SCHEMEOFINSTRUCTION&EXAMINATION
B.E.(ElectricalandElectronicsEngineering)VII–SEMESTER

S.No.	CourseCode	CourseTitle	Scheme ofInstruction				Scheme ofExamination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Durationi nHrs	
TheoryCourses										
1	PC428EE	ControlofElectricDrives	3	-	-	3	30	70	3	3
2	PC429EE	PowerSystemOperationandControl	3	-	-	3	30	70	3	3
3	PC430EE	PowerElectronicApplicationstoPowerSystems	3	-	-	3	30	70	3	3
4	PE5EE	ProfessionalElective-III	3	-	-	3	30	70	3	3
5	PE5EE	ProfessionalElective-IV	3	-	-	3	30	70	3	3
6	OE6EE	OpenElective–II	3	-	-	3	30	70	3	3
Practical/LaboratoryCourses										
7	PC465EE	PowerSystemsLab	-	-	2	2	25	50	3	1
8	PC466EE	ElectricalSimulationLab	-	-	2	2	25	50	3	1
9	PW702EE	ProjectWorkPhase–I	-	-	6	6	50	-	-	3
10	PW701EE	SummerInternship*	-	-	-	-	50	-	-	1
	Total		**18**	**-**	**10**	**28**	**330**	**520**	**-**	**24**

ProfessionalElective–III&IV		
1	PE507EE	ElectricalDistributionSystems
2	PE508EE	UtilizationofElectricalEnergy
3	PE509EE	PowerQualityEngineering
4	PE510EE	EnergyManagementSystemsandSCADA

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./Auto mobile 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:HumanitiesandSocialSciences   BS:BasicScience   ES: Engineering
ScienceMC:MandatoryCourse   PC:ProfessionalCore   PE:ProfessionalElective
L:Lecture   T:Tutorial   P:Practical   D:Drawing
CIE:ContinuousInternalEvaluation   SEE:SemesterEndEvaluation(Univ.Exam)   EE:ElectricalEngg.

Note:
1. Eachcontacthourisaclockhour
2. Thedurationofthepracticalclassistwohours,howeveritcanbeextendedwherevernecessary,toenablethestudenttocompletetheexperiment.

CourseCode	CourseTitle						Core/Elective
PC428EE	**ControlofElectricDrives**						**Core**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

CourseObjectives

➢ Understandtheconceptsofdevelopmentofcontrolcircuits,remotecontrolandelectricinterlockinginanindustry

➢ Understandtheconstructionandoperationofvariouscontrolcomponentsforthecontrolcircuits

➢ UnderstandthedevelopmentofcontrolcircuitsforvariousoperationsofbothDCandACmachines.

➢ Tounderstandtheprocedurefortroubleshootingofcircuits

➢ Tounderstandthedrivercircuitsforstepmotor

CourseOutcomes

Attheendofthecoursethestudentwillbeableto:

1. Understand thecontrolcircuitsforremotecontrolandinterlockingofelectricdrives

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.

UNITI
IntroductionofElectricalControlofMachines: Manualcontrol–MagneticcontrolSemi-automaticandAutomaticcontrolofModernmachinery–DevelopmentofControlcircuits–TwowireandThreewirecontrol–Remotecontrol–Interlockingofdrives–Controlcircuitcomponents–Symbolsforcontrolcomponents–Fuses,SwitchesandFuseSwitchunits.

UNITII
Protection of motors : Moulded– Case Circuit Breaker (MCCB) and Miniature Circuit Breaker (MCB) – Contactors–Typesofcontactors–Contactorratings,Relays–D.CSeriescurrentrelay–Frequencyresponsiverelay – 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 – Floatswitch.

UNITIII
Control of Three-PhaseInductionMotors:Motorcurrentat startandduringacceleration– Automaticstarters– IncrementResistortypestarter–AutomaticAutotransformerstarter–Opencircuitandclosed-circuittransition –AutomaticStar-DeltastartersOpencircuitandclosed 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.

SuggestedReading:

1. BhattacharyaS.KandBrijinderSingh,*ControlofElectricalMachines*,NewAgeInternationalPublishers,NewDelhi.
2. AthaniV.V,*StepperMotors—Fundamentals,ApplicationsandDesign*,NewAgeInternationalPublishers,NewDelhi.
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 interconnected 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 Y bus.
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. Analyze 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.

CourseCode	CourseTitle						Core/Elective
PC430EE	**PowerElectronicApplicationstoPowerSystems**						**Core**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

CourseObjectives
- ➢ TounderstandtheissuesinvolvedinexistingPowerTransmissionsystem
- ➢ TobefamiliarwiththeTechniquestoovercometheproblemsassociatedwithACPowerTransmissionsystem
- ➢ ToUnderstandingthecontrolofactiveandreactivepowercontrolusingPowerelectronicconverters

CourseOutcomes
Aftercompletingthiscourse,thestudentwillbeableto
1. Understand the need for FACTSdevicesinPowerTransmissionsystem.
2. Explain and apply shunt and series compensators.
3. Explain and apply UPFC andIPFC for real and reactive power control
4. Explain and applythepowertransmissionschemesforHVDCTransmission
5. Analyze and compare controlschemes ofHVDCsystem

UNIT-I
FACTS concepts: Reactive power control in electrical power transmission, principles of conventional reactivepowercompensators.IntroductiontoFACTS,flowofpowerinACparallelpaths,meshedsystems,basictypeso fFACTScontrollers,definitionsofFACTScontrollers,briefdescriptionofFACTScontrollers.

UNIT-II
Static shunt and series compensators: Shunt compensation - objectives of shunt compensation, methods ofcontrollableVARgeneration,staticVARcompensators-
SVC,STATCOM,SVCandSTATCOMcomparison.Series compensation - objectives of series compensation, thyristor switched series capacitors (TCSC), staticseriessynchronouscompensator(SSSC),poweranglecharacteristics,andbasicoperatingcontrolschemes.

UNIT-III
Combinedcompensators: Introduction,operatingprinciple,independentreal and reactive power flow controller and control structure ofUnifiedpowerflowcontroller(UPFC) andInterline power flow controller (IPFC).IntroductiontoActivepowerfilteringConcepts

UNIT-IV
HVDCTransmissionsystem:Introduction,comparisonofACandDCsystems,applicationsof DC transmission, types of DClinks, Layout of HVDC Converter station and various equipments. HVDCConverters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuitrepresentationofrectifierandinverterconfigurations

UNIT-V
Control of HVDC system: Principles of control, desired features of control, converter control characteristics,powerreversal,Ignitionanglecontrol,currentandextinctionanglecontrol. Introduction to multiterminal DC systems and applications, comparison of series andparallelMTDCsystems.

SuggestedReading:
1. Song,Y.H.andAllanT.Johns,*FlexibleACