SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Electrical and Electronics Engineering) VII – SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC428EE	Control of Electric Drives	3	-	-	3	30	70	3	3
2	PC429EE	Power System Operation and Control	3	-	-	3	30	70	3	3
3	PC430EE	Power Electronic Applications to Power Systems	3	-	-	3	30	70	3	3
4	PE5_EE	Professional Elective - III	3	-	-	3	30	70	3	3
5	PE5_EE	Professional Elective - IV	3	-	-	3	30	70	3	3
6	OE6_EE	Open Elective – II	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	PC465EE	Power Systems Lab	-	-	2	2	25	50	3	1
8	PC466EE	Electrical Simulation Lab	-	-	2	2	25	50	3	1
9	PW702EE	Project Work Phase – I	-	-	6	6	50	-	-	3
10	PW701EE	Summer Internship*	-	-	-	-	50	-	-	1
Total			**18**	**-**	**10**	**28**	**330**	**520**	**-**	**24**

Professional Elective – III & IV		
1	PE507EE	Electrical Distribution Systems
2	PE508EE	Utilization of Electrical Energy
3	PE509EE	Power Quality Engineering
4	PE510EE	Energy Management Systems and SCADA

Open Elective – II		
1	OE603EE	Non-Conventional Energy Sources (Not for EEE & EIE)
2	OE604EE	Transducers and Sensors (Not for EEE/ EIE)
3	OE621AE	Automotive Safety and Ergonomics (Not for Mech./Prod./Auto. Engg. students)
4	OE621ME	Entrepreneurship (Not for Mech./Prod./Automobile Engg. students)
5	OE811CE	Green Building Technologies (Not for Civil Engg. Students)
6	OE802CS	Data Science Using R (Not for CSE Students)
7	OE816IT	Cyber Security (Not for IT Students)

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
MC: Mandatory Course PC: Professional Core PE: Professional Elective
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam) EE: Electrical Engg.

Note:

1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Course Code	Course Title						Core / Elective
PC428EE	**Control of Electric Drives**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understand the concepts of development of control circuits, remote control and electric interlocking in an industry
- Understand the construction and operation of various control components for the control circuits
- Understand the development of control circuits for various operations of both DC and AC machines.
- To understand the procedure for trouble shooting of circuits
- To understand the driver circuits for step motor

Course Outcomes

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

1. Understand the control circuits for remote control and interlocking of electric drives
2. Make use of circuit breakers and relays for protection of motors.
3. Explain the control of Induction Motor.
4. Explain the control of synchronous Motor and DC Motor.
5. Explain the control of stepper Motor.

UNIT I

Introduction of Electrical Control of Machines: Manual control – Magnetic control Semi-automatic and Automatic control of Modern machinery – Development of Control circuits–Two wire and Three wire control – Remote control – Interlocking of drives – Control circuit components –Symbols for control components–Fuses, Switches and Fuse Switch units.

UNIT II

Protection of motors : Moulded– Case Circuit Breaker (MCCB) and Miniature Circuit Breaker (MCB) – Contactors – Types of contactors – Contactor ratings, Relays – D.C Series current relay – Frequency responsiverelay – Latching relay – Over load relays – Bimetallic Thermal over load relay – time delay relay (Timers) – Motor drivers Electronic timer – Phase failure relay – Push button switches – Types, Limit switch – Float switch.

UNIT III

Control of Three-Phase Induction Motors: Motor current at start and during acceleration – Automatic starters – Increment Resistor type starter – Automatic Autotransformer starter – Open circuit and closed-circuit transition – Automatic Star-Delta starters Open circuit andclosed circuit transition – Starters for multi-speed motors.

UNIT IV

D.C Motor Control: Single-phase DC motor control using controlled rectifier and chopper circuit for continuous armature current operation. Dual converter control, circulating current and non-circulating current modes of operation, Principles of closed loop control for D.C drives. Control circuit for direct reversing and forward stop reverse operation –Jogging operation of D.C motor – Control circuits for braking action.

UNIT-V

Induction Motor Control: Speed control of 3-phase induction motor with A.C voltage regulators, Voltage source inverters and Cyclo-converters, Static rotor resistance control, slip power recovery schemes: Static Krammer drive and Scherbius drive.

Suggested Reading:

1. Bhattacharya S.K and Brijinder Singh, *Control of Electrical Machines*, New Age International Publishers, New Delhi.
2. Athani V.V, *Stepper Motors — Fundamentals, Applications and Design,* New Age International Publishers, New Delhi.
3. G.K.Dubey, *Fundamentals of Electrical Drive,* Narosa Publishing House

Course Code	Course Title						Core / Elective
PC429EE	**Power System Operation and Control**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC408EE, PC418EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand the concepts and Importance of Load flow studies, Economic Operation of thermal power units, frequency control of inter connected Power System Networks.
- To make the students understand about reactive Power Control and Stability of Power System Networks.

Course Outcomes

After completing this course, the student will be able to

1. Solve load flow by appropriate modelling of the given power system and formulation of Ybus.
2. Evaluate generation mix for economic operation with and without transmission losses.
3. Explain load frequency control and estimate the frequency deviation through modelling.
4. Analyse and describe different types of power system stability and establish SSSL.
5. Identify various methods of voltage control and study the reactive power compensation.

UNIT-I

Load Flow Studies: Formulation of Y bus by inspection method, modelling of tap changing and phase shifting transformer, Formulation of load flow problem, Solution of load flow by Gauss-Seidel, Newton-Raphson, Decoupled and Fast Decoupled methods, comparison of different load flow methods.

UNIT-II

Economic Operation of Power System: Input-Output curves, Heat rates and incremental cost curves, Equal Incremental cost criterion neglecting transmission losses with and without generator limits, Bmn coefficients, Economic operation including transmission losses.

UNIT-III

Load Frequency Control: Governor Characteristics, Regulation of two generators, coherency, concept of control area, Incremental power balance of a control area, Single area control, Flat frequency control, Flat tie-line frequency control, Tie-line bias control, Advantages of pool operation, Development of model for two-area control.

UNIT-IV

Power System Stability: Definitions of Steady state stability and Transient stability, Steady state stability of a synchronous machine connected to infinite bus, calculation of steady state stability limit, synchronous machine models with and without saliency, Equal area criterion, Application of equal area criterion, Swing equation, Step by step solution of Swing equation, factors effecting transient stability, Auto Reclosures.

UNIT-V

Reactive Power Control: Mathematical formulation of voltage stability problem, Reactive power generation by synchronous generators, Automatic voltage regulators,FACTS Controllers-TCSC, STATCOM, UPFC.

Suggested Readings:

1. C.L. Wadhwa, *Electric Power Systems*, New Age International (p) Ltd
2. D. P. Kothari and I.J. Nagrath, *Modern Power System Analysis,* Tata McGraw Hill.
3. John. J. Grangier, William D. Stevenson Jr., *Power System Analysis*, Tata McGraw Hill.
4. Haadi Sadat , *Power System Analysis,* Tata McGraw Hill.
5. Elgerd, *Electrical Energy Systems Theory,* Tata McGraw Hill
6. P. Chandrashaker, P. Satish Kumar, *Computer Methods in Power Systems – Analysis with MATLAB,* BSP Publishers, 2020.

