Gurugram University Gurugram

Curriculum for UG Degree Course

in

Electrical and Electronics Engineering

(Engineering and Technology)

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 5

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		Power System I	3	1	0	3	30	70	100
2	PCC		Digital System Design	3	1	0	3	30	70	100
3	PCC		Communication Systems	3	1	0	3	30	70	100
4	PCC		Digital Signal Processing	3	1	0	3	30	70	100
5	PEC		Professional Elective I	3	0	0	3	30	70	100
6	OEC		Open Elective I	3	0	0	3	30	70	100
7	LC		Power System I Lab	0	0	2	1	50	50	100
8	LC		Digital System Design Lab	0	0	2	1	50	50	100
9	LC		Communication Systems Lab	0	0	2	1	50	50	100
10	LC		Digital Signal Processing Lab	0	0	2	1	50	50	100
11	PT		Practical Training-I	0	0	2	1	100	-	100
Total							**23**			**1100**

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.		Special Electrical Machine	3
2.		VLSI	3
3.		Nano Electronics	3
4.		High Speed Electronics	3
5.		Bio-Medical Electronics	3
6.		Power Quality	3

POWER SYSTEM I

Course Code					
Category	**Professional Core Courses**				
Course title	**Power System I**				
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 Objectives:

1. To learn about power system.
2. To gain understanding of faults in power system.
3. To understand Switch gear and protection.
4. To learn about Solar and wind system.

Unit-I

Basic concepts: Introduction, Review of Three-phase systems. Analysis of simple three phase circuits. Single-phase representation of balance three-phase network, The one-line diagram and the impedance or reactance diagram, Per unit (PU) system, Complex power, The steady state model of synchronous machine, Transmission of electric power, Representation of loads.

Unit-II

Fault Analysis: Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

Unit-III

Switchgear and protection: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application

Unit-IV

Introduction to DC Transmission and Solar PV System: DC Transmission Systems: Line- Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission.

Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators.

Course Outcomes:

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

1. Understand the concepts of power systems.
2. Understand the various power system components.
3. Evaluate fault currents for different types of faults.
4. Understand basic protection schemes and circuit breakers.
5. Understand concepts of HVDC power transmission
6. Understand renewable energy generation.

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012
6. EHV-AC/DC Transmission System; S. Rao: Khanna Pub.
7. C.L Wadhwa, “Electrical Power system” new age publication.

8. Transmission & Distribution of Electrical Engineering: Westing House & Oxford Univ. Press, New Delhi
9. Power System Protection & Switchgear by B. Ram, McGraw Hill

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	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 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. Behavioral 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, System Verilog interfaces, System Verilog port connections, Interface instantiation. Interfaces Arguments, Interface Modports, Interface References, Tasks and functions in interface, Verilog Event Scheduler, System Verilog 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. Demonstrate 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

Text/Reference books:

1. Samir Palnitkar “Verilog HDLA Guide to Digital Design Synthesis, “2ndEdition, 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.

COMMUNICATION SYSTEMS

Course Code					
Category	**Professional Core Courses**				
Course title	**Communication Systems**				
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 Objectives:

1. To introduce the students to the basics of different types of modulation techniques
2. To aim at a comprehensive coverage of design of radio transmitter and receiver
3. The course aims to make the student familiar with Digital Modulation and Demodulation techniques.
4. To understand Digital transmission, reception etc.

Unit-I

Course Contents: Review of signals and systems, Frequency domain of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Unit-II

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.
Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Unit-III

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter Symbol Interference and Nyquist criterion.
Bandpass Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Unit-IV

Information Measures: Discrete Source models-Memoryless and Stationary, Mutual Information, Self-Information, Conditional Information, Average Mutual Information, Entropy, Entropy of block, Conditional Entropy, Information Measures for Analog Sources.

Course Outcomes:

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

1. Illustrate the principles of amplitude and angle modulation techniques
2. Understand probability and random process.
3. Analyze the performance of waveform coding techniques.
4. Compare bandpass digital modulation techniques for bit error rate, bandwidth and power requirements
5. Understand the concept of information rate and channel capacity.
6. Understand the concepts of information measure.

Text/Reference Books:

1. B.P.Lathi,Zhi Ding “Modern Digital and Analog Communication”, Oxford, 4th Edition,2011
2. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
3. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
4. Taub H. and Schilling D.L., "Principles of Communication Systems",Tata McGraw Hill, 2001.
5. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.
6. R. Anand, Communication Systems, Khanna Book Publishing Company, 2011.

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 and 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:

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

SPECIAL ELECTRICAL MACHINES

Course Code					
Category	**Professional Elective Courses**				
Course title	**Special Electrical Machines**				
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 describe Poly phase machines.
2. Get familiarized with various structures of induction motor.
3. To discuss Stepper motor.
4. Design and realize various permanent magnet machine.

