DEPARTMENT OF ELECTRICAL ENGINEERING

Scheme of Instruction

and

Syllabi of

B.E. (Electrical & Electronics Engineering)

V & VI SEMESTER

AICTE Model Curriculum

2020-2021

UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)

OSMANIA UNIVERSITY

HYDERABAD – 500 007, TELANGANA

UNIVERSITY COLLEGE OF ENGINEERING

Vision

The Vision of the Institute is to generate and disseminate knowledge through a harmonious blending of Science, Engineering and Technology. To serve the society by developing a modern technology in students' heightened intellectual, cultural, ethical and humane sensitivities, fostering a scientific temper and promoting professional and technological expertise.

Mission

- To achieve excellence in Teaching and Research
- To generate, disseminate and preserve knowledge
- To enable empowerment through knowledge and information
- Advancement of knowledge in Engineering, Science and Technology
- Promote learning in free thinking and innovative environment
- Cultivate skills, attitudes to promote knowledge creation
- Rendering socially relevant technical services for the community
- To impart new skills of technology development
- To inculcate entrepreneurial talents and technology appreciation programmes
- Technology transfer and incubation

DEPARTMENT OF ELECTRICAL ENGINEERING

Vision

To strive for excellence in education and research; meet the requirement of industry in the field of electrical engineering to serve the nation.

Mission

- To provide knowledge-based technology and service to meet the needs of society in electrical and allied industries.
- To help in building national capabilities for excellent energy management and to explore non-conventional energy sources.
- To create research-oriented culture and to provide competent consultancy.
- To create and sustain environment of learning in which students acquire knowledge and learn to apply it professionally with due consideration of ethical and economic issues.
- To be accountable through self-evaluation and continuous improvement.

Programme Educational Objectives(PEOs) for BE (EEE) programme

PEO1	To provide students with a solid foundation in Mathematics, Sciences and Electrical Engineering which prepares students for further studies and hence research in Electrical Engineering and for a wide range of career opportunities in Industries and academics.
PEO2	To train the students with good engineering breadth so as to comprehend, analyze, innovate and design new products in electrical domain, to provide technical solutions to real life problems and to render technical services to the needs of the society.
PEO3	To inculcate professional and ethical attitude, creative, effective communication and presentation skills and enhanced ability to work in teams to pursue complex, open-ended investigations and research in electrical engineering for effective knowledge transfer.
PEO4	To provide students with an academic environment aware of excellence, proactiveness, leadership positions in multidisciplinary teams,entrepreneurial talent and lifelong learning for successful professional career.

Programme Outcomes (POs) of BE (EEE) Programme

Engineering Graduates will be able to:

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs) of BE (EEE) Programme

Engineering Graduates will be able to:

PSO1	Find solutions for effective operation and control of power systems to achieve quality and reliable power supply.
PSO2	Provide solutions for efficient and intelligent control of electric drives and renewable energy systems with electronic circuits for domestic and industrial applications.

SCHEME OF INSTRUCTION

V - SEMESTER

B.E. (Electrical & Electronics Engineering)

AICTE Model Curriculum

S. No.	Course Code	Course Title	Scheme of Instruction			Contact Hours / Week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1.	PC501EE	Electrical Machines-III	3	1	0	4	30	70	4
2.	PC502EE	Measurements and Instrumentation	3	1	0	4	30	70	4
3.	PC503EE	Linear Control Systems	3	1	0	4	30	70	3
4.	PC504EE	Microprocessors and Microcontrollers	3	0	0	3	30	70	3
5.	HS901MB	Managerial Economics and Accountancy	3	0	0	3	30	70	3
6.	**ProfessionalElective-I**		3	0	0	3	30	70	3
	PE511EE	Electric Distribution System							
	PE512EE	Renewable Energy Sources							
	PE513EE	Hybrid Electric Vehicles							
Practical									
1.	PC551EE	Power Electronics Lab	0	0	2	2	25	50	1
2.	PC552EE	Microprocessors and Microcontrollers Lab	0	0	2	2	25	50	1
			18	**03**	**04**	**25**	**230**	**520**	**22**

L: Lectures
T: Tutorials
P: Practical classes
CIE: Continuous Internal Evaluation
SEE: Semester End Examination

PC501EE

ELECTRICAL MACHINES-III

Instruction: 4periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 4

Course Objectives*:*

- To be able to understand in detail about synchronous machines. Construction, principle, performance characteristics and testing.
- To understand the construction, principle and performance characteristics of special machines.

Course Outcomes:

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

1. Acquire the knowledge of types, Constructional Details, characteristics and applications of synchronous generator, synchronous motor, PMSM and brushless DC motors.
2. Explain different methods used to evaluate voltage regulation of synchronous generator.
3. Analyze the behavior of an alternator under transient disturbances.

UNIT - I

Synchronous machines: Types and Constructional Details - Types of Winding, Winding factors - E.M.F. equation - Fractional pitch and fractional slot windings - Suppression of harmonics and tooth ripple -Armature reaction and reactance - Synchronous impedance.

UNIT - II

Synchronous Generator: Voltage Regulation - Phasor diagram of alternator with non-salientpoles - O.C. and S.C. Characteristics- Synchronous impedance, Ampere turn, ZPF methods for finding regulation - Principle of two reaction theory and its application for the salient pole-synchronous machine analysis - Synchronizing and parallel operation.

UNIT-III

Synchronous Motor: Theory of operation - Vector diagram - Variation of current and p.f. withexcitation - Hunting and its prevention - Current and power circle diagram - Predetermination of performance - Methods of starting and synchronizing - Synchronizing power, Synchronous condenser. Applications.

UNIT- IV

Transient Stability Studies: Elementary ideas of transient behavior of an Alternator – Threephase short circuit of an Alternator- Analysis of symmetrical and asymmetrical short circuit current.

UNIT-V

Special Machines: Brushless D.C. Motors:Construction & Principle of Operation, Torque equation, Torque -angle Characteristics, Applications.
Switched Reluctance Motor: Constructional features, Principle of operation, Torque production, Torque - angle characteristics, various operating modes of SRM, applications.
Permanent Magnet Synchronous Motor: Construction, principle operation of PMSM and theiroperating characteristics. Applications.

Suggested Reading*:*

1. Kothari D.P. &Nagrath I.J. - Electrical Machines - Tata McGraw Hill, 2004.
2. Bhimbra P.S. - Generalized Theory of Electrical Machines, Khanna Publications, 2000.
3. Say MG. - The Performance and Design of AC. Machines - Pitman Publication, 2002.
4. Irving L. Kosow - Electric Machinery and Transforn1ers, PPH, Pearson Education, 2nd Edition. 2009.

PC502EE

MEASUREMENTS AND INSTRUMENTATION

Instruction: 4periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 4

Course Objectives:

- To learn and understand the fundamental concepts, principle of operation andapplications of various electrical measuring instruments.
- To understand various types of Bridges in measurement of resistance, inductance, capacitance and frequency.
- To understand the operation and applications of Ballistic Galvanometer, Flux meter and DC/AC Potentiometer.
- To understand the application of CRO for measurement of Amplitude, Phase and frequency of sinusoidal signals.

Course Outcomes:

At the end of the course students will be able to

1. Choose the suitable instrument like Ammeter, Voltmeter for AC/DC applications.
2. Select suitable Bridge for measurement of electrical parameters and quantities.
3. Use CRO for measurement of Amplitude, Phase and frequency of sinusoidal signals.

UNIT I

Instruments: indicating, Recording and Integrating instruments, Ammeter, Voltmeter, Expression for torque of moving coil, moving iron, Dynamometer, induction and electrostatic instruments. Extension of range of instruments, Wattmeter Torque expression for dynamometer instruments, Reactive power measurement.

UNIT II

Meters: Energy meters, single phase and 3-phase, Driving torque and braking torque equations, Errors and testing compensation, Maximum demand indicator, Power factor meters, Frequency meters, Electrical resonance and Weston type of synchroscope.

UNIT III

Bridge Methods and transducers: Measurement of inductance, capacitance and resistance using Bridges, Maxwell's, Hay's. bridge, Anderson, Wein, Desauty's, Schering's bridges, Kelvin's double bridge, Megger, Loss of charge method, Wagner's earthing device, Transducers - Analog and digital transducers, Strain gauges and Hall effect transducers.

UNIT IV

Magnetic Measurements and instrument transformers: Ballistic galvanometer, Calibration by Hibbert' s magnetic standard flux meter, Lloyd-Fischer square for measuring iron loss, Determination of B-H curve and Hysteresis loop using CRO, Instrument transformers – Current and potential transformers, ratio and phase angle errors of CT's and PT's.

UNIT V

Potentiometers: Crompton's DC and AC polar and coordinate types, Applications, Measurements of impedance, Calibration and ammeter voltmeter and wattmeter. Use of oscilloscope in frequency, phase and amplitude measurements

Suggested Reading:

1. Shawney A.K., Electrical and Electronics Measurements and Instruments, Dhanpatrai& Sons, Delhi, 2000.
2. Umesh Sinha, Electrical, Electronics Measurement & Instrumentations, Satya Prakashan, New Delhi.
3. Golding E.W., Electrical Measurements & Measuring Instruments, Sir Issac& Pitman & Sons Ltd., London.
4. U.A.Bakshi, A.V.Bakshi, Electrical and Electronic Instrumentation, Technical publications

PC503EE

LINEAR CONTROL SYSTEMS

Instruction: 4periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To develop basic skills of utilizing mathematical tools needed to analyze and design classical linear control systems.
- To understand and develop the state space representation of control systems.

Course Outcomes:

At the end of the course students will be able to

1. Understand the concept of the terms control systems, feedback, Mathematical modeling of Electrical and Mechanical systems.
2. Explain the time domain and frequency response analysis of control systems.
3. Acquire the knowledge of various analytical techniques used to determine the stability of control systems.
4. Able to understand the importance of design of compensators.
5. Able to demonstrate controllability and observability of moderncontrol systems.

UNIT-I

Introduction to Control Systems: Classification of control systems. Feed-Back Characteristics,Effects of feedback - Mathematical modeling of Electrical and Mechanical systems -Transfer function- Transfer function of Potentiometer, synchro, AC servo motor, DC servo motor - Block diagram reduction technique - Signal flow graph, Mason's gain formula

UNIT-II

Time Domain Analysis: Standard test signals - Time response of first order systems – Transientresponse of second order system for unit step input, Time domain specifications - Steady state response - Steady state errors and error constants - Effects of P, PD, Pl and PID controllers.

UNIT-III

Stability Analysis in S-Domain: The concept of stability - Routh's stability Criterion, Absolutestability and relative stability- limitations of Routh's stability.
Root Locus Technique: The root locus concept - construction of root loci- Effects of adding poles and zeros on the root loci.

UNIT-IV

Frequency Response Analysis: Introduction to frequency response - Frequency domainspecifications - Bode plot - Stability analysis from Bode plots - Determination of transfer function from the Bode Diagram - Polar Plots, Nyquist Plots, Stability Analysis, Gain margin and phase margin.

Control System Design: Introduction - Lag, Lead and Lag-Lead Compensator design infrequency Domain.

UNIT-V

State Space Analysis: Concepts of state, State variables and state model, Derivation of statemodels of linear time invariant systems - Controllable, Observable and Diagonal state models - State transition matrix - Solution of state equation - Concepts of Controllability and Observability.

Suggested Reading:

1. Nagrath I.J. &Gopal.M - Control System Engineering, Wiley Eastern, 2003.
2. B.C.Kuo - Automatic Control Systems, Wiley India edition, 7th Edition, 2002.
3. K.Ogata - Modern Control System, Prentice Hall of India, 4th edition, 2002.
4. N.C.Jagan - Control Systems, B.S Publications, 2nd edition,2008.

PC504EE

MICROPROCESSORS AND MICROCONTROLLERS

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand about 8085 microprocessor architecture, Instruction set and addressing modes.
- To know the use of interfacing devices and process of interfacing.
- To understand about 8051 microcontroller architecture, and programming.

Course Outcomes:

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

1. Understand 8085 microprocessor architecture and its operation.
2. Write assembly language program for a given task.
3. Interface memory and I/O devices to 8085 using peripheral devices.
4. Understand microcontrollers uses and their applications.
5. Write microcontroller programs and interface devices.

UNIT- I

Microprocessor Architecture: Microprocessors, Microcomputers, and Assembly Language, Architecture Details and its operation, Bus organization of 8085, Registers, Memory unit of 8085, Instruction decoding & execution, 8085-Based single board Microcomputer, Pin out Diagram of 8085, Bus timings, 8085 Interrupts (Hardware and Software), 8085 Vectored Interrupts.

UNIT-II

8085 Programming: The 8085 Programming Model, Operand Types, Instruction Format, Addressing Modes, Instruction set, Writing and debugging simple assembly Language Programs, Delays.

UNIT-III

Interfacing:Memory and I/O interfacing, Programmable Peripheral Interface8255 (PPI), Interfacing seven segment display, Interfacing matrix keyboard, A/D and D/A interfacing, Programmable Interval Timer (8253), Programmable Interrupt Controller (8259).

UNIT- IV

Microcontroller Architecture: Types of Microcontrollers, 8051 Microcontroller – Architecture, Memory organization, special function registers, pins and signals, timing and control, Ports and circuits, Counters and timers, Serial data input / output, Interrupts & timers.

UNIT-V

8051 Programming: The 8051-programming model, Operand Types, Instruction cycle,addressing modes, 8051 instruction set, Classification of instructions. Simple programs and I/O interfacing.

Suggested Reading:

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing, Fifth Edition, 2011.

2. Krishna Kant - Microprocessors and Microcontrollers - Architecture, Programming and System Design 8085, 8086, 8051, 8096, Prentice-Hall India - 2007.

3. Kenneth. J. Ayala “The 8051 Microcontroller Architecture Programming and Applications", Thomson publishers, 2nd Edition, 2007.

4. A.K. Ray &Bhurchandi, Advanced Microprocessors and Peripherals, Tata McGraw Hill, 2003.

HS901MB

MANAGERIAL ECONOMICS AND ACCOUNTANCY

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To learn important concepts of Managerial Economics
- To understand various parameters that determine the consumers' behavior.
- To understand the concepts of capital budgeting and payback period.

Course Outcomes:

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

1. Understand management concepts and apply them to evaluate business decisions.
2. Evaluate the factors that affect production.
3. Estimate working capital requirements.
4. Evaluate of capital budgeting opportunities.
5. Understand the concepts of various book-keeping methods.

UNIT-I

Meaning and Nature of Managerial Economics: Managerial Economics and its usefulness to Engineers, Fundamental Concepts of Managerial Economics-Scarcity, Marginalism, Equimarginalism, Opportunity costs, Discounting, Time Perspective, Risk and Uncertainty, Profits, Case study method.

UNIT-II

Consumer Behavior: Law of Demand, Determinants, Types of Demand; Elasticity of Demand (Price, Income and Cross-Elasticity); Demand Forecasting, Law of Supply and Concept of Equilibrium.

UNIT - III

Theory of Production and Markets: Production Function, Law of Variable Proportion, ISO quants, Economics of Scale, Cost of Production (Types and their measurement), Concept of Opportunity Cost, Concept of Revenue, Cost-Output relationship, Break-Even Analysis, Price - Output determination under Perfect Competition and Monopoly.

UNIT-IV

Capital Management: Significance, determination and estimation of fixed and working capital requirements, sources of capital, Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems.

UNIT-V

Book-keeping: Principles and significance of double entry book keeping, Journal, Subsidiary books, Ledger accounts, Trial Balance, concept and preparation of Final Accounts with simple adjustments, Analysis and interpretation of Financial Statements through Ratios.

Suggested Reading:

1. Mehta P.L., Managerial Economics - Analysis, Problems and Cases,Sulthan Chand & Sons Educational Publishers, 2011
2. Maheswari S.N., Introduction to Accountancy, Vikas Publishing House, 2005
3. Pandey I.M., Financial Management, Vikas Publishing House, 2009

PE511EE

ELECTRICAL DISTRIBUTION SYSTEM

(Professional Elective – I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the concepts and Importance of different loads characteristics, Design of Sub-Transmission Lines, Sub-Stations and Feeders.
- To make the students understand about importance of Power Quality and Applications of capacitors in distribution systems.

Course Outcomes:

At the end of the course students will be able to

1. Understand the concept of different factors used in design of distribution system components.
2. Explain the different types of secondary distribution systems and their performances.
3. Acquire the knowledge of various components, functions and applications of distribution automation and SCADA.
4. Design the optimal locations and ratings of shunt capacitors used in radial feeder for different loading conditions.

UNIT-I

Introduction, Load characteristics. Diversified demand. Non- coincidence demand. Coincidence factor, contribution factor Problems. Rate structure, customer billing, types of distribution transformers.

UNIT-II

Design of Sub-transmission lines and distribution sub-stations. Substation bus schemes, rating of distribution substation, service area with multiple feeders, percent voltage drop Calculations.

UNIT-III

Design considerations of primary systems, radial type, loop type primary feeder, primary feeder loading, uniformly distributed load application to a long line. Design considerations of secondary systems. Secondary banking. Secondary networks. Network transformers, unbalanced loads and voltages.

UNIT-IV

Voltage drop and power loss calculations of 3-phase systems. Voltage fluctuations, measures to reduce flickering. Methods of load flow of Distribution Systems - forward sweep and backward sweep methods.

UNIT-V

Application of capacitors to distribution systems. Effect of series and shunt capacitors, power factor correction, economic justification for capacitors. Best capacitor location-Algorithm. Distribution Automation: Definitions, Components of distribution SCADA.

Suggested Reading:

1. TuranGonen, Electric Power Distribution Engineering, Mc Graw Hill Book Co., International Student Edition. 1986.
2. A.S. Pabla, Electric Power Distribution, Tata McGraw Hill Publishing Company Ltd., 1997.

PE512EE

RENEWABLE ENERGY SOURCES

(Professional Elective – I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the concepts and Importance of renewable energy sources such as solar, wind, biomass, tidal power.
- To make the students understand the advantages and disadvantages of different renewable energy sources

Course Outcomes:

At the end of the course students will be able to

1. Explain the advantages, disadvantages and applications of different conventional and non-conventional sources.
2. Acquire the knowledge of various components, principle of operation and present scenario of different conventional and non-conventional sources.

UNIT-I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2 °2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells — Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT-III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations - Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT-IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-thermal Energy - Types of Geo-thermal Energy Systems - Applications of Geo-thermal Energy.

UNIT-V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass -Biomass gasifiers.

Suggested Reading:

1. Rai G.D, *Non-Conventional Sources of Energy*,Khandala Publishers, New Delhi, 1999.
2. M.M.El-Wakil, *Power Plant Technology*. McGraw Hill, 1984.
3. John Twidell, Tony Weir, Renewable Energy Resources, 3rd Edition, Taylor and Francis.

PE513EE

HYBRID ELECTRIC VEHICLES

(Professional Elective – I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Know the history of electric hybrid electric vehicles (EV & HEV) and emphasize the need and importance of EV-HEV for sustainable future.
- Introduce the fundamental concepts and principles of electric and hybrid electric vehicles drive train topologies
- Develop a thorough understanding of the key elements of EV/HEV: Electric Machines for Propulsion Applications and Energy Sources.

Course Outcomes:

At the end of the course students will be able to

1. To identify and describe the history and evolvement of electric & hybrid electric vehicles to emphasize on the need and importance of EV/HEV for sustainable future.
2. To identify and describe the principles of various EV/HEVs drive train topologies along with their power flow control and fuel efficiency estimation.
3. To design and select electric propulsion system components for EV/HEV drives suitability for the desirable performance and control.
4. To compare and evaluate various energy sources and energy storage components for EV and HEV applications.

UNIT-I

INTRODUCTION: Basics of vehicles mechanisms, history of electric vehicles (EV) and hybrid electric vehicles (HEV), need and importance of EV and HEV, Power/Energy supplies requirements for EV/HEV applications, vehicle power source characterization, and transmission characteristics.

Vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion – Propulsion System Design.

UNIT-II

DRIVE-TRAIN TOPOLGIES: Review of electric traction, various electric drive-train topologies, basics of hybrid traction system, various hybrid drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis.

UNIT-III

ELECTRICAL MACHINES & POWER CONVERTERS: Electric system components for EV/HEV, suitability of DC and AC machines for EV/HEV applications, AC and DC Motor drives. Permanent magnet and switch reluctance machines, configuration and control of drives. Power Converters- Converters for EV and HEV applications.

UNIT-IV

ENERGY SOURCES FOR EV/EHV: Requirements of energy supplies and storage in EV/HEV, Review of batteries, fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, characteristics and comparison of energy sources for EV/HEV, hybridization of different energy sources.

UNIT-V

ELECTRIC VEHICLES CHARGING STATIONS: Type of Charging station, Selection and Sizing of charging station, Components of charging Station and Single line diagram of charging station. Contactless inductive charging- Stationary Inductive Charging, resonant and compensation circuit topologies.

Suggested Reading:

1. Electric Vehicle Technology Explained, by James Larminie, John Lowry, WIELY USA, 2012.
2. Hybrid Electric Vehicles: Principles and Applications with practical perspective, Chris Mi, M. Abdul Masrur & David Wenzhong Gao, WIELY, 2011
3. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.
4. SimoraOnori, Hybrid Electric Vehicles Energy Management Strategies, Springer.

PC551EE

POWER ELECTRONICS LAB

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits: 1

Course Objectives:

- To be able to understand various power switching devices, trigger circuits, characteristics and applications by conducting the experiments.
- To learn and understand the rectifiers, choppers and inverters principle operation, characteristics and applications.