Course Code	Course Title						Core / Elective
PC430EE	**Power Electronic Applications to Power Systems**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand the issues involved in existing Power Transmission system
- To be familiar with the Techniques to overcome the problems associated with AC Power Transmission system
- To Understanding the control of active and reactive power control using Power electronic converters

Course Outcomes

After completing this course, the student will be able to

1. Understand the need for FACTS devices in Power Transmission system.
2. Explain and apply shunt and series compensators.
3. Explain and apply UPFC and IPFC for real and reactive power control
4. Explain and apply the power transmission schemes for HVDC Transmission
5. Analyze and compare control schemes of HVDCsystem

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 typesof 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: Introduction, operating principle, independentreal and reactive power flow controller and control structure of Unified power flow controller (UPFC) and Interline power flow controller (IPFC). Introduction to Active power filtering Concepts

UNIT-IV

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 equipments. 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. Introduction to multiterminal 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.
2. Hingorani ,L.Gyugyi, *Concepts and Technology of Flexible AC Transmission System*, IEEE Press New York, 2000.
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 AngelesCamacho *FACTS – Modeling and simulation in Power Networks* John Wiley & Sons, 2002.

Course Code	Course Title						Core/Elective
PE507EE	**Electric Distribution Systems (Professional Elective-III / IV)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The objectives of this course is to impart knowledge of

- 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

After completing this course, the student will be able to:

1. Understand the concept of different factors used in distribution system.
2. Design Sub-transmission lines and distribution sub-stations.
3. Understand the Design considerations of primary and secondary systems
4. Calculate the voltage drop and power loss in distribution system.
5. Understand the automation and voltage control of distribution system.

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 and 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. 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. Advanced Metering Infra and Automatic Metering Reading.

Suggested Readings:

1. V. Kamaraju, *Electrical Power Distribution System*, Tata McGraw Hill Publishing Company Ltd.
2. Turan Gonen, *Electric Power Distribution Engineering*, Mc Graw Hill Book Co., International Student Edition. 1986.
3. A.S. Pabla, *Electric Power Distribution*, Tata McGraw Hill Publishing Company Ltd., 1997

Course Code	Course Title						Core / Elective
PE508EE	**Utilization of Electrical Energy (Professional Elective-III /IV)**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To introduce the students and understand Utilization of electrical energy for various applications like industrial heating, welding etc.,
- To understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
- To understand the concept of electrification of traction system.

Course Outcomes

After completing this course, the student will be able to

1. Understand electrical heating and welding for industrial applications.
2. Explain the control methods of induction and synchronous motors.
3. Design illumination for different application.
4. Understand the traction mechanics.
5. Understand the characteristics of traction motors.

UNIT-I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens. Design of elements. Core type furnace, Coreless type furnace, High frequency eddy current heating, Dielectric heating, Arc furnace. Electric Welding: Resistance welding, Welding transformer and its rating. Various types of Electric arc welding and Electric resistance welding.

UNIT-II

Schematic Utilization and Connection Diagram for Motor Control:

Two supply sources for 3-phase Induction motors. Direct reversing, remote control operation, Jogging operation of induction motor. Contactor control circuit. Pushbutton control stations. Over load relays, limit switches, Float switches. Interlocking methods for reversing control. Starting of Synchronous motor and motor protection.

UNIT-III

Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inverse square law and cosine law, Solid angle, lighting calculations, determination of M.S.C.P, Rousseau's construction, Discharge lamps, Sodium vapour lamps, Mercury vapour lamps, Fluorescent lamps, Starting and power factor corrections, Stroboscopic effects, Neon signs, Application to factory lighting, Street lighting and Flood lighting.

UNIT-IV

Electric Traction: System of Electric Traction, transmission of Drive, system of track electrification, Traction mechanics, Speed time curves, tractive effort, Power of Traction motor, Specific energy consumption, Mechanics of train movement, Coefficient of adhesion.

UNIT-V

Traction Motors: Desirable characteristics, DC series motors, AC series motors, 3-phase induction motors, DC motor series & parallel control, Shunt bridge transition, Energy saving.

Suggested Readings:

1. Partab G, "*Art and Science of Utilization of Electric Power*", publisher Dhanpatrai& Sons, 1990.
2. Raina K.B & Bhattacharya S.K., "*Electrical Design, Estimating and Costing*", publisher, Wiley Eastern Ltd., 1991.
3. Dubey G.K., "*Fundamentals of Electric Drives*", publisher, Narosa Public House, Delhi, 2001.
4. Openshaw Taylor, "*Utilization of Electrical Energy*".
5. Wadhwa C.L., "*Generation, Distribution & Utilization of Electrical Energy*", publisher, Wiley, 1989

Course Code	Course Title						Core / Elective
PE509EE	**Power Quality Engineering (Professional Elective-III / IV)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The student able to learn and understand the importance of power quality, different power quality issues and their effects in power system network

Course Outcomes

After completing this course, the student will be able to

1. Describe the different PQ disturbances and state remedies to improve PQ.
2. Determine voltage sag for different network configurations.
3. Explain the effect of ASD systems on power quality and the effect of voltage sags on operationof various electrical machines.
4. Analyze the harmonic levels in industrial distribution systems.
5. Describe power quality monitoring and measuring techniques.

UNIT-I

Introduction: Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring. Power Quality Data: Data collection, Data analysis, Database structure, Creating PQ databases, Processing PQ data.

UNIT-II

Voltage Sag Characterization: Voltage sag – definition, causes of voltage sag, voltage sag magnitude, monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, Meshed systems, voltage sag duration. Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-III

PQ Considerations in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications, mitigation of harmonics. Characterization of voltage sags experienced by three-phase ASD systems: Types of sags and phase - angle jumps. Effects of momentary voltage dips on the operation of induction and synchronous motors. Voltage sag coordination for reliable plant operation.

UNIT-IV

Effects of Harmonics on Power Quality: Harmonic analysis of industrial customers, technical barriers in ASDs. Methods of evaluation of harmonic levels in industrial distribution systems. Harmonic effects on transformers. Impact of distribution system capacitor banks on PQ. Guidelines for limiting voltage harmonics.

UNIT-V

Power Quality Monitoring: Introduction, site surveys, Transducers, IEC measurement techniques for Harmonics, Flicker, IEC Flicker meter.

Suggested Readings:

1. Math H.J. Bollen, *Understanding Power Quality Problems*, IEEE Press, 1999.
2. Roger C. Dugan, MarkF. McGranaghan, Surya Santoso, H. WayneBeaty, *Electrical Power Systems Quality*, Second Edition, Tata McGraw-Hill Edition.
3. C. Sankaran, *Power Quality*, CRC Press, 200.

Course Code	Course Title						Core / Elective
PE510EE	**Energy Management Systems and SCADA (Professional Elective-III / IV)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	**Credits**
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Outline energy management systems and unit commitment and its solution techniques.
- Discuss power generation scheduling with limited energy.
- Describe the architecture, functions and applications of supervisory control and data acquisition (SCADA) and apply SCADA in power system automation and communications.

Course Outcomes

After completing this course, the student will be able to

1. Understand energy management centers.
2. Explain the principles of power generation scheduling.
3. Understand the components of SCADA.
4. Explain the configurations of SCADA and its application in Power System.
5. Understand the SCADA communication protocols.