Unit-I

POLY-PHASE AC MACHINES: Construction and performance of double cage and deep bar three phase induction motors, production of rotating magnetic field, induction motor action, e.m.f. induced in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power), stator voltage control, stator resistance control, frequency control, rotor resistance control, slip power recovery control, induction motor as an induction generator.

Unit-II

SINGLE-PHASE INDUCTION MOTORS: Construction, equivalent circuit, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor start capacitor-run and shaded pole motors.
SINGLE-PHASE COMMUTATOR MOTORS: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction Motors. Construction, principle of operation, applications.
TWO PHASE AC SERVO MOTORS: Construction, torque-speed characteristics, performance and applications.

Unit-III

STEPPER MOTORS: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications.
SWITCHED RELUCTANCE MOTORS: Construction; principle of operation; torque production, modes of operation, drive circuits.

Unit-IV

PERMANENT MAGNET MACHINES: Permanent magnet dc motors, sinusoidal PM ac motors, brushless dc motors and their important features and applications, PCB motors. Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors;

Course Outcomes:

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

1. Impart knowledge on principle of operation and performance of all ac and dc machines with small and higher rating.
2. Understand the concepts of rotating magnetic fields.
3. Understand construction of all ac machines.
4. Analyze performance characteristics of ac machines.
5. Analyze torque and speed characteristics of all ac machines.
6. Prepare the students to have a basic knowledge about motoring, generating and braking mode of ac machines

Text/ reference books:

1. Principle of Electrical Machines, V K Mehta, Rohit Mehta, S Chand
2. Electric Machines, Ashfaq Hussain, Dhanpat Rai
3. Electric Machines: I. J. Nagrath and D.P. Kothari, TMH, New Delhi.

4. Generalized theory of Electrical Machines: P.S. Bhimbra (Khanna Pub.)
5. Electric Machinery, Fitzgerald and Kingsley, MGH.
6. P.C. Sen “Principles of Electrical Machines and Power Electronics” John willey& Sons, 2001
7. G. K. Dubey “Fundamentals of Electric Drives” Narosa Publishing House, 2001.

VLSI

Course Code					
Category	**Professional Elective Courses**				
Course title	**VLSI**				
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 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

BASIC MOS TRANSISTOR: Enhancement mode and Depletion mode – Fabrication (NMOS, PMOS, CMOS, BiCMOS) Technology – NMOS transistor current equation – Second order effects – MOS Transistor Model.

Unit-II

NMOS and CMOS INVERTER AND GATES: NMOS and CMOS inverter – Determination of pull up / pull down ratios – Stick diagram – Lamda based rules – Super buffers – BiCMOS and steering logic.

Unit-III

SUB SYSTEM DESIGN and LAYOUT: Structured design of combinational circuits – Dynamic CMOS and clocking – Tally circuits – (NAND-NAND, NOR-NOR and AOI logic) – EXOR structure – Multiplexer structures – Barrel shifter.

Unit-IV

DESIGN OF COMBINATIONAL ELEMENTS and REGULAR ARRAY LOGIC: NMOS PLA – Programmable Logic Devices - Finite State Machine PLA – Introduction to FPGA.
VHDL PROGRAMMING: RTL Design – Combinational logic – Types – Operators – Packages – Sequential circuit – Sub-programs – Test benches. (Examples: address, counters, flipflops, FSM, Multiplexers / De-multiplexers).

Course 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.

Text/Reference books:

1. D. A. Pucknell, K. Eshraghian, 'Basic VLSI Design', 3rd Edition, Prentice Hall of India, New Delhi, 2003.
2. Introduction to Digital Integrated Circuits: Rabaey, Chandrakasan and Nikolic.
3. Principles of CMOS VLSI Design: Neil H.E. Weste and Kamran Eshraghian; Pearson.
4. N.H.Weste, 'Principles of CMOS VLSI Design', Pearson Education, India, 2002
5. VLSI Technology: S.M. Sze; McGraw-Hill.

NANO ELECTRONICS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Nano 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 various aspects of nano-technology and the processes involved in making nano components and material.
2. To leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. To understand various aspects of nano-technology.
4. To understand the processes involved in making nano components and material.

Unit-I

Introduction to nanotechnology, applications of nano electronics. Basics of Quantum Mechanics: 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, one dimensional, two dimensional and three dimensional, properties and applications Characterization techniques for nanostructured materials: SEM, TEM and AFM

Unit-IV

Nano electronics devices: Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron 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 in making nano components and material.
3. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
4. Understand various aspects of nano-technology and
5. Understand the processes involved in making 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 (Advanced Electronic Material and Novel Devices), Wiley-VCH, latest edition
3. K.E. Drexler, Nano systems, Wiley, latest edition
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University 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: 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 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 of packages, 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 High frequency)

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-over distortion Efficiency RF power output stages.
Mixers –Up conversion Down conversion, Conversion gain and spurious response. Oscillators Principles. PLL Transceiver architectures.