Course Outcomes:

At the end of the course students will be able to

1. Able to understand speed control of motors by using controlled rectifier
2. Able to understand the applications of cycloconverters
3. Able to simulate different power electronic devices using software

LIST OF EXPERIMENTS

1. R, RC, UJT Trigger Circuits for SCR's.
2. Design and fabrication of trigger circuits for single phase half-controlled and fully controlled bridge rectifiers.
3. Study of SCR chopper.
4. Design and fabrication of trigger circuit for MOSFET chopper.
5. Study of forced commutation techniques of SCRs.
6. Speed control of separately excited DC motor by controlled rectifier.
7. Speed control of universal motors using choppers.
8. Study of single phase half and fully controlled rectifier.
9. Study of single phase and three phase AC voltage controller.
10. Study of single phase dual converter.
11. Study of single phase cyclo converter.
12. IGBT based PWM inverters.
13. Simulation of single phase half and fully controlled rectifier.
14. Simulation of single phase and three phase AC voltage controller.
15. Simulation of single phase inverter & three phase inverter.

Note: At least ten experiments should be conducted in the Semester.

Suggested Reading:

1. Bimbra.P.S. - Power Electronics, Khanna Publications, 2006.
2. Rashid M.H. - Power Electronics Circuits, Devices and Applications - PHI, 2004.
3. Singh. M.D., Khanchandani K.B. - Power Electronics - TMH, 14th reprint, 1999.
4. Mohan, Undeland& Robbins - Power Electronic Converters. Applications and Design - John Wiley & Sons - 3rd Edition, 2007.

PC552EE

MICROPROCESSOR AND MICROCONTROLLERS LAB

Instruction: 2periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits: 1

Course Objectives:

- Developing of assembly level programs and providing the basics of the processors
- To provide solid foundation on interfacing the external devices to the processor according to the user requirements to create novel products and solutions for the real time problems
- To assist the students with an academic environment needed for a successful professional career.

Course Outcomes:

At the end of the course students will be able to

1. Familiarize with the assembly language programming.
2. Write programs for given task using different addressing modes.
3. Interface various IO devices using 8255 PPI
4. Write programs using various interrupts.
5. Interface the microcontroller for some real-life applications.

LIST OF PROGRAMS:

For 8085:

6. Signed/unsigned multiplication and division.
7. Finding average, largest, square root,etc.
8. Sorting set of numbers.
9. Code conversion like BCD numbers into binary.
10. 8255 PPI for interfacing LEDs.
11. 8255 PPI for interfacing to generate triangular wave using DAC.
12. Using interrupts.
13. Interfacing seven segment display.
14. Interfacing matrix keyboard.

For 8051:

1. Data transfer – block move, exchange, sorting, finding largest element in array.
2. Arithmetic instructions: multi byte operations.
3. Boolean & logical instructions (Bit manipulations).
4. Programs to generate delay, programs using serial port and on chip timer/counter.
5. Use of JUMP and CALL instructions.
6. Square wave generation using timers.
7. Interfacing of keyboard and 7-segment display module.
8. DAC interfacing for generation of sinusoidal wave.

SCHEME OF INSTRUCTION
B.E. (Electrical & Electronics Engineering)
VI – SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			Contact Hours / Week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1.	BS603MT	Mathematics-III (Probability and Statistics)	3	1	0	4	30	70	4
2.	PC601EE	Switchgear and Protection	3	1	0	4	30	70	4
3.	PC602EE	Signals and Systems	3	1	0	4	30	70	3
4.	**Professional Elective - II**		3	0	0	3	30	70	3
	PE621EE	Power Electronic Applications to Power Systems							
	PE622EE	Electrical Energy Conservation and Auditing							
	PE623EE	Power System Reliability							
5.	**Open Elective**		3	0	0	3	30	70	3
	OE601BM	Engineering Applications in Medicine							
	OE602CE	Disaster Management							
	OE603EC	Electronic Instrumentation							
	OE604EC	Principles of Electronic Communication Systems							
	OE605ME	3D Printing Technology							
	OE606ME	Finite Element Method							
Practical									
1.	PC651EE	Electrical Machines Lab-II	0	0	2	2	25	50	1
2.	PC652EE	Measurements and Instrumentation Lab	0	0	2	2	25	50	1
3.	PC653EE	Control Systems Lab	0	0	2	2	25	50	1
4.	PW961EE	Summer Internship	Six weeks during summer vacation and evaluation will be done in VII Semester						
			15	**03**	**06**	**24**	**225**	**500**	**20**

L: Lectures
T: Tutorials
P: Practical classes
CIE: Continuous Internal Evaluation
SEE: Semester End Examination

BS603MT

MATHEMATICS-III

(Probability and Statistics)

Instruction: 4 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 4

Course Objectives:

- To understand concepts of probability and probability distribution functions
- To derive probability density function of transformations of random variables.
- To understand statistical applications in engineering context and apply wherever necessary.

Course Outcomes:

At the end of the course students will be able to

1. Upon completion of this course, students will be able to
2. Understand basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables.
3. Derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions.
4. Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables.
5. Apply statistical measures and techniques based on requirement

UNIT-I

Basic Probability: Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

UNIT-II

Continuous Probability Distributions: Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.
Bivariate Distributions: Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

UNIT-III

Basic Statistics: Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

UNIT-IV

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

UNIT-V

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

Suggested Reading:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
3. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
4. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.
5. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
6. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000.
7. T. Veerarajan, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.

PC601EE

SWITCHGEAR AND PROTECTION

Instruction: 4 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 4

Course Objectives:

- To be able to understand the need of protection in power system and protection with conventional and static relays.
- To understand the protection of transformers, generators and need of circuit breakers.

Course Outcomes:

At the end of the course, students will be able to

1. Acquire the knowledge of construction, working principles of different electromagnetic and static relays used to protect generators, transformers, transmission lines and distribution feeders.
2. Analyze the Characteristics of over current, over voltage, distance and differential relays and also their applications in power system networks.
3. Explain the working principle. Construction, rating and applications of different types of circuit breakers used in power system networks.
4. Understand the construction details, advantages, disadvantages of Gas Insulation substations.

UNIT- I

Introduction to Protective Relays: Need for protection - primary protection - backup protection- Zones of protection - Definitions of relay pick up and reset values - Classification of relays - Operating principles and construction of Electromagnetic and Induction type relays. Over current relay - Over voltage - Directional relay - Universal relay torque equation. Over current protection for radial feeder and ring mains - Protection of parallel lines - Relay settings for over current relays Earth fault and phase fault protection.

UNIT - II

Static phase and Amplitude comparators: Characteristics of dual input comparators. StaticRelays -Instantaneous over current relay - Definite time over current relay - Inverse time over current relay - Directional over current relay (Block diagram approach only)
Distance protection - Characteristics of 2- input distance relays on the RX diagram - Input characteristics for various types of distance relays - 3-step distance relays, Microprocessor based over current relay (block diagram).

UNIT- III

Transformer and Generator Protection: Differential relays -Percentage differential relaysprotection of generator and transformer using percentage differential relays, Split phase protection, Overheating, Loss of excitation - Protection of transformers against magnetizing inrush - Buchholz relay - Protection of earthing transformers.