UNIT-I

Energy Management Centers: Introduction, Energy management centers and their functions, architectures, recent developments, characteristics of power generating units and economic dispatch, unit commitment (spinning reserve, thermal, hydro and fuel constraints), solution techniques of unit commitment.

UNIT-II

Generation Scheduling: Generation scheduling with limited energy, energy production cost models, budgeting and planning, practical considerations, interchange evaluation for regional operations, types of interchanges, exchange costing techniques.

UNIT-III

Supervisory Control And Data Acquisition: Introduction to supervisory control and data acquisition, SCADA functional requirements and components. SCADA Application: General features, functions and applications, benefits of SCADA, architectures of SCADA, applications of SCADA.

UNIT-IV

SCADA and Power Systems: Configurations of SCADA, RTU (remote terminal units) connections, power systems SCADA and SCADA in power system automation.

UNIT-V

SCADA and Communication: SCADA communication requirements, SCADA communication protocols: past present and future, structure of a SCADA communications protocol.

Suggested Readings:

1. John D Mc Donald, Mini S. Thomas, *Power System SCADA and Smart Grids*, CRC Press, 2015
2. Handschin E, *Energy Management Systems*, Springer Verlag, 1st Edition, 1990.
3. John D Mc Donald, *Electric Power Substation Engineering*, CRC press, 1st Edition, 2001.
4. Wood, A J and Wollenberg, B F, *Power Generation Operation and Control*, John Wiley and Sons, 2nd Edition 2003.
5. Bisht T.K. , *SCADA and Energy Management System,* S K Kataria and Sons 2013
6. Green, J N Wilson, R, *Control and Automation of Electric Power Distribution Systems*, Taylor and Francis, 1st Edition, 2007.
7. Turner, W C, *Energy Management Handbook*, Fairmont Press, 5th Edition, 2004.

Course Code	Course Title						Core / Elective
OE603EE	**Non-Conventional Energy Sources (Open Elective –II)**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To impart the knowledge of basics of different non-conventional types of power generation & power plants in detail so that it helps them in understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature

Course Outcomes

After completing this course, the student will be able to

1. Understand the different nonconventional sources and the power generation techniques to generate electrical power.
2. Explain the Solar energy power development and different applications.
3. Explain different wind energy power generation techniques and applications.
4. Understand power generation using OTEC and Geothermal energy.
5. Explain power generation from Bio-mass.

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 H_2O_2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonatecells - 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 Readings:

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.

Course Code	Course Title						Core / Elective
OE604EE	**Transducers and Sensors (Open Elective – II)**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To expose the students to various sensors and transducers for measuring mechanical quantities.
- To understand the specifications of sensors and transducers.
- To learn the basic conditioning circuits for various sensors and transducers.
- To introduce advances in sensor technology.

Course Outcomes:

After completing this course, the student will be able to

1. Understand the static characteristics of Measurement system and sensors.
2. Explain resistive transducers.
3. Explain capacitive and inductive transducers.
4. Understand the temperature measurement using transducers.
5. Understand the principle and working of various advanced sensors and transducers.

UNIT -I

Introduction to measurement system (MS) static characteristics of MS: linearity, Hysteresis, Threshold, Repeatability, Reliability and maintainability, Span, Calibration.

Sensor Fundamentals: Basic sensor technology and sensor system Sensor characteristics, system characteristics, instrument selection, data acquisition and readout, and installation.

UNIT-II

Resistive Transducer: Classification of transducers, Basic requirements of transducers, Variable resistance transducers; Potentiometers, Strain gauge (SG), types of Strain Guage.

UNIT-III

Variable capacitive transducers: Capacitance, Principles, Capacitance displacement transducers, Capacitive hygrometer, and capacitive proximity transducers.

Variable inductive transducers: Linear variable differential transformer, Rotary variable differential transformer.

UNIT-IV

Measurement of temperature: Standards for calibration of temp. Temperature measuring devices, types of filled in system thermometers — liquid in glass, vapour pressure, bimetallic on solid rod thermometer Resistance temperature detectors, thermostat thermocouple.

UNIT-V

Advance Sensors: Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Digital displacement sensors, Fibre optic sensor, Semiconductor sensor and Smart sensors.

Suggested Reading:

1. C.S.Rangan, G R Sarma & V S N Mani, *Instrumentation Devices and Systems*-TMH, 2nd Edition 2004
2. B.Nakra & Chowdhari, *Instrumentation Measurement and Analysis*, TMH, 2nd Edition 2003
3. D.V.S.Murthy, *Transducers and Instrumentation*, PHI, 1995 4. John P. Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education, 2000.
4. Doebelin E.O, *Measurement Systems - Application and Design*, 4th Edition, McGraw-Hill, New
5. Patranabis D, *Principles of Industrial Instrumentation*, 2nd Edition, Tata McGraw Hill, New Delhi, 1997.
6. Jon Wilson *Sensor Technology Handbook* , Newness Publication Elsevier.

AUTOMOTIVE SAFETY AND ERGONOMICS

OE 621 AE

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

Objectives:

1. To impart knowledge of automotive safety and ergonomics
2. To understand the basics of vehicle collision and its effects.
3. To understand the various safety concepts used in passenger cars
4. To Gain knowledge about various safeties and its equipment.
5. To understand the concepts of vehicle ergonomics.

Outcomes:

Student will be able to

1. Explain the types and importance of vehicle safety.
2. Describe the various safety equipments used in automobiles.
3. Demonstrate the modern tools used for vehicle safety.
4. Explain the role of automotive ergonomics in automobiles.
5. Demonstrate the best comfort and convenience system in vehicle.

UNIT – I

Introduction: Design of the Body for safety, Energy equations, Engine location, Effects of Deceleration inside passenger compartment, Deceleration on impact with stationary and movable obstacle, Concept of Crumble zone and Safety sandwich construction, Active and passive safety, Characteristics of vehicle structures, Optimization of vehicle structures for crash worthiness, Types of crash / roll over tests, Regulatory requirements for crash testing, instrumentation, High speed photography, image analysis.

UNIT – II

Safety Concepts: Active safety- driving safety, Conditional safety, Perceptibility safety and Operating safety, Passive safety: Exterior safety, Interior safety, Deformation behaviour of vehicle body, Speed and acceleration characteristics of passenger compartment on impact, pedestrian safety, human impact tolerance, determination of injury thresholds, severity index, study of comparative tolerance, Study of crash dummies.

UNIT – III

Safety equipments: Seat belt, automatic seat belt fastening system, Collapsible steering column, tilt-able steering wheel, Air bags, electronic systems for activating air bags, Frontal design for safety, collision warning system, Causes of rear end collision, frontal object detection, rear vehicle object detection system, Object detection system with braking system interactions. Anti-lock braking system ESP and EBD systems

UNIT – IV

Vehicle Ergonomics: Introduction to human body - anthropometrics and its application to vehicle ergonomics, Cockpit design, Driver comfort – seating, visibility, Man-machine system-psychological factors – stress, attention, Passenger comfort - ingress and egress, spaciousness, Ventilation, temperature control, Dust and fume prevention and vibration, Interior features and conveniences, Use of modern technology for the same

UNIT – V

Comfort and Convenience System: Cabin comfort - in-car air conditioning – overall energy efficiency, Air management, central and Unitary systems, air flow circuits, air cleaning, ventilation, air space diffusion, Compact heat exchanger design, controls and instrumentation, Steering and mirror adjustment, central locking system, Garage door opening system, tire pressure control system, rain sensor system, environment information system, Automotive lamps, types, design, construction, performance, Light signalling

devices- stop lamp, Rear position lamp, Direction indicator, Reverse lamp, reflex reflector, position lamp, gas discharge lamp, LED, Adoptive front lighting system (AFLS) and Daylight running lamps (DRL).