Unit-IV

Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control 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: A Handbook 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

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 therapeutic equipments.

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; Heart sound; 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; Computer tomography; 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 handling bio- 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 therapeutic 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 Hall of India, New Delhi, latest edition

POWER QUALITY

Course Code					
Category	**Professional Elective Courses**				
Course title	**Power Quality**				
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 the various power quality phenomenon, their origin and monitoring and mitigation methods.
2. To understand the effects of various power quality phenomena in various equipments and distinguish between the various categories of power quality problems.
3. To understand the root of the power quality problems in industry and their impact on performance and economics.
4. To apply appropriate solution techniques for power quality mitigation based on the type of problem.
5. To understand importance of grounding and power distribution protection techniques on voltage quality.

Unit-I

Introduction to Power Quality: Terms and definitions of transients, Long Duration Voltage Variations: Under Voltage and Sustained Interruptions; Short Duration Voltage Variations: Interruption, Voltage Sag, Voltage Swell; Voltage Imbalance; Notching; D C offset; Waveform distortion; Voltage fluctuation; Power frequency variations.

Unit-II

Voltage Sag: Sources of voltage sag: Motor starting, Arc furnace, Fault clearing; Estimating voltage sag performance and principle of its protection; Solutions at end user level: Isolation Transformer, Voltage Regulator, Static UPS, Rotary UPS, Active Series Compensator.

Unit-III

Electrical Transients: Sources of Transient Over voltages- Atmospheric transients; Switching transients: Motor starting transients, PF correction capacitor switching transients, UPS switching transients; Neutral voltage swing; Devices for over voltage protection.
Harmonics: Causes of harmonics; Current and Voltage harmonics; Measurement of Harmonics; Effects of harmonics on – Transformers, AC motors, Capacitor banks, Cables, and Protection devices, Energy metering and Communication lines; Harmonic mitigation techniques.

Unit-IV

Measurement and Mitigation of Power Quality Problems: Power quality measurement devices: Harmonic Analyzer, Transient Disturbance Analyzer, Wiring and Grounding tester, Flicker meter, Oscilloscope, Multi-meter; Introduction to Custom Power Devices - Network reconfiguration devices; Load compensation and Voltage regulation using DSTATCOM; Protecting sensitive loads using DVR; Unified Power Quality Conditioner (UPQC).

Course Outcomes:

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

1. Understand the various power quality phenomenon, their origin and monitoring and mitigation methods.
2. Understand the effects of various power quality phenomena in various equipments and distinguish between the various categories of power quality problems.
3. Understand the root of the power quality problems in industry and their impact on performance and economics.
4. Apply appropriate solution techniques for power quality mitigation based on the type of problem.
5. Understand importance of grounding on power quality.
6. Explain power distribution protection techniques and its impact on voltage quality.

Text/ reference books:

1. Roger C Dugan, McGrahan, Santoso & Beaty, “Electrical Power System Quality” McGraw Hill

2. Arinthom Ghosh & Gerard Ledwich, “Power Quality Enhancement Using Custom Power Devices” Kluwer Academic Publishers
3. C. Sankaran, “Power Quality” CRC Press.
4. Francisco C. De La Rosa, “Harmonics and Power Systems” CRC Publication
5. Ambrish Chandra, Bhim Singh, and Kamal Al-Haddad,” Power Quality: Problems and Mitigation Techniques” Wiley publication

POWER SYSTEM I LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Power System I 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	3Hrs				

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

LIST OF EXPERIMENTS:

(A) Hardware Based:

1. To determine negative and zero sequence reactances of an alternator.
2. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation
3. To study the IDMT over current relay and determine the time current characteristics
4. To study percentage differential relay
5. To study Impedance, MHO and Reactance type distance relays
6. To study ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.
7. To study operation of oil testing set.
8. To understand PV modules and their characteristics like open circuit voltage, short circuit current, Fill factor, Efficiency,
9. To understand I-V and P-V characteristics of PV module with varying radiation and temperature level
10. To understand the I-V and P-V characteristics of series and parallel combination of PV modules.
11. To understand wind energy generation concepts like tip speed, torque and power relationship, wind speed versus power generation

(B) Simulation Based Experiments (using MATLAB or any other software)

12. To obtain steady state, transient and sub-transient short circuit currents in an alternator
13. To perform symmetrical fault analysis in a power system
14. To perform unsymmetrical fault analysis in a power system

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 power systems.
2. Understand the various power system components.
3. Evaluate fault currents for different types of faults.
4. Understand basic protection schemes and circuit breakers.
5. Understand concepts of HVDC power transmission
6. Understand renewable energy generation.