UNIT-IV

Circuit Breakers : Need for circuit breakers, Parts of circuit breaker trip coil circuit-Arcproperties - Principles of arc quenching - Theories, Recovery and restriking voltages - Rating of circuit breakers - Rated symmetrical and asymmetrical breaking current - Rated making current - Rated capacity, Voltage and frequency of circuit breakers, Auto re-closure-duty cycle, Current chopping - Resistance switching - Derivations of RR'RV - Maximum RRRV, Recovery voltage, Problems - Types of circuit breakers - Oil, Minimum oil, Air, Air blast, SF , Vacuum and miniature circuit breakers, Testing of circuit breakers.

UNIT-V

Gas Insulated Substations & Over Voltage Protection: Constructional details (components), Merits and Demerits of Gas Insulated Substations over conventional Air insulated Substations. Protection of transmission lines against direct lightning strokes – ground wires - Protection angle - Protection zone - Tower footing resistance and its effects - Equipment protection assuming rod gaps, arcing horns - Different types of lightning arresters - their construction Surge absorbers - Peterson coil - Insulation coordination.

Suggested Reading:

1. Wadhwa C.L. - Electrical Power System, Wiley Eastern Ltd., 3rd Edition-2002.
2. Badriram&Viswakarma-Power System Protection & Switchgear, Tata McGraw Hill, 2003.
3. Sunil S. Rao - Switchgear & Protection, Khanna Publications, 2000.
4. M.S. Naidu - Gas Insulated Substations, I.K. int. Publishing House Pvt. Ltd. -2008.

PC602EE

SIGNALS AND SYSTEMS

Instruction: 4periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the classification of continuous-time and discrete-time signals and systems
- To develop ability to solve systems represented by differential equations and difference equationsusing analytical methods and Laplace and Z-transforms.
- To acquire the knowledge of representing the signals in frequency domain using Fourier seriesand Fourier transform.

Course Outcomes:

At the end of the course, students will be able to

1. Classify and analyze the continuous time signals and discrete time signals and systems.
2. Generate discrete time signals through sampling process and reconstruct them.
3. Determine the responses of continuous and discrete-time systems which are represented bydifferential equations and difference equations.
4. Analyze continuous time systems with the help of Laplace transform and discrete time systemwith Z-transform.
5. Analyze the continuous and discrete-time systems in frequency domain with the help of Fourierseries and Fourier Transform.

UNIT-I

Introduction to continuous time signals: Examples of signals and systems as seen in everyday life in relation to engineering and science. Signalproperties: periodicity, absolute integrability, determinism and stochastic character. Some special signalsof importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals;Introduction to discrete-time signals - Sampling and Reconstruction: The Sampling Theorem and its implications. Spectra of sampled signals. Aliasing and its effects.Reconstruction: ideal interpolator, zero-order hold and first-order hold. Classification of discrete timesignals.

UNIT-II

Behavior of continuous and discrete-time LTI systems: System properties: linearity: additivity and homogeneity, shift-invariance, causality and stability. Lineartime invariant system, properties convolution integral and convolution sum. System representationthrough differential equations and difference equations.

UNIT-III

Laplace transforms: Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior.
Z-transforms: The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis and solution to difference equations.

UNIT-IV

Frequency domain representation of continuous time signals: Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, properties, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality.

UNIT-V

Frequency domain representation of discrete time signals: The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Introduction to the applications of signal and system theory: modulation for communication, filtering,feedback control systems.

Suggested Reading:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.

2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, andApplications", Pearson, 2006.

3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.

4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.

5. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.

6. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.

7. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

PE621EE

POWER ELECTRONIC APPLICATIONS TO POWER SYSTEMS

(Professional Elective-II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the classification of different FACTS Devises and their operating principles.
- To develop ability to analyze the utility of various converters for different applications.
- To acquire the knowledge HVDC systems, their operation and control.

Course Outcomes:

At the end of the course, students will be able to

1. Understand controllers for controlling the power flow through a dc link and compute filter parameters.
2. Apply impedance, phase angle and voltage control for real and reactive power flow in ac transmission systems
3. Analyze and select a suitable FACTS controller for a given power flow condition
4. Evaluate HVDC and EHVAC transmission
5. Analyze converter configurations used in HVDC and their control mechanisms.

UNIT - I

FACTS concepts: Reactive power control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers.

UNIT - II

Static shunt and series compensators: Shunt compensation - objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators - SVC, STATCOM, SVC and STATCOM comparison. Series compensation - objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes.

UNIT -III

Combined compensators: Unified power flow controller (UPFC) - Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters.

UNIT IV

HVDC transmission: HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DC links, Layout of HVDC Converter station and various equipment. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations

UNIT V

Control of HVDC system: Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics-introduction, generation, ac filters and dc filters.
Introduction to multi terminal DC systems and applications, comparison of series and parallel MTDC systems.

Suggested Reading:

1. Song, Y.H. and Allan T. Johns, _Flexible AC Transmission Systems (FACTS), Institution of Electrical Engineers Press, London, 1999.
2. Hingorani,L.Gyugyi, Concepts and Technology of Flexible AC Transmission System, IEEE Press New York, 2000 ISBN –078033 4588.
3. Padiyar, K.R., _HVDC transmission systems, Wiley Eastern Ltd., 2010.
4. Mohan Mathur R. and Rajiv K.Varma, Thyristor - based FACTS controllers for Electrical transmission systems‘, IEEE press, Wiley Inter science , 2002.
5. Padiyar K.R., FACTS controllers for Transmission and Distribution systems, New Age International Publishers, 1st Edition, 2007.
6. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho FACTS–Modeling and simulation in Power Networks, John Wiley & Sons, 2002.

PE622EE

ELECTRICAL ENERGY CONSERVATION AND AUDITING

(Professional Elective – II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the current energy scenario and importance of energy conservation.
- To understand the concepts of energy management.
- To understand the methods of improving energy efficiency in different electrical systems.
- To understand the concepts of different energy efficient devices.

Course Outcomes:

At the end of the course students will be able to

1. Identify the demand supply gap of energy in Indian scenario.
2. Analyze the concepts of energy management.
3. Draw the process flow and energy balance diagrams of energy facilities.
4. Select appropriate energy conservation method to reduce the wastage of energy.

UNIT-I

Energy Scenario: Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

UNIT-II

Basics of Energy and its various forms: Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

UNIT-III

Energy Management & Audit: Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

UNIT-IV

Energy Efficiency in Electrical Systems: Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

UNIT-V

Energy Efficient Technologies in Electrical Systems: Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Suggested Reading:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)

2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)

3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.

4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

PE623EE

POWER SYSTEM RELIABILITY

(Professional Elective – II)

Instruction: 3periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Understand various reliability evaluation techniques.
- Analyze generating system reliability using time and frequency methods.
- Analyze reliability for transmission and distribution systems.

Course Outcomes:

At the end of the course, students will be able to

1. Explain the terms Bathtub curve, system security, contingency and reliability of power system network.
2. Understand the importance of load point and system reliability indices of power system network.
3. Able to develop capacity outage probability tables of composite power system networks.

UNIT –I

Definition of reliability and failure: Bathtub curve, concepts of probability, evaluation techniques, Markov process, recursive technique, security levels of system, reliability cost, adequacy indices, functions of system security, contingency analysis, linear sensitivity factors, hierarchical levels in power system reliability assessment.