Suggested Readings:

1. Prasad, Priya and BelwafaJamel, "*Vehicles Crashworthiness and Occupant Protection*", American Iron and Steel Institute, USA.
2. JullianHappian-Smith "*An Introduction to Modern Vehicle Design"* SAE, 2002
3. Bosch - "*Automotive Handbook*" - 5th edition - SAE publication - 2000.
4. *"Recent development in Automotive Safety Technology*", SAE International Publication. Editor: Daniel J Helt, 2013.
5. Keitz H.A.E. "*Light Calculations and Measurements*", Macmillan 1971.

ENTREPRENEURSHIP

OE621ME

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

Objectives:

1. To motivate students to take up entrepreneurship in future
2. To learn nuances of starting an enterprise & project management
3. To understand the design principles of solar energy systems, their utilization and performance evaluation
4. To understand the behavioural aspects of entrepreneurs and time management

Outcomes:

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

1. Understand Indian Industrial Environment, Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
5. Understand the Behavioural aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

Unit-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

Unit-II:

Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.

Unit-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

Unit-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

Unit-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Reading:

1. Vasant Desai, *"Dynamics of Entrepreneurial Development and Management"*, Himalaya Publishing House,1997

2. Prasanna Chandra, *"Project-Planning, Analysis, Selection, Implementation and Review"*, Tata McGraw-Hill Publishing Company Ltd. 1995.
3. Stephen R. Covey and A. Roger Merrill, *"First Things First"*, Simon and Schuster Publication, 1994.
4. G.S. Sudha, *"Organizational Behaviour"*,1996.
5. Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship"*, Tata Me Graw Hill Publishing Company Ltd., 5lh Ed.,2005.

GREEN BUILDING TECHNOLOGIES

OE 602 CE

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

Objectives:

1. To impart knowledge of the principles behind the green building technologies
2. To know the importance of sustainable use of natural resources and energy.
3. To understand the principles of effective energy and resources management in buildings
4. To bring awareness of the basic criteria in the green building rating systems
5. To understand the methodologies to reduce, recycle and reuse towards sustainability.

Outcomes:

Student will be able to

1. Define a green building, along with its features, benefits and rating systems.
2. Describe the criteria used for site selection and water efficiency methods.
3. Explain the energy efficiency terms and methods used in green building practices.
4. Select materials for sustainable built environment & adopt waste management methods.
5. Describe the methods used to maintain indoor environmental quality.

UNIT – I

***Introduction to Green Buildings*:** Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT – II

***Site selection and planning*:** Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

UNIT – III

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT – IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolona cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials

UNIT – V

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.
Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. *IGBC Green Homes Rating System, Version 2.0.*, Abridged reference guide, 2013, Indian Green Building Council Publishers
2. GRIHA version 2015, GRIHA rating system, *Green Rating for Integrated Habitat Assessment*
3. '*Alternative building materials and technologies*' by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. '*Non-Conventional Energy Resources*' by G. D. Rai, Khanna Publishers.
5. *Sustainable Building Design Manual, Vol.1 and 2*, TERI, New Delhi 2004

DATA SCIENCE USING R

OE 802 CS

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

Objectives:

1. To learn basics of R Programming environment: R language, R- studio and R packages.
2. To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting.
3. To learn Decision tree induction, association rule mining and text mining.

Outcomes:

Student will be able to

6. Use various data structures and packages in R for data visualization and summarization.
7. Use linear, non-linear regression models, and classification techniques for data analysis.
8. Use clustering methods including K-means and CURE algorithm

UNIT – I

Introduction To R: Introduction, Downloading and Installing R, IDE and Text Editors, Handling Packages in R.

Getting Started With R: Introduction, Working with Directory, Data Types In R, Few Commands for Data Exploration.

Loading and Handling Data In R: Introduction, Challenges of Analytical Data Processing, Expression, Variables, Functions, Missing Values Treatment In R, Using _As' Operator To Change The Structure Of The Data, Victors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregation And Group Processing Of A Variable, Simple Analysis Using R, Methods For Reading Data, Comparison Of R GUI's For Data Input, Using R With Databases And Business Intelligence Systems.

UNIT – II

Exploring Data In R: Introduction, Data Frames, R Functions for Understanding Data in Data Frames, Load Data Frames, Exploring Data, Data Summary, Finding the Missing Values, Invalid Values And Outliers, Descriptive Statistics, Spotting Problems In Data with Visualization.

UNIT – III

Linear Regression Using R: Introduction, Model Fitting, Linear Regression, Assumptions of Linear Regression, Validating Linear Assumption.

Logistic Regression: Introduction, What Is Regression?, Introduction To Generalized Linear Model, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression, Multinomial Logistic Regression Model.

UNIT – IV

Decision Tree: Introduction, What Is A Decision Tree?, Decision Tree Representation In R, Appropriate Problems For Decision Tree Learning, Basic Decision Tree Learning Algorithm, Measuring Features, Hypothesis Space Search In Decision Tree Learning, Inductive Bias In Decision Tree Learning, Why Prefer Short Hypotheses, Issues In Decision Tree Learning.

Time Series In R: Introduction, What Is Time Series Data, Reading Time Series Data, Decomposing Time Series Data, Forecasts Using Exponential Smoothing, ARIMA Models.

UNIT – V

Clustering: Introduction, What Is Clustering, Basic Concepts in Clustering, Hierarchical Clustering, K-Means Algorithm, CURE Algorithm, Clustering in Non-Euclidean Space, Clustering for Streams and Parallelism.

Association Rules: Introduction, Frequent Itemset, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance Based Clustering Transaction and Association.
Text Mining: Introduction, Definition of Text Mining, A Few Challenges in Text Mining, Text Mining Verses Data Mining, Text Mining In R, General Architectures of Text Mining Systems, Pre-Processing of Documents In R, Core Text Mining Operations, Using Background Knowledge for Text Mining, Text Mining Query Languages.
Mining Frequent Patterns, Associations and Correlations: Basic Concepts and Methods.
Frequent Itemset, Closed Itemset And Association Rules.
Frequent Itemset: Mining Methods, Pattern Evaluation Methods, Sentiment Analysis**.**

Suggested Readings:

1. Data Analytics using R by Seema Acharya. McGraw Hill education.
2. Practical Data Science with R, Nina Zumel and John Mount, Manning Shelter Island.
3. 'The R book, Crawley, Michael J. John Wiley & Sons, Ltd

CYBER SECURITY

OE 816 IT

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

Objectives:

1. To familiarize various types of cyber-attacks and cyber-crimes
2. To give an overview of the cyber laws
3. To study the defensive techniques against these attacks

Outcomes:

Student will be able to

1. Understand different types of cyber-attacks
2. Understand the types of cybercrimes and cyber laws
3. To protect them self and ultimately the entire Internet community from such attacks

UNIT – I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance –Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT – II

Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains-medical, financial.