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	3Hrs				

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 and Sequential Design Exercises using FPGA (Spartan 3) and CPLD

1. Design of Half-Adder, Full Adder, Half Subtractor, Full Subtractor
2. Design a parity generator
3. Design a 4 Bit comparator
4. Design a RS and JK Flip flop
5. Design a 4: 1 Multiplexer
6. Design a 4 Bit Up / Down Counter with Loadable Count
7. Design a 3: 8 decoders
8. Design a 8 bit shift register
9. Design a arithmetic unit
10. Implement ADC and DAC interface with FPGA
11. Implement a serial communication interface with FPGA
12. Implement a Telephone keypad interface with FPGA
13. Implement a VGA interface with FPGA
14. Implement a PS2 keypad interface with FPGA
15. 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.

COMMUNICATION SYSTEMS LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Communication Systems 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	3Hrs				

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

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. To study and waveform analysis of amplitude modulation and determine the modulation index of amplitude modulation.
2. To study and waveform analysis of amplitude demodulation by any method.
3. To study and waveform analysis of frequency modulation and determine the modulation index of frequency modulation.
4. To study and waveform analysis of frequency demodulation by any method.
5. To study Amplitude Shift Keying (ASK) modulation.
6. To study Frequency Shift Keying (FSK) modulation.
7. To study Phase Shift Keying (PSK) modulation.
8. To study and waveform analysis of phase modulation.
9. To study Phase demodulation.
10. To study Pulse code modulation.
11. To study Pulse amplitude modulation and demodulation.
12. To study Pulse width modulation.
13. To study Pulse position modulation.
14. To study delta modulation.
15. To deliver a seminar by each student on ADVANCE COMMUNICATION SYSTEMS.

Note: -

1. Total ten experiments are to be performed in the semester
2. At least seven experiments should be performed from the above list. Remaining three experiments should be performed as designed and set by the concerned institution as per the scope of the syllabus.

Lab Outcomes:

At the end of this lab, students will demonstrate the ability to;

1. Illustrate the principles of amplitude and angle modulation techniques
2. Understand probability and random process.
3. Analyze the performance of waveform coding techniques.
4. Compare bandpass digital modulation techniques for bit error rate, bandwidth and power requirements
5. Understand the concept of information rate and channel capacity.
6. Understand the concepts of information measure.

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	3Hrs				

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

1. Introduction to MATLAB.
2. 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 and 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.

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	100				
Exam	**-**				
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.

Gurugram University Scheme of Studies and Examination

Bachelor of Technology Semester 6

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		Power System II	3	1	0	3	30	70	100
2	PCC		Control System	3	1	0	3	30	70	100
3	PCC		Microprocessors and Microcontrollers	3	1	0	3	30	70	100
4	PEC		Professional Electives II	3	0	0	3	30	70	100
5	PEC		Professional Electives III	3	0	0	3	30	70	100
6	OEC		Open Elective II	3	0	0	3	30	70	100
7	LC		Power System II Lab	0	0	2	1	50	50	100
8	LC		Control System Lab	0	0	2	1	50	50	100
9	LC		Microprocessors and Microcontrollers Lab	0	0	2	1	50	50	100
10	PROJ		Project-I	0	0	4	2	50	50	100
11	HSMC		Economics for Engineers*	2	0	0	-	30	70	100*
Total							**23**			**1000**

NOTE:

1. 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.
2. Choose any one from each of the Professional Elective Course-II and III
3. Choose any one from Open Elective Course-II

PROFESSIONAL ELECTIVE- II (Semester-VI)

Sr. No	Code	Subject	Credit
1.		Robotics and Automation	3
2.		Energy Management and Auditing	3
3.		Introduction to MEMS	3
4.		Wireless Sensor Networks	3
5.		Mobile Communications	3

PROFESSIONAL ELECTIVE- III (Semester-VI)

Sr. No	Code	Subject	Credit
1.		Power Plant Engineering	3
2.		Power System Protection	3
3.		Electrical and Hybrid Vehicle	3
4.		Modelling and Analysis of Electrical Machines	3
5.		Electrical Safety and Standards	3

***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.

POWER SYSTEM-II

Course Code					
Category	**Professional Core Courses**				
Course title	**Power System II**				
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 Objectives:

1. To learn about power flow analysis.
2. To gain understanding of economics of power system.
3. To understand voltage and load frequency control.
4. To learn about power system stability.

Unit-I

Power Flow Analysis: Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations.

Unit-II

Economic Operation of Power Systems: Distribution of loads between units within a plant. Distribution of loads between plants, Transmission loss equation, Classical Economic dispatch with losses. Optimal unit commitment problems and their solutions.

Unit-III

Voltage and Load Frequency Control: Introduction to control of active and reactive power flow, control of voltage, Excitation systems. Introduction to Load Frequency Control and Automatic generation control, Single area and modelling of AGC, Concept of multi area AGC.

Unit-IV

Power System Stability: Concepts, steady state and transient stability, swing equations, equal area criterion. Solution of Swing Equation, Transient stability algorithm using modified Euler's method and fourth order Runga Kutta method, – multi-machine stability analysis.

