multispectral Image Enhancement. Image Observation Models, Inverse and Wiener filtering; FIR Wiener Filters, Filtering using Image Transform Causal Models and recursive filtering Maximum entropy restoration. Extrapolation of band limited signal.

UNIT-IV

IMAGE ANALYSIS AND IMAGE COMPRESSION: Spatial feature extraction, Edge detection and boundary extraction Boundary, region and moment representations structures, Texture, Image Segmentation, Reconstruction from Projections, Pixel Coding, Productive Techniques, Transform Coding Theory, Coding of Image, Coding of two-tone image.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the need for image transforms different types of image transforms and their properties.
2. Develop any image processing application and understand the rapid advances in Machine vision.
3. Learn different techniques employed for the enhancement of images.
4. Learn different causes for image degradation and overview of image restoration techniques.
5. Understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.
6. Learn different feature extraction techniques for image analysis and recognition.

Text Books:

1. Anil Jain, Digital Image Processing, PHI.
2. Gonzalez and Woods, Image Processing, Addison Wesley & Sons.
3. Digital Image Enhancement, Restoration and Compression, 4th Edition, SE Umbaugh, Taylor & Francis/CRC Press, 2023
4. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication",1st edition, PHI