UNIT – III

Logical Design: Blue print for security. Security Policy, standards and Practices, Design of Security Architecture.

Physical Design: Security Technology, Physical Design of Security SDLC Firewalls, Dialup Protection, Intrusion Detection Systems, Scanning and analysis tools, and Content filters.

UNIT – IV

Cryptography: The basic elements of cryptography: symmetric (Symmetric Key-DES, IDEA, and AES), and public key cryptography (Public Key Encryptions-RSA).

UNIT – V

Message digest (MD-5, SHA), and digital signatures.

SSL and SET: SSL and SET protocols, Internet transactions using both SSL and SET.

Suggested Readings:

1. Michael E. Whitman and Herbert J. Mattord, "*Principles of Information Security*", Thomson, 2003.
2. William Stallings, "*Cryptography and Network Security*", Pearson Education, 2000.
3. Nina Godbole, "*Information System Security*", John Wiley & Sons, 2008.

Course Code	Course Title						Core / Elective
PC465EE	**Power System Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Power System –I & Power System -II	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To determine regulation & efficiency of short, medium and long transmission lines and to calculate A, B, C, D constants.
- To understand the importance of protective relays in power system such as different protection of transformer DMT Characteristics of over current relay, Buchholz relay and static relays.
- To understand the procedure to determine sequence parameters of transformer and alternator.

Course Outcomes

1. Determine ABCD constants of transmission lines and evaluate regulation, efficiency.
2. Acquire knowledge in relay setting for safe operating of power system.
3. Determine sequence parameters of transformer and alternator and draw its importance.
4. Determine the time constant of an alternator.
5. Determine the dielectric strength of oil and calculate the efficiency of string insulators.

List of Experiments:

1. Determination of regulation & efficiency of Short, Medium and Long transmission lines.
2. IDMT characteristics of Over-current relay & Study of Bucholz relay.
3. Determination of A, B, C, D constants of Short, Medium and Long lines. Drawing of Circle diagrams.
4. Differential protection of transformer.
5. Sequence impedance of 3-Phase Alternators.
6. Determination of positive, negative and zero-sequence reactance of 3- Phase transformers using sequence current excitation fault calculation.
7. Synchronous machine reactance and time constant from 3-Phase S. Ctest.
8. Characteristics of Static relays.
9. Static excitation of Synchronous Generator.
10. Determination of dielectric strength of oils and study of Megger.
11. Parallel operation of Alternators.
12. Measurement of capacitance of 3-core cables.
13. Fault location of Underground cables.
14. Simulation of string of insulators for determination of Voltage distribution and String efficiency.

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

Course Code	Course Title						Core / Elective
PC466EE	**Electrical Simulation Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**2**	**25**	**50**	**1**

Course Objectives

- The student learns analysis of electrical system through computer simulation, using software packages.
- To simulate a given electrical circuits in any environment, to analyse its dynamic characteristics and to figure out its stability considerations.

Course Outcomes

After completing this course, the student will be able to

1. Simulate the concepts of Electrical Circuits, Control Systems and Power Systems and interpret data.
2. Demonstrate the knowledge of programming environment, compiling, debugging, linking and executing variety of programs in MATLAB.
3. Demonstrate ability to develop Simulink models for various electrical systems.
4. Validate simulated results from programs/Simulink models with theoretical calculations.

Simulation experiments should be conducted in the following areas using MATLAB / Simulink (with DSP Tool Box, Control System Tool Box & Power System Tool Box) PSpice /PSCAD / SABER / EDSA/ Power Trans

1. Verification of Network theorems
    a. Thevinin's theorem
    b. Superposition theorem
    c. Maximum power transfer theorem.
2. Transient responses of Series RLC, RL and RC circuits with Sine and Step inputs.
3. Series and Parallel resonance.
4. Bode plot, Root-Locus plot and Nyquist plot.
5. Transfer function analysis
    (i) Time response for Step input
    (ii) Frequency response for Sinusoidal input.
6. Design of Lag, Lead and Lag - Lead compensators.
7. Load flow studies.
8. Fault analysis.
9. Transient stability studies.
10. Economic Power Scheduling
11. Design of filters (Low pass filter).
12. Chopper fed dc motor drives.
13. VSI /CSI Fed induction motors drives. Doubly fed Induction motor.
14. Phase Control of DC motor Drives.
15. Control of BLDC motor.

Note: At least ten experiments should be conducted.

Course Code	Course Title						Core / Elective
PW702EE	**Project Work Phase – I**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	6	50	-	**3**

Course Objectives

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.
The department will appoint a project coordinator who will coordinate the following:
Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries).
Grouping of students (max 3 in a group)
Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.
Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes' presentation followed by 10 minutes' discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

- Problem definition and specification
- Literature survey
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts
- Presentation- oral and written.

Course Code	Course Title						Core / Elective
PW **701 EE**	**Summer Internship**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	-	**50**	-	**1**

Course Objectives

- Produce an accurate record of work performed during the Internship/Co-op
- Apply engineering knowledge to a problem in industry
- Produce a technical report
- Discuss work in a team environment, if relevant to the project
- Conduct herself/himself responsibly, safely, and ethically in a professional environment

Course Outcomes

After completing this course, the student will be able to

1. Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.
2. Gain working practices within Industrial/R&D Environments.
3. Prepare reports and other relevant documentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organisations/Computer Industry/Software Companies/R&D Organization for a period of 4-6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship

- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the project executed and
2. 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 students at the workplace and awarded 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 Industry Attachment Program.

Note: Students have to undergo summer internship of 4-6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Electrical and Electronics Engineering) VIII – SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PE5_EE	Professional Elective - V	3	-	-	3	30	70	3	3
2	PE5_EE	Professional Elective -VI	3	-	-	3	30	70	3	3
3	OE6_EE	Open Elective-III	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
4	PW703EE	Project Work Phase - II	-	-	16	16	50	100	-	8
Total			**09**	**-**	**16**	**25**	**140**	**310**	**-**	**17**

Professional Elective – V & VI		
1.	PE511EE	AI Techniques in Electrical Engineering
2.	PE512EE	Advances in Power Electronics
3.	PE513EE	Grid Integration of Renewable Energy Systems
4.	PE514EE	Smart Grid Technology

Open Elective – III		
1.	OE605EE	Smart Building Systems (Not for EEE & EIE)
2.	OE606EE	Programmable Logic Controllers (Not for EEE & EIE)
3.	OE631AE	Automotive Maintenance (Not for Mech./Prod./Auto. Engg. students)
4.	OE631ME	Mechatronics (Not for Mech./Prod./Auto. Engg. students)
5.	OE603CE	Road Safety Engineering (Not for Civil Engg. Students)
6.	OE604IT	Software Engineering (Not for IT Students)

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
MC: Mandatory Course PC: Professional Core PE: Professional Elective
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam) EE: Electrical Engg.

Note:

1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Course Code	Course Title						Core / Elective
PE511EE	**AI Techniques in Electrical Engineering (Professional Elective – V / VI)**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- To be able to understand basics of ANN & Fuzzy based systems.
- To make the students to understand the ANN based systems for function approximation used in load forecasting.