UNIT –II

Generation System Models: Capacity outage probability tables, loss of load indices, equivalent forced outage rate, capacity expansion analysis, scheduled outages, evaluation methods on period basis, loss of energy indices.

UNIT –III

Generation model with no derated states. System risk indices: System risk indices with individual and cumulative load model, practical system studies.

UNIT - IV

Radial configurations, conditional probability approach, network configurations, state selection, system and load point indices, application to practical system, data requirements for composite system reliability evaluation.

UNIT - V

Evaluation techniques, interruption indices: customer oriented, load and energy oriented, application to radial systems, effects of lateral distributor protection, disconnects, protection failures and transferring loads, probability distribution of reliability indices.

Suggested Reading:

1. Ali Chowdhury, Don Koval, ―Power Distribution System Reliability: Practical Methods and Applications‖, Wiley-IEEE Press, 2nd Edition, 2009.
2. Cepin, Marko, ―Assessment of Power System Reliability‖, Springer, 2nd Edition, 2011.
3. Roy Billinton, R N Allan, ―Reliability Evaluation of Power Systems‖, Springer, 1st Edition, 1996.
4. Roy Billington and Ronald N.Allan, *Reliability Evaluation of Engineering Systems*, Plenum Press, New York, 1992.
5. Endrenyi, *Reliability Modelling in Electrical Power Systems* - John Wiley & Sons, 1980.

OE601BM

ENGINEERING APPLICATIONS IN MEDICINE
(Open Elective-I)

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To make the students gain basic knowledge of Human Physiology.
- To make the students learn the applications of various branches of engineering in Medicine.

Course Outcomes: Upon the completion of the course, the students will be able to:

1. Describe the major organ systems of the human body
2. Understand the concepts of bioelectricity and medical instruments
3. Apply solid and fluid mechanics principles to joints and blood flow respectively
4. Learn the need and applications of BCI
5. Analyze and choose proper biomaterial for various applications

UNIT-I
Evolution of Modern healthcare, Major organ systems- Cardiovascular, Respiratory, Nervous, Skeletal, Muscular. Homeostasis. Physiological signals and their diagnostic importance.

UNIT-II
Bioelectricity-Excitable cells, Resting potential, Action potential, Accommodation, Strength-Duration Curve, Propagation of impulses in myelinated and unmyelinated nerves.
Medical Instrumentation System-Functions, Characteristics, Design Challenges.
Signal Processing-QRS detection.

UNIT-III
Solid mechanics-Analysis of muscle force and joint reaction force for the limb joints.
Fluid mechanics-Factors governing and opposing blood flow, Wind-Kessel model, Application of Hagen-Poiseuille flow to blood flow.

UNIT-IV
Brain-Computer Interface: Brain signals for BCIs, Generic setup for a BCI, Feature extraction and Feature translation involved in BCIs. Typical applications-Word forming, Device control.

UNIT-V
Materials and Tissue Replacements-Types of Biomaterials- Metals, Polymers, Ceramics and Composites and their applications in Soft and Hard tissue replacements. Implants-Manufacturing process, Design, fixation.

Suggested Reading:

1. John Enderle, Susan M. Blanchard and Joseph Bronzino, *Introduction to Biomedical Engineering*, Second Edition, Elsevier, 2005.
2. Ozkaya, Nordin. M, *Fundamentals of Biomechanics*, Springer International Publishing, 4th Edition, 2017.
3. Khandpur R.S., *Handbook of Biomedical Instrumentation*, Tata McGraw Hill, 2016.
4. John G.Webster, *Medical Instrumentation: Application and Design*, John Wiley and Sons Inc., 3rd Ed., 2003.

OE 602CE

DISASTER MANAGEMENT
(Open Elective-I)

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To introduce basic conceptual understanding of natural & man-made hazards and different contextual aspects.
- To develop the knowledge and understanding of the International and nationalstrategy for disaster reduction (UN-ISDR)
- To ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.
- To promote the use of science and technology for implementing the disaster risk reduction (DRR) plans and policies.

Course Outcomes:

1. Aptitude to link hazards, risk, vulnerability, differential impacts and capacity building to the life and property loss during disasters and its impacts on the society and sustainability.
2. Ability to understand various aspects of natural and man-made hazards and emerging trends
3. Acquaintance with different steps involved in disaster risk reduction (DRR) and international initiatives for prevention, mitigation and preparedness.
4. Knack to appreciate the national policy and role of individuals, communities, and government organizations in disaster management.
5. Capacity to identifying current technological constraints and hazard specific solutions, particularly construction codes etc.

UNITI: INTRODUCTION TO DISASTER

- Understanding the Concepts, Definitions and Terminologies used in the field of Disaster Management (i.e., Hazard, Risk, Vulnerability, Resilience, and Capacity Building).
- Differential impacts of Disasters in terms of Gender, Age, Social Status, Location, Prosperity, Disabilities.
- Disaster- Development Nexus.

UNIT II: TYPES of HAZARDS AND EMRGING TRENDS

- Classification, Causes, Consequences and Controls of
  I) Geophysical hazards-Earthquakes, Landslides, Tsunami
  II) Weather related hazards- Meteorological (Cyclones, Storm-surge and Lighting), Hydrological (Floods, Droughts, Avalanches), Climatological (Wildfire, Cold & Heat Waves)
  III) Biological hazards-Epidemic & Pandemics,
  IV) Technological hazards-Chemical, Industrial, Nuclear
  V) Man-made hazards-Structural Failure, Fire, Transportation accidents, Terrorism and Wars
- Emerging Disasters- Urban Areas, Climate Change.

- Regional and Global Trends-loss of life & Property in various hazards

UNIT III: DISASTER MANAGEMENT CYCLE AND INTERNATIONAL FRAMEWORK

- Disaster Management Cycle
  Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Micro zonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness
  During Disaster – Evacuation – Disaster Communication – Search and Rescue– Emergency Operation Centre – Incident Command System – Relief and Rehabilitation –
  Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment
- Paradigm Shift in Disaster Management: International Decade for Natural Disaster Reduction; Yokohama Strategy; Hyogo Framework of Action

UNIT IV: DISASTER RISK MANAGEMENT IN INDIA

- Disaster Profile of India – Mega Disasters of India and Lessons Learnt
- Disaster Management Act 2005 – Institutional and Financial Mechanism
- National Policy on Disaster Management,
- National Guidelines and Plans on Disaster Management;
- Role of Government (local, state and national),Non-Government and Inter-governmental Agencies

UNIT V: TECHNOLOGICAL APPROACHES TO DISASTER RISK REDUCTION

- Geo-informatics in Disaster Management (RS, GIS, GPS and RS)
- Disaster Communication System (Early Warning and Its Dissemination)
- Land Use Planning and Development Regulations
- Disaster Safe Designs and Constructions
- Structural and Non-Structural Mitigation of Disasters
- Science &Technology Institutions for Disaster Management in India

Suggested Books/ Material/ References

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
4. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
5. Disasters in India Studies of grim reality, AnuKapur& others, 2005, 283 pages, RawatPublishers, Jaipur
6. 10 Disaster Management Act 2005, Publisher by Govt. of India
7. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
8. National Disaster Management Policy, 2009, GoI

OE 603EC

ELECTRONIC INSTRUMENTATION

(Open Elective-I)

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To familiarize with various measurement parameters and Standards of measurement.
- To learn the working principles of various types of Microphones and Hygrometers.
- To understand the operation and applications of CRO.
- To understand about the operation of various transducers.
- To understand the importance of biomedical instrumentation and Virtual instrumentation.