Course Outcomes:

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

1. Use numerical methods to analyse a power system in steady state.
2. Formulate Ybus and Zbus.
3. Apply load flow analysis on a power system.
4. Understand stability constraints in a synchronous grid.
5. Understand methods to control the voltage, frequency and power flow.
6. Understand the basics of power system economics

Text/References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

CONTROL SYSTEM

Course Code					
Category	**Professional Core Courses**				
Course title	**Control System**				
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 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 Representation Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system

Unit-II

Time Response Analysis and Stability Concept Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant 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 Analysis Bode Plot - Polar Plot- Nyquist Plots-Design of compensators using Bode Plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation

Unit-IV

Control System Analysis Using State Variable Methods State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function 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:

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 and Gopal, "Modern Control Engineering", New Age International, New Delhi

MICROPROCESSORS AND MICROCONTROLLERS

Course Code					
Category	**Professional Core Courses**				
Course title	**Microprocessors and Microcontrollers**				
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.

1. To develop an in-depth understanding of the operation of microprocessors and microcontroller.
2. To master the assembly language programming using concepts like assembler directives, procedures, macros, software interrupts etc.
3. To create an exposure to basic peripherals, its programming and interfacing techniques.
4. To understand the concept of Interrupts and interfacing details of 8086 and microcontroller.

Unit-I

THE 8086 MICROPROCESSOR

Introduction to 8086 — Microprocessor architecture — Addressing modes — Instruction set and assembler directives — Assembly language programming — Modular Programming — Linking and Relocation — Stacks — Procedures — Macros — Interrupts and interrupt service routines — Byte and String Manipulation.

Unit-II

8086 SYSTEM BUS STRUCTURE

8086 signals — Basic configurations — System bus timing –System design using 8086 — I/O programming — Introduction to Multiprogramming — System Bus Structure — Multiprocessor configurations — Coprocessor, closely coupled and loosely Coupled configurations — Introduction to advanced processors.

Unit-III

I/O INTERFACING

Memory Interfacing and I/O interfacing — Parallel communication interface — Serial communication interface — D/A and A/D Interface — Timer — Keyboard /display controller — Interrupt controller — DMA controller — Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller.

Unit-IV

MICROCONTROLLER

Architecture of 8051 — Special Function Registers (SFRs) — I/O Pins Ports and Circuits — Instruction set — Addressing modes — Assembly language programming.

INTERFACING MICROCONTROLLER

Programming 8051 Timers — Serial Port Programming — Interrupts Programming — LCD and Keyboard Interfacing — ADC, DAC and Sensor Interfacing — External Memory Interface- Stepper Motor and Waveform generation — Comparison of Microprocessor, Microcontroller, PIC and ARM processors

Course Outcomes:

At the end of this course students will be able to:

1. Understand the fundamentals of Microprocessors.
2. Understand the internal design of 8051 microcontroller along with the features and their programming.
3. Competent with the on-chip peripherals of microcontrollers.
4. Design different interfacing applications using microcontrollers and peripherals.
5. Demonstrate the limitations and strengths of different types of microcontrollers and their comparison.
6. Build systems using microcontrollers for real time applications.

List of References:

1. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Penram International, 2009.
2. Douglas Hall, “Microprocessor and Interfacing”, 2nd Edition, TMH, 2006.
3. Muhammad A. Mazidi, “The 8051 Microcontroller And Embedded Systems Using Assembly and C”, 2nd Edition., PHI, 2012.
4. Kenneth J. Ayala, “The 8051 Microcontroller”, 3rd Edition., Cengage Learning Publication, 2007.
5. Ajit Pal, “Microcontrollers: Principals and Applications”, 2nd Edition, PHI, 2011. 6. Datasheet of P89V51RD2

ROBOTICS AND AUTOMATION

Course Code					
Category	**Professional Elective Courses**				
Course title	**Robotics and 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 and sequence of operations, Hydraulic and Pneumatic Circuits using Time Delay Valve and Quick Exhaust Valve, Memory Circuit and Speed Control of a Cylinder, Troubleshooting and "Causes and 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 and 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.
4. to learn PLC
5. to demonstrate an ability to solve inverse kinematics of simple robot manipulators.
6. 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

ENERGY MANAGEMENT AND AUDITING

Course Code					
Category	**Professional Elective Courses**				
Course title	**Energy Management and Auditing**				
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 illustrate the concept energy management.
2. To introduce to energy audit study.
3. To study the basics of electrical energy management.
4. To learn about alternative energy.

Unit-I

Introduction: Introduction to energy management, Organizational Structure, Energy Policy and planning, Peak Demand controls, Methodologies, Types of Industrial Loads, Optimal Load Scheduling-Case studies.