Course Outcomes

At the end of the course students will be able to

1. Differentiate soft computing and hard computing techniques
2. Make use of different ANN learning rules
3. Understand Fuzzy logic based systems
4. Apply Genetic algorithms.
5. Solve problems in Power System Operation and Control using AI Techniques.

UNIT-I:

Introduction: definition of AI - difference between soft computing techniques and hard computing systems, expert systems brief history of ANN, Fuzzy and GA

UNIT-II:

Artificial Neural Networks: Introduction, Models of Neuron Network-Architectures –Knowledge representation, Artificial Intelligence and Neural networks–Learning process-Error correction learning, Hebbian learning – Competitive learning-Boltzman learning, supervised learning-Unsupervised learning–Reinforcement learning-Learning tasks. Multi-layer perceptron using Back propagation Algorithm (BPA). Applications of ANN for load forecasting, voltage control.

UNIT-III:

Fuzzy Logic: Introduction –Fuzzy versus crisp, Fuzzy sets-Membership function –Basic Fuzzy set operations, Properties of Fuzzy sets –Fuzzy cartesion Product, Operations on Fuzzy relations –Fuzzy logic –Fuzzy Quantifiers, Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods .

UNIT-IV:

Genetic Algorithms: Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modeling – Genetic operators-Cross over-Single site cross over, Two point cross over –Multi point cross over-Uniform cross over, Matrix cross over-Cross over Rate-Inversion & Deletion, Mutation operator –Mutation –Mutation Rate-Bit-wise operators, Generational cycle-convergence of Genetic Algorithm.

UNIT-V:

Applications of AI: Fuzzy logic for Automatic Generation control, voltage stability and Genetic Algorithm for Automatic Generation Control, Economic Load dispatch.

Reference Books:

1. S. Rajasekaran, G. A. Vijayalakshmi, *Neural Networks, Fuzzy logic and Genetic Algorithms*, Pai PHI publication,
2. Kalyanmoy De, *Optimization for Engineering Design*, PHI publication
3. Kalyanmoy Deb, *Multi-objective Optimization using Evolutionary Algorithms*, Willey Publications.

Course Code	Course Title						Core / Elective
PE512EE	**Advances in Power Electronics (Professional Elective – V / VI)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	**Credits**
	L	T	D	P			
PC411EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To make the student familiar with the concepts of
- Understanding of requirements of high power devices.
- Understanding the operation of various power converters.
- Design concepts of controllers for power electronic converters.

Course Outcomes

After completing this course, the student will be able to

1. Explain about High power devices
2. Obtain emulated resistance by using PWM rectifiers.
3. Perform state space modelling of DC-DC converters.
4. Understand soft-switching converters
5. Explain the operation of Multi-level inverters.

UNIT-I

Introduction to switches: Advanced Silicon devices - Silicon HV thyristors, MCT, BRT &EST. SiC devices - diodes, thyristors, JFETs & IGBTs. Gallium nitrate devices - Diodes, MOSFETs.

UNIT-II

Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of the current waveform, single phase and three-phase converter systems incorporating ideal rectifiers and design examples. Non-linear phenomena in switched mode power converters: Bifurcation and Chaos.

UNIT-III

Control of DC-DC converters: State space modelling of Buck, Boost, Buck-Boost, Cuk Fly back, Forward, Push-Pull, Half & Full-bridge converters. Closed loop voltage regulations using state feedback controllers.

UNIT-IV

Soft- switching DC - DC Converters: zero-voltage-switching converters, zero-current switching converters, Multi- resonant converters and Load resonant converters.

UNIT-V

Advance converter topologies: Multi level converters - Cascaded H-Bridge, Diode clamped, NPC, Flying capacitor. Modular Multi-level converters (MMC), Multi-Input DC-DC Converters, Multi pulse PWM current source converters, interleaved converters, Z-Source converters.

Suggested Readings:

1. Andrzej M Trzynadlowski, 'Introduction to Modern Power Electronics, John Wiley and sons. Inc, New York, 1998
2. L. Umanand, 'Power Electronics Essentials &Applications', Wiley publishing Company, 1st Edition,2014
3. B. Jayant Balinga, 'Advanced High Voltage Power Device Concepts', Springer New York 2011.
4. BIN Wu, 'High Power Converters and AC Drives', IEEE press Wiley Interscience, 2006.
5. Satish Kumar Peddapelli, *Pulse Width Modulation- Analysis and Performance in Multilevel Inverters*, De-Gruyter Oldenbourg Publisher, Germany, 2016.

Course Code	Course Title						Core / Elective
PE513EE	**Grid Integration of Renewable Energy Systems (Professional Elective – V / VI)**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

Upon successful completion of the course the students will be familiar with:

- To introduce the characteristics of various types of renewable energy sources and converters.
- To explain the power system operation, power quality, renewable energy grid integration and types of grid.
- To study the basic analysis and operation techniques on power electronic systems.
- To understand power control and management systems for grid.
- To understand the issues in grid integration of renewable energy sources.

Course Outcomes

At the end of the course, the student should be able to:

1. Identify the characteristics of renewable energy sources and converters.
2. Understand the operation of power system
3. Analyze the importance of power electronic systems in renewable power applications.
4. Realize the management systems for grid integration.
5. Analyze the challenges faced by the grid when integrating renewable energy sources.

UNIT-I

Review of characteristics of power sources: Basic review of power generation from wind - Solar PV - Thermal - Small hydro - Biomass power strategies in each of these energy conversion systems - Review of maximum power point tracking techniques in solar PV and wind (perturb & observe, hill climbs, incremental conductance).

UNIT-II

Power system operation: Introduction on electric grid, supply guarantees, power quality and stability, introduction to renewable energy grid integration, concept of mini/micro grids and smart grids; wind, solar, biomass power generation profiles, generation electric features, Load scheduling.

UNIT-III

Introduction to basic analysis and operation techniques on power electronic systems: functional analysis of power converters, power conversion schemes between electric machines and the grid, power systems control using power converters; electronic conversion systems application to renewable energy generation systems, basic schemes and functional advantages; wind power and photovoltaic power applications.

UNIT-IV

Power control and management systems for grid integration: island detection systems, synchronizing with the grid; Issues in integration of converter-based sources; Network voltage management; power quality management and frequency management; Influence of PV/WECS on system transient response.

UNIT-V

Issues in grid integration of renewable energy sources: Overview of challenges in integrating renewable sources to the grid - Impact of harmonics on power quality – need to maintain voltage within a band and fluctuations in voltage because of renewable integration - power inverter and converter technologies - mechanism to synchronize power from renewable sources to the grid - overview of challenges faced in designing power injection from offshore generation sources - challenges in modeling intermittent nature of renewable power in a power system.

Suggested Readings:

1. Kersting W. H. *Distribution System Modeling and Analysis*, Second Edition, CRC Press, 2004.
2. Vittal V. and Ayyanar R. *Grid Integration and Dynamic Impact of Wind Energy*, Springer, 2012.
3. Bollen M. H. and Hassan F. *Integration of Distributed Generation in the Power System*, Wiley-IEEE Press, 2011.
4. Keyhani A. *Design of Smart Power Grid Renewable Energy Systems*, Wiley–IEEE Press, 2011.
5. Muhannad H. R. *Power Electronics: Circuits, Devices and Applications*, Pearson Prentice Hall. 2004.
6. Gellings C. W. *The Smart Grid: Enabling Energy Efficiency and Demand Response*, First Edition, CRC Press, 2009.
7. Teodorescu R. Liserre M. Rodriguez P. *Grid Converters for Photovoltaic and Wind Power Systems*, First Edition, Wiley-IEEE Press, 2011.