Course Outcomes:

1. Analyze the various characteristics of measurement parameters and Standards of measurement.
2. Evaluate the operation and application of microphones
3. Use the CROs for various applications and explore its features.
4. Explore various types of Transducers and their characteristics.
5. Analyze the operation of various biomedical instruments and the features of Virtual Instrumentation.

UNIT – I

Measurement parameters: History of instrumentation. Error in Measurement, Types of Errors, Statistical analysis of errors, Limiting errors, Standards of measurement, IEEE and ISO standards.

UNIT – II

Microphones and Hygrometers: Microphones: Microphones and their types, Humidity measurement, resistive, capacitive, aluminium-oxide and crystal Hygrometer types – Operation and applications.

UNIT – III

CRO: Basic Principle of CRT, its features, Block diagram and operation of CRO, Oscilloscope Controls, Waveform display, Measurement of frequency and Phase using Lissajous method, Applications and Advantages of CRO.

UNIT –IV

Transducers: Introduction, Electrical Transducer, Factors for Selecting a Transducer, Active and Passive Transducers, Operation and applications of Resistive transducers, Strain gauges and Thermistors.

UNIT –V

Biomedical and Virtual Instrumentation: Biomedical instrumentation, Bio-potential electrodes, Principles of operation and applications of ECG, EEG, EMG, X-ray machines, CT scanners and Introduction to virtual instrumentation.

Suggested Reading:

1. Albert D.Helfrick and William D.Cooper, *"Modern Electronic Instrumentation and Measurement Techniques",* Prentice-Hall of India Private Limited, New Delhi, 1996.
2. H S Klasi, *"Electronic Instrumentation", Tata* McGraw-Hill Company Limited, New Delhi, 2004.
3. David A.Bell, *"Electronic Instrumentation and Measurements",* 2nd Edition, Prentice-Hall of India Private Limited, New Delhi, 1994.
4. R.S.Khandpur, *"Handbook of biomedical Instrumentation",* Tata McGraw- Hill publishing company Limited, New Delhi, 2000.

OE604EC

PRINCIPLES OF ELECTRONIC COMMUNICATION SYSTEMS
(Open Elective-I)

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- Provide an introduction to fundamental concepts in the understanding of communications systems.
- Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
- Provide an introduction to the evolution of wireless systems and current wireless technologies.

Course Outcomes: Student will be able to

1. Understand the working of analog and digital communication systems
2. Understand the OSI network model and the working of data transmission
3. Understand the concepts of modulation and demodulations
4. Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.
5. Understand the principles of optical communications systems

UNIT- I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels, Signal Transmission Concepts-Baseband transmission and Broadband transmission, Communication parameters-Transmitted power, Channel bandwidth and Noise, Need for modulation Signal Radiation and Propagation-Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT- II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT- III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP.

UNIT- IV

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony. Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT- V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, And OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee,

Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Reading:

1. Louis E. Frenzel, "*Principles of Electronic Communication Systems*", 3e, McGraw Hill publications, 2008.
2. Behrouz A. Forouzan,*"Data Communications and Networking",* 5e TMH, 2012.
3. Kennady, Davis, "*Electronic Communications systems*", 4e, TMH, 1999.

OE605ME

3D PRINTING TECHNOLOGY
(Open Elective-I)

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To understand the fundamental concepts of 3D Printing, its advantages and limitations.
- To know the working principle, advantages, disadvantages and applications of liquid, solid and Powder based 3D Printing Technologies.
- To know the various types of STL file errors and other data formats used in 3D Printing Technology.
- To know the features of various 3D Printing software's.
- To know diversified applications of 3D Printing Technologies.

Course Outcomes: At the end of the course the student will be able to:

1 Interpret the features of 3D Printing and compare it with conventional methods.
2 Illustrate the working principle of liquid, solid and powder-based 3D Printing Technologies.
3 Identify various types of errors in STL file and other data formats used in 3D Printing Technology.
4 Select suitable software used in 3D Printing Technology.
5 Apply the knowledge of various 3D Printing technologies for developing innovative applications.

UNIT-I

Introduction: Prototyping fundamentals: Need for time compression in product development, Historical development, Fundamentals of 3D Printing, 3D Printing Process Chain, Advantages and Limitations of 3D Printing, 3D Printing wheel, Commonly used Terms, Classification of 3D printing processes, Fundamental Automated Processes: Distinction between 3D Printing and Conventional Machining Processes.

UNIT-II

Liquid-based 3D Printing Systems: Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Polyjet: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Solid-based 3D Printing System: LaminatedObject Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT-III

Powder Based 3D Printing Systems: Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following 3D Printing Technologies like Selective laser sintering (SLS), Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS), Electron Beam Melting (EBM),

UNIT-IV

3D Printing Data Formats & Software: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. 3D Printing Software's Features: Magics, Mimics, Solid View, View Expert, 3 D Rhino, 3 D doctor, Flash Print, Object Studio, Cura, ITK Snap, 3-matic, Simplant, 3-matic, Simplant, MeshLab, Ansys for Additive Manufacturing.

UNIT-V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Biopolymers, Packaging, Disaster Management, Entertainment and Sports industry.

Suggested Reading:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific
2. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing- Ian Gibson, David W Rosen, Brent Stucker, Springer, Second Edition, 2010.
3. Rapid Prototyping & Engineering Applications – Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.
4. RafiqNoorani,Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley& Sons, 2006.
5. NPTEL Course on Rapid Manufacturing. https://nptel.ac.in/courses/112/104/112104265/

OE606ME

FINITE ELEMENT METHOD
(Open Elective-I)

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To understand the theory and application of the finite element method for analyzing structural systems.
- To learn Approximation theory for structural problems as the basis for finite element methods.
- To learn formulations for a variety of elements in one, two, and three dimensions. Implementations of element formulations will be examined using Mat lab.
- To understand modeling and analysis of structures using planar, solid, and plate elements

Course Outcomes: Upon successful completion of this course, the student will be able to:

1 Demonstrate a basic understanding of the concepts, mathematical formulation and numerical implementation.
2 Demonstrate the ability to invoke appropriate assumptions, select proper elements and develop FEA models that adequately and efficiently represent physical systems.
3 Underlying the FEA as applied to solid mechanics.
4 Solve 2D vector variable problems and analyze higher order elements and its applications.
5 Create his/her own FEA computer programs using Matlab to solve simple engineering problems.

UNIT I: Introduction

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II: One-Dimensional Problems

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes.

UNIT III: Two Dimensional Scalar Variable Problems

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Torsion of Non circular shafts – Quadrilateral elements – Higher Order Elements.

UNIT IV: Two-Dimensional Vector Variable Problems
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements.

UNIT V: Isoparametric Formulation
Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

Suggested Reading:

1. TirupathiR.ChandraputlaandAshok,D.Belgundu"IntroductiontoFiniteElementsinEngineering" , PearsonEducation,2002, 3rdEdition.
2. RaoS.S.,"TheFiniteElementMethodsinEngineering",pergamonPress,1989.
3. Segerlind,L.J. "AppliedFiniteElementAnalysis",WileyPublication,1984.
4. ReddyJ.N., "AnIntroductiontoFiniteElementMethod",McGraw-HillCompany,1984.