Unit-II

Energy Auditing: Introduction, Energy Auditing Services, Basic Components of an Energy Audit, Specialized Audit Tools, Industrial Audits, Commercial Audits, Residential Audits, Indoor Air Quality and basics of economic analysis, cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.

Unit-III

Electric Energy Management: Introduction, Power Supply Effects of Unbalanced Voltages on the Performance of Motors, Power Factor, Electric motor Operating Loads, Determining Electric Motor Operating Loads, Power Meter, Slip Measurement, Electric Motor Efficiency, Sensitivity of Load to Motor RPM, Theoretical Power Consumption, Motor Efficiency Management, Motor Performance Management Process

Unit-IV

Alternative Energy: Introduction, Solar Energy, Wind Energy and other renewable resources for energy management.

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

1. Understand the fundamentals of energy management systems.
2. Carry out various energy audit processes.
3. Describe Indoor Air Quality and basics of economic analysis
4. Understand various factors affecting performance of system.
5. Describe methods to improve efficiency of electrical energy systems.
6. Asses the use of alternative energy sources in improving the energy management

Text Books:

1. Wayne C. Turner, Steve Doty, Energy Management Handbook, The Fairmont Press, Inc.
2. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, Guide to Energy Management, CRC Press.
3. Albert Thumann, William J. Younger, Handbook of Energy Audits, CRC Press, 2003.
4. Charles M. Gottschalk, Industrial energy conservation, John Wiley & Sons, 1996.
5. Craig B. Smith, Energy management principles, Pergamon Press.
6. D. Yogi Goswami, Frank Kreith, Energy Management and Conservation Handbook, CRC Press, 2007
7. G.G. Rajan, Optimizing energy efficiencies in industry -, Tata McGraw Hill, Pub. Co., 2001.
8. IEEE recommended practice for energy management in industrial and commercial facilities, IEEE std 739 - 1995
9. M Jayaraju and Premlet, Introduction to Energy Conservation and Management, Phasor Books, 2008
10. Paul O'Callaghan, Energy management, McGraw Hill Book Co.

INTRODUCTION TO MEMS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Introduction to MEMS**				
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 illustrate the concept of micro/nanosystems.
2. To introduce to state-of-the-art lithography techniques for micro/nanosystems.
3. To study the new materials, science and technology for micro/nanosystem applications
4. To learn about state-of-the-art micromachining and packaging technologies.

Unit-I

Overview of MEMS and Microsystems: 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 in miniaturization: Introduction to Scaling, Scaling in Geometry, Rigid Body dynamics, Electrostatic forces, Electromagnetic forces, Electricity, Fluid Mechanics, Heat Transfer, Over view of Micro/Nano Sensors, Actuators and Systems.

Unit-II

Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isot ropic 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 (COs): After studying this course, students will be able:

1. Be introduced to the field of micro/nanosystems
2. Grain a knowledge of basic approaches for micro/nanosystem design
3. Gain a knowledge of state-of-the-art lithography techniques for micro/nanosystems.
4. Learn new materials, science and technology for micro/nanosystem applications.
5. Understand materials science for micro/nanosystem applications
6. Understand state-of-the-art micromachining and packaging technologies

Text Books:

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.

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 Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks, Mobile Adhoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

Unit-II

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, BMAC protocol, 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 and design constraints, Operating systems and execution 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. Waltenegus Dargie , Christian Poellabauer, " Fundamentals Of Wireless Sensor Networks
2. Theory And Practice", By John Wiley & Sons Publications ,2011
3. Sabrie Soloman, "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 and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "TinyOS Programming" by Cambridge University Press 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 3G cellular standards.

Unit-II

Large scale signal propagation. Fading channels-Multipath and small-scale fading- Doppler shift, doppler spread, average and rms delay spread, coherence bandwidth and coherence time, 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, Mobility Procedures - 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 PLANT ENGINEERING

Course Code					
Category	**Professional Elective Courses**				
Course title	**Power Plant Engineering**				
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. Acquaint the students to basic concepts of power plant.
2. To stimulate the students to think about power generation by renewable and non-renewable energy resources.
3. To acquaint the students to different types of power plant.
4. To Understand the principal components, efficiency and types of power plants.

Unit-I

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Unit-II

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit-III

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit-IV

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Outcomes:

Upon completion of the course students will be able to:

1. Understand the basics of Power Plants.
2. Understand the idea about the power generation by renewable and non-renewable energy resources.
3. Understand about the different types of cycles and natural resources used in power plants and their applications.
4. Understand the principal components and types of nuclear reactors.
5. Understand the principal components and types of hydro power plants.
6. Estimate different efficiencies associated with power plant systems.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998

POWER SYSTEM PROTECTION

Course Code					
Category	**Professional Elective Courses**				
Course title	**Power System Protection**				
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. Acquaint the students to basic concepts of protection system.
2. To understand the protection schemes for different power system components.
3. To understand the basic principles of digital protection.
4. To understand system protection schemes, and the use of wide-area measurements.