Course Code	Course Title						Core / Elective
PE514EE	**Smart Grid Technology (Professional Elective – V / VI)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand various aspects of smart grid
- To study various smart transmission and distribution technologies
- To appreciate distribution generation and smart consumption
- To know the regulations and market models for smart grid

Course Outcomes

1. Understand technologies for smart grid.
2. Appreciate the DC distribution and smart grid systems.
3. Realize the Smart Grid Communications and Measurement Technology.
4. Summarize the renewable energy and storage
5. Outline the smart grid control

UNIT-I

Introduction to Smart Grid: Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions-comparison of Power Grid and Smart Grid-New Technologies for Smart Grid – Advantages – Present development and International policies in Smart Grid, Indian Smart Grid. Key Challenges for Smart Grid. Components and Architecture of Smart Grid - Description.

UNIT-II

DC Distribution and Smart Grid: AC Vs DC Sources-Benefits of and drives of DC power delivery systems – Powering equipment and appliances with DC-Data centers and information technology loads – Future neighborhood - Potential future workand research.

UNIT-III

Smart Grid Communications and Measurement Technology: Communication and Measurement – Monitoring, Smart Meters, Automated Meter Reading, Phasor Measurement Unit (PMU), Wide area measurement System (WAMS).

UNIT-IV

Renewable Energy and Storage: Introduction to Renewable Energy Technologies-Micro grids-Storage Technologies-Electric Vehicles and plug-in hybrids-Environmental impact and Climate Change-Economic Issues. Grid integration issues of renewable energy sources.

UNIT-V

Smart Power Grid System Control: Load Frequency Control (LFC) in Micro Grid System – Voltage Control in Micro Grid System, Reactive Power Control in Smart Grid.

Suggested Readings:

1. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 2013.
2. A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Application", Springer Edition, 2010.
3. Iqbal Hussein, "Electric and Hybrid Vehicle: Design fundamentals", CRC Press, 2003.
4. Gil Masters, Renewable and Efficient Electric Power System, Wiley-IEEE Press, 2004.
5. Fereidoon P. Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012.
6. Jean Claude Sabonnadiere, Nouredine Hadjsaid, "Smart Grids". Wiley-ISTE, IEEE Press, May 2012.
7. Smart Grid Handbook for regulators and Policy Makers Nov. 2017

Course Code	Course Title						Core / Elective
OE605EE	**Smart Building Systems (Open Elective-III)**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand the basic blocks of Building Management System.
- To design various sub systems (or modular system) of building automation
- To integrate all the sub systems.

Course Outcomes

At the end of the course students will be able to

1. Understand and analyze current philosophy, technology, terminology, and practices used in building automation
2. Interpret different safety and security standards for building management System
3. Design access control system
4. Understand security systems and premier intrusion
5. Identify various tools and techniques in BMS for Design of Secure, Safe and Smart building

UNIT-I

Introduction: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT-II

Fire Alarm (FA) System: concept of fire, Fire modes, History, Components, and Principles of Operation. Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. Types of FAS Architectures, Examples. Classification of FAS loops, Examples. FAS Design procedure in brief, NFPA 72A, BS 5839, IS, Concept of IP enabled fire & alarm system, design aspects and components of PA system.

UNIT-III

Access Control System: Access Components, Access control system Design.

CCTV: Camera Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. CCTV Applications.

UNIT-IV

Security Systems Fundamentals: Introduction to Security Systems, Concepts.

Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security system design for verticals. concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control –DAC, MAC, RBAC.

EPBX System & BMS subsystem integration: Design consideration of EPBX system and its components, integration of all the above systems to design BMS.

UNIT-V

Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.

Building Management System: IBMS (HVAC, Fire & Security) project cycle, Project steps BMS, Advantages & Applications of BMS, IBMS Architecture, Normal & Emergency operation, Advantages of BMS.

Suggested Reading:

1. Jim Sinopoli, *Smart Buildings*, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Reinhold A. Carlson, Robert A. Di Giandomenico, *Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs),* R.S. Means Company Publishing, 1991.
3. Albert Ting-Pat So, WaiLok Chan, Kluwer , *Intelligent Building Systems*, Academic publisher,3rd ed.,2012.

4. Robert Gagnon, *Design of Special Hazards and Fire Alarm Systems*, Thomson Delmar Learning; 2nd edition, 2007.
5. Levenhagen, John I.Spethmann, Donald H, *HVAC Controls and Systems*, McGraw-Hill Pub.
6. Hordeski, Michael F, *HVAC Control in the New Millennium*, Fairmont press, 2001.
7. Bela G. Liptak, *Process Control-Instrument Engineers Handbook*, Chilton book co.

Course Code	Course Title						Core / Elective
OE606EE	**Programmable Logic Controllers (Open Elective-III)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- To be able to understand basics of Programmable logic controllers, basic programming of PLC.
- To make the students to understand the Functions and applications of PLC

Course Outcomes

At the end of the course students will be able to

1. Understand PLC basics and advantages.
2. Develop PLC programs for industrial applications.
3. Explain PLC counter functions.
4. Understand PLC Arithmetic functions.
5. Make use of data handling functions.

UNIT-I

PLC Basics: Definition and History of PLC - PLC advantages and disadvantages - Over all PLC Systems - CPUs and Programmer Monitors - PLC input and output models - Printing PLC Information- Programming Procedures - Programming Equipment - Programming Formats- Proper Construction of PLC Diagrams - Devices to which PLC input and output modules are connected - Input on/off switching devices - Input analog devices - Output analog on/off devices and output analog devices.

UNIT-II

Basic PLC Programming: Programming on/off inputs to produce on/off outputs - PLC input instructions - Outputs - Operational procedures - Contact and coil input/output programming examples - Relation of digital gate logic contact / coil logic - PLC programming and conversion examples - Creating ladder diagrams from process control descriptions - Sequence listings - Large process ladder diagram constructions.

UNIT-III

Basic PLC Functions: General Characteristics of Registers - Module addressing - Holding registers - Input registers - output registers - PLC timer functions - examples of timer functions. Industrial applications - PLC counter functions.

UNIT-IV

Intermediate Functions: PLC Arithmetic functions - PLC additions and subtractions - The PLC repetitive clock - PLC Multiplications, Division and Square Root - PLC trigonometric and log functions - Other PLC arithmetic functions - PLC number comparison functions. PLC basic comparison functions and applications - Numbering systems and number conversion functions - PLC conversion between decimal and BCD-Hexadecimals numbering systems.

UNIT-V

Data Handling Functions: The PLC skip and master control relay functions - Jump functions - Jump with non return - Jump with return. PLC data move Systems - The PLC functions and applications. PLC functions working with bits - PLC digital bit functions and applications - PLC sequence functions - PLC matrix functions.

Suggested Reading:

1. John W. Weff, Ronald A. Reis, Programmable Logic Controllers, Prentice Hall of India Private Limited, Fifth edition, 2003.
2. Frank D. Petruzella, *Programmable Logic Controllers*, 5th Edition, Mc-Graw Hill, 2019.