PC651EE

ELECTRICAL MACHINES LAB – II

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits: 1

Course Objectives:

- To learn operation and performance characteristics of induction machines by conducting various experiments and tests practically.
- To understand the operation and performance characteristics of synchronous machines by conducting various experiments and tests.

Course Outcomes:

At the end of the course, students will be able to

1. Understand Performance characteristics of single-phase induction motor
2. Understand the importance of Voltage regulation of an alternator
3. Explain different methods used to measure the voltage regulation of an alternator

LIST OF EXPERIMENTS:

1. No-load test, blocked rotor test and load test on 3-phase induction motor.
2. Speed control of 3-phase induction motor by (a) Cascade connection (b) Rotor resistance control (C) Pole changing (d) Slip power recovery scheme.
3. Performance characteristics of single-phase induction motor.
4. Voltage regulation of an alternator by (a) Synchronous impedance method (b) Ampere - turn method (c) Z.P.F. method.
5. Regulation of alternator by slip test.
6. Determination of V curves and inverted V curves of synchronous motor.
7. Power angle characteristics of a synchronous machine.
8. Power factor improvement of three phase Induction motor using capacitors.
9. Dynamic braking of 3-phase induction motor.
10. Speed control of BLOC motor.
11. Load characteristics of induction generator.
12. Speed control of SRM motor.

Note: Atleast ten experiments should be conducted in the Semester.

Suggested Readin g :

1. Kothari D.P. &Nagrath I.J. - Electrical Machines - Tata McGraw Hill, 2004.
2. Bhimbra P.S. - Generalized Theory of Electrical Machines, Khanna Publications, 2000.
3. Say MG. - The Performance and Design of AC. Machines - Pitman Publication, 2002.
4. Irving L. Kosow - Electric Machinery and Transforn1ers, PPH, Pearson Education, 2nd Edition. 2009.
5. Satish Kumar Peddapelli and Sridhar Gaddam, Electrical Machines - A Practical Approach, De Gruyter Publisher, Germany, 2020.

PC652EE

MEASUREMENTS AND INSTRUMENTATION LAB

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits: 1

Course Objectives:

- To train the students for acquiring practical knowledge for measuring resistance, inductance and capacitance using various bridges.
- To train the student for the usage of A.C. and D.C. potentiometers.
- To make the student understand the operation of CRO and its usefulness in finding the amplitude, phase and frequency of waveforms.

Course Outcomes:

At the end of the course, students will be able to
1. Measure the inductance, capacitance and resistance using various bridges.
2. Measure resistance and calibrate ammeter, voltmeters and wattmeter using A.C. and D.C. potentiometers.
3. Have hands on experience on the operation of CRO.

LIST OF EXPERIMENTS
1. Measurement of low resistance by Kelvin's Double Bridge.
2. Calibration of single phase energy meter.
3. Measurement of inductance by Maxwell's and Anderson's bridges.
4. Measurement of capacitance by Desauty's and Schering's bridges.
5. Measurement of Iron losses by Lloyd, Fishers magnetic square.
6. Measurement of Resistance and calibration of Ammeter using D.C. potentiometer.
7. Calibration of voltmeter and wattmeter using D.C. potentiometer.
8. Measurement of unknown voltage and impedance using A.C. potentiometer.
9. Calculation of iron losses using B-H curve with oscilloscope.
10. Localizing Ground and short circuit faults using Murray loop test and Varley loop test.
11. Measurement of relative permittivity (Ɛr) of a dielectric medium using Schering bridge.
12. Measurement of frequency of unknown sinusoidal signal with CRO.
13. Measurement of phase and amplitude using CRO.
14. Calibration of given power factor meter using calibrated voltmeter, ammeter and wattmeter.

Note: Atleast ten experiments should be conducted in the Semester.

Suggested Reading:
1. Shawney A.K., *Electrical and Electronics Measurements and Instruments*, Dhanpatrai& Sons, Delhi, 2000.
2. Umesh Sinha, *Electrical, Electronics Measurement & Instrumentations*, Satya Prakashan, New Delhi.
3. Golding E.W., *Electrical Measurements & Measuring Instruments*, Sir Issac& Pitman & Sons Ltd., London.

PC653EE

CONTROL SYSTEMS LAB

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits: 1

Course Objectives:

- To develop transfer function of various control system plants practically by conducting the experiments.
- To understand the various controllers, basic features of PLC
- Programming and control system concepts using MATLAB.

Course Outcomes:

At the end of the course students will be able to

1. Able to understand Performance of P, PI and PID Controllers
2. Able to develop PLC programs for certain applications
3. Acquire the knowledge of Data acquisition system and Industrial process control

LIST OF EXPERIMENTS

1. Characteristics of D.C. and AC. Servomotor and their transfer function.
2. Characteristics of synchros.
3. Frequency response of second order system.
4. Operating characteristics of Stepper motor.
5. Step response of second order system.
6. D.C. Position control system.
7. A.C. Position control system.
8. Performance of P, PI and PID Controller on system response.
9. Design of lag and lead compensation.
10. ON - OFF temperature control systems.
11. Simulation of control system concepts using MATLAB.
12. PLC (Programmable Logic Controller) applications. (a) Bottle filling (b) Speed control of Stepper motor (c) Liquid level control.
13. Data acquisition system and applications.
14. Industrial process control trainer.

Note: Atleast ten experiments should be conducted in the Semester.

Suggested Reading:

1. Nagrath I.J. &Gopal.M - Control System Engineering, Wiley Eastern, 2003.
2. B.C.Kuo - Automatic Control Systems, Wiley India edition, 7th Edition, 2002.
3. K.Ogata - Modern Control System, Prentice Hall of India, 4th edition, 2002.
4. N.C.Jagan - Control Systems, B.S Publications, 2nd edition, 2008.

PW961EE

SUMMER INTERNSHIP*

Instruction: 6 weeks *CIE: 50 marks*
Credits: 2

Course Objectives:

- To give an experience to the students in solving real life practical problems with all its constraints.
- To give an opportunity to integrate different aspects of learning with reference to real life problems.
- To enhance the confidence of the students while communicating with industry engineers and give an opportunity for useful interaction with them and familiarize with work culture and ethics of the industry.

Course Outcomes:

At the end of the course, students will be able to

1. Design/develop a small and simple product in hardware or software.
2. Complete the task or realize a prespecified target, with limited scope, rather than taking up a complex task and leave it.
3. Learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to prespecified criteria.
4. Implement the selected solution and document the same.
5. Able to write a technical report and present it to appropriate audience

Summer Internship is introduced as part of the curricula for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from an Electronics Industry / R & D Organization / National Laboratory for a period of 8 weeks. This will be during the summer vacation following the completion of the VI semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide.

After the completion of the project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department. Award of sessionals are to be based on the performance of the student at the work place to be judged by industry guide and internal guide (25 Marks) followed by presentation

before the committee constituted by the department (25 Marks). One faculty member will co-ordinate the overall activity of Summer Internship.

***Students have to undergo summer internship of 6 Weeks duration at the end of semester VI and credits will be awarded after evaluation in VII semester.**