Unit-I

Introduction and Components of a Protection System

Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers, Generator Protection: External and internal faults – differential protection – biased circulating current protection – self balance system – over-current and earth fault protection – protection against failure of excitation

Unit-II

Faults and Over-Current Protection

Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination. Transformer protection: Differential protection – self-balance system of protection – overcurrent and earth fault protection – Buchholz's relay and its operation.

Unit-III

Equipment Protection Schemes

Directional, Distance, Differential protection. Bus bar Protection, Bus Bar arrangement schemes.

Modelling and Simulation of Protection Schemes

CT/PT modelling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

Unit-IV

System Protection

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

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

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of faults in a network.
3. Understand the protection schemes for different power system components.
4. Analyze model and simulation of protection schemes.
5. Understand the basic principles of digital protection.
6. Understand system protection schemes, and the use of wide-area measurements.

Text/References:

1. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
2. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.
3. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
4. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
5. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

ELECTRICAL AND HYBRID VEHICLE

Course Code					
Category	**Professional Elective Courses**				
Course title	**Electrical and Hybrid Vehicle**				
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. Acquaint the students to basic concepts of electric and hybrid electric vehicles.
2. To understand the power electronics devices and electrical machines.
3. To understand the different energy storage devices.
4. To understand different configurations of electric vehicles.

Unit-I

ELECTRIC VEHICLES

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

Unit-II

BATTERY

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

Unit-III

DC and AC ELECTRICAL MACHINES

Motor and Engine rating, Requirements, DC machines, three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

Unit-IV

ELECTRIC VEHICLE DRIVE TRAIN

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

HYBRID ELECTRIC VEHICLES

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

Course Outcomes:

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

1. Explain the basics of electric and hybrid electric vehicles.
2. Explain the architecture, technologies and fundamentals of EV.
3. Analyse the use of different power electronics devices and electrical machines in hybrid electric vehicles.
4. Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies.
5. Explain the use of different control and select appropriate technology in EV.
6. Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs.

Reference Books:

1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
3. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
4. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000

MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

Course Code					
Category	**Professional Elective Courses**				
Course title	**Modelling and Analysis of Electrical Machines**				
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 provide a comprehensive exposure to electrical machine design.
2. To understand various design principles and magnetic circuits.
3. To work on detailed designs.
4. To know about various computer aided design.

Unit-I

GENERAL: General features and limitations of electrical machine design. Types of enclosures, heat dissipation, temperature rise heating and cooling cycles and ratings of machine machines. Cooling media used.

BASIC DESIGN PRINCIPLES: Output equation and output coefficient, Specific electric and magnetic loading. Effect of size and ventilation.

Unit-II

MAGNETIC CIRCUITS: MMF calculation for airgun and iron parts of electrical machines, gap contraction coefficient. Real and apparent flux densities. Estimation of magnet current of transformers and rotating machines, no load current of transformers and induction motors. Leakage flux and reactance calculations for transformers and rotating machines, Design of field magnet.

Unit-III

DETAILED DESIGN: Design of transformer, D.C. machines induction motor and synchronous machine and their performance calculations.

Unit-IV

COMPUTER AIDED DESIGN: Computerization of design Procedures. Development of Computer program and performance prediction. Optimization techniques and their applications to design Problems.

Course Outcomes:

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

1. Describe electrical machine design.
2. Analyze and apply various design principles.
3. Understand magnetic circuits.
4. Carry out detailed design.
5. Carry out proper computer aided design.
6. Apply optimization technique to design problems.

Text books:

1. A course in Electrical Machine Design by A.K. Sawhney, Khanna Pub.

Reference books:

1. Theory, performance and Design of alternating current machines by MG Say, ELBS, 15th Ed. 1986.
2. Theory, Performance and Design of Direct Current machines by A.E. Clayton, 3rd Ed. 1967. Optimization Techniques, S.S. Rao

ELECTRICAL SAFETY AND STANDARDS

Course Code					
Category	**Professional Elective Courses**				
Course title	**Electrical Safety and Standards**				
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 provide a comprehensive exposure to electrical hazards.
2. To understand various grounding techniques and safety procedures
3. To understand various safety audit Electrical safety programme structure
4. To know about various electrical maintenance techniques

Unit-I

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram electrician's safety kit.

Unit-II

General requirements for grounding and bonding- definitions- grounding of electrical equipment bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment- system grounding- purpose of system grounding-grounding electrode system grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems.

Unit-III

The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment, procedure for low, medium and high voltage systems- the one minute safety audit Electrical safety programme structure, development- company safety team safety policy programme implementation- employee electrical safety teams- safety meetings- safety audit accident prevention- first aid-rescue techniques-accident investigation

Unit-IV

Safety related case for electrical equipments, Various Standards: IEEE, IEC, IS..., regulatory bodies national electrical safety code-standard for electrical safety in work place- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

Course Outcomes:

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

1. Describe electrical hazards and safety equipment.
2. Analyze and apply various grounding and bonding techniques
3. Select appropriate safety method for low, medium and high voltage equipment.
4. Understand various safety audit Electrical safety programme structure
5. Participate in a safety team.
6. Carry out proper maintenance of electrical equipment by understanding various standards.