AUTOMOTIVE MAINTENANCE

OE 631 AE

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

Objectives:

1. To study basic types of vehicle maintenance along with its importance
2. To understand the trouble diagnosis procedure for electrical and electronic systems in automobiles
3. To acquaint with various Trouble shooting, fault tracing practices available in automobile industry
4. To understand the maintenance procedure for air-conditioning in automobiles.

Outcomes:

Student will be able to

1. Demonstrate the maintenance procedure for automotive Engine.
2. Illustrate the trouble diagnosis procedure for electrical systems like Battery, Starting Systems
3. Identify the trouble diagnosis procedure for steering and suspension system
4. Illustrate trouble diagnosis procedure for lubrication and fuel delivery system etc.
5. Explain trouble diagnosis procedure for heating system of automobile.

UNIT – I

Maintenance, Workshop Practices, Safety and Tools: Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis.
vehicles, fire safety - First aid. Basic tools –Scheduled maintenance services – service intervals - Towing and recovering.

UNIT – II

Engine and Engine Subsystem Maintenance: introduction engine IC Engine General Engine service- cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management. **S**ervice - fault diagnosis- servicing emission controls.

UNIT – III

Transmission and Driveline Maintenance: Clutch- general checks, adjustment and service- road testing, Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

UNIT – IV

Steering, Brake, Suspension and Wheel Maintenance: *Inspection*, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage.

UNIT – V

***Auto Electrical and Air Conditioning Maintenance*:** Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

Suggested Readings:

1. Ed May "Automotive Mechanics Volume 2", McGraw Hill Publications, 2003

2. Ed May, "*Automotive Mechanics Volume Two*", McGraw Hill Publications, 2003
3. *Vehicle Service Manuals of reputed manufacturers*
4. *Bosch Automotive Handbook*, Sixth Edition, 2004

MECHATRONICS

OE 631 ME

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

Objectives:

Student has to understand the

1. How to identify, formulate, and solve engineering problems
2. The design a system, component, or process to meet desired needs within realistic constraints
3. The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
4. The use of drive mechanisms and fluid power systems
5. The use of industrial electronic devices
6. The demonstrate the design of modern CNC machines, and Mechatronics elements

Outcomes:

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

1. Model and analyse electrical and mechanical systems and their interconnection
2. Integrate mechanical, electronics, control and computer engineering in the design of Mechatronics systems
3. Do the complete design, building, interfacing and actuation of a Mechatronics system for a set of specifications
4. Be proficient in the use of fluid power systems in various Mechatronics applications
5. Demonstrate the use of industrial electronic devices
6. Demonstrate the design of modern CNC machines, and Mechatronics elements

Unit-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

Unit-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems
Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

Unit-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydro pneumatic circuits

Unit-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to microprocessor & micro controller, Temperature measurement interface and LVDT interface, Systems response

Unit-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Suggested Reading:

1. William Bolton, Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education

2. HMT Ltd, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998
3. Michaels Histand & David G, Alciatore, Introduction to Mechatronics and Measurement Systems, Tata McGraw-Hill International Edition
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, Cengage Learning
5. S.R. Majumdar, Oil Hydraulic Systems – Principles & Maintenance, McGraw-Hill Publishing Company Limited, New Delhi
6. Godfrey Onwubolu, Mechatronics: Principles and Applications, Butterworth-Heinemann

ROAD SAFETY ENGINEERING

OE 821 CE

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

Objectives:

1. Introduction to various factors considered for road safety and management
2. Explain the road safety appurtenances and design elements
3. Discuss the various traffic management techniques

Outcomes:

Student will be able to

1. Understand the fundamentals of traffic safety analysis
2. Analyze Accident data
3. Remember the concepts of road safety in urban transport
4. Apply crash reduction techniques
5. Design of urban Infrastructure considering safety aspects.

UNIT – I

Introduction: Road Safety scenario in India and World, Road Accident Characteristics.

Traffic Safety Analysis: Fundamentals of Traffic Engineering - Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons.

UNIT – II

Accident Analysis: Accident Investigations and Risk Management, Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction. Application of computer analysis of accident data.

UNIT – III

Road Safety in planning and Geometric Design: Vehicle And Human Characteristics, Road Design and Road Equipment's, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care.

UNIT – IV

***Traffic Signals & Road signs*:** Traffic Signals, Factors affecting signal design, street lighting, Provisions for NMT Vehicles in India, Safety Provisions for Pedestrians & Cyclists, Road Signs and Pavement Markings.

Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, signs.

UNIT – V

Traffic Management safety audit: Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

Suggested Readings:

1. Kadiyali L.R,. *Traffic Engineering and Transport planning*, 9th Edition, Khanna Tech
2. Publishers, 2013.
   C.E.G. Justo, A. Veeraragavan and S. K. Khanna, *Highway Engineering*, 10th Edition,
3. Nem Chand Publishers, 2017.
   Donald Drew, *Traffic Flow Theory Chapter 14 in Differential Equation Models*, Springer,
4. 1983
   C. Jotinkhisty and B. Kent Lall, *Transportation Engineering – An Introduction, 3rd Edition,*

5. Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson, *Handbook of Road Safety measures, second Edition, Emerald Publishing, 2009.*
6. Highway Research Programme (NCHRP) Synthesis 336.*A synthesis of Highway Research Board, Washington D.C, 2016.*

SOFTWARE ENGINEERING

OE 822 IT

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

Objectives:

1. To introduce the basic concepts of software development processes from defining a product to shipping and maintaining
2. To impart knowledge on various phases, methodologies and practices of software development
3. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metrics

Outcomes:

Student will be able to

1. Acquired working knowledge of alternative approaches and techniques for each phase of software development
2. Judge an appropriate process model(s) assessing software project attributes and analyze necessary requirements for project development eventually composing SRS.
3. Creation of visual models to describe (non-) algorithmic solutions for projects using various design principles.
4. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting knowledge on patterns.

UNIT – I

Introduction to Software Engineering:

A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models

UNIT – II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.

System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.

Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT – III

Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.

Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

UNIT – IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Modeling Component-Level Design: Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components.

Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT – V

Testing: Strategies: A Strategic Approach to Conventional Software Testing, Test Strategies for O-O Software.

Tactics: Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods.

Debugging: Debugging Techniques, The Art of Debugging.

Product Metrics: A Framework for Product Metrics, Metrics for each phase of software development.

Software Quality: Definition, ***Quality Assurance:*** Basic Elements, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO9000 Quality Standards, SQA Plan.

Suggested Readings:

1. Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, 7th Edition, McGraw Hill, 2009
2. Ali Behforooz and Frederick J. Hudson, *Software Engineering Fundamentals*, Oxford University Press, 1996
3. Pankaj Jalote, *An Integrated Approach to Software Engineering*, 3rd Edition, Narosa Publishing House, 2008

Course Code	Course Title						Core / Elective
PW703EE	**Project Work Phase - II**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**16**	**50**	**100**	**8**

Course Objectives

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The aim of Project work– Phase II is to implement and evaluate the proposal made as part of Project Work - Phase I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of internship candidates from groups made as part of project Work-Phase I
2. Re-Allotment of internship students to project guides
3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

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