Text/References

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield,'Electrical Safety Handbook', McGraw-Hill Education, 4thEdition, 2012.
2. Sunil S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi, 1988.

3. Maxwell Adams.J, ‘Electrical Safety- a guide to the causes and prevention of electric hazards’, The Institution of Electric Engineers, IET 1994.
4. Ray A. Jones, Jane G. Jones, ‘Electrical Safety in the Workplace’, Jones & Bartlett Learning, 2000.

POWER SYSTEM II LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Power System II 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	3Hrs				

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

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. Draw the flow chart and develop the computer program for the formation of the Y Bus of a generalized network.
2. Draw the flow chart and develop the computer program for the formation of the Z Bus of a generalized network.
3. To plot the swing curve and observe the stability.
4. To perform load flow analysis using Gauss Seidel method.
5. To perform load flow analysis using Newton-Raphson method.
6. To study comparison of different load flow methods
7. To develop the program for stability analysis.
8. To observe transmission losses and efficiency with variations in power for the given example.
9. Simulation study on LFC of two area interconnected power system.
10. Simulation study on voltage control in multi area interconnected power system.

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. Use numerical methods to analyse a power system in steady state.
2. Formulate Ybus and Zbus.
3. Apply load flow analysis on a power system.
4. Understand stability constraints in a synchronous grid.
5. Understand methods to control the voltage, frequency and power flow.
6. Understand the basics of power system economics

CONTROL SYSTEM LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Control System 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	3Hrs				

Notes:

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

(iii) 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 and to execute microprocessor or computer-based control of the same by changing number of steps, direction of rotation and 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 unit step 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 of k.
15. Plot root locus of given transfer function and to find out S, Wd, Wn at given root and to discuss 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.

MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Course Code					
Category	**Laboratory Courses**				
Course title	**Microprocessors and Microcontrollers 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	3Hrs				

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.

(iii) Group of students for practical should be 15 to 20 in number.

List of Experiments:

1. Write a program using 8085 and verify for:
   a) Addition of two 8-bit numbers.
   b) Addition of two 8-bit numbers (with carry).
2. Write a program using 8085 and verify for:
   a) 8-bit subtraction (display borrow)
   b) 16-bit subtraction (display borrow)
3. Write a program using 8085 for multiplication of two 8- bit numbers by repeated addition method. Check for minimum number of additions and test for typical data.
4. Write a program using 8085 for multiplication of two 8- bit numbers by bit rotation method and verify.
5. Write a program using 8086 for finding the square root of a given number and verify.
6. Write a program using 8086 for copying 12 bytes of data from source to destination and verify.
7. Write a program using 8086 and verify for:
   a) Finding the largest number from an array.
   b) Finding the smallest number from an array.
8. Write a program using 8086 for arranging an array of numbers in descending order and verify.
9. Write a program using 8086 for arranging an array of numbers in ascending order and verify.
10. Write a program to interface a two-digit number using seven-segment LEDs. Use 8085/8086 microprocessor and 8255 PPI.
11. Write a program to control the operation of stepper motor using 8085/8086 microprocessor and 8255 PPI.
12. To study implementation and interfacing of Display devices Like LCD, LED Bar graph and seven segment display with Microcontroller 8051/AT89C51
13. To study implementation and interfacing of Different motors like stepper motor, DC motor and servo Motors.
14. Write an ALP for temperature and pressure measurement
15. Write a program to interface a graphical LCD with 89C51

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 be able to:

1. Understand the fundamentals of Microprocessors.
2. Understand the internal design of 8051 microcontroller along with the features and their programming.
3. Competent with the on-chip peripherals of microcontrollers.
4. Design different interfacing applications using microcontrollers and peripherals.
5. Demonstrate the limitations and strengths of different types of microcontrollers and their comparison.
6. Build systems using microcontrollers for real time applications.

PROJECT-I

Course Code					
Category	**Project**				
Course title	**Project-I**				
Scheme	**L**	**T**	**P**	**Credits**	**Semester: VI**
	0	**0**	**4**	**2**	
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 solving skills.
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. Research and 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.

ECONOMICS FOR ENGINEERS

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

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 and supply in price determination and effect of changes in demand and supply on prices.

Unit-IV

Indian Economy- Nature and characteristics of Indian economy as under developed, developing and mixed economy (brief and elementary introduction), Privatization - meaning, merits and demerits. Globalization of Indian economy - merits and demerits. Banking- Concept of a Bank, Commercial Bank- functions, Central Bank- functions, Difference between Commercial and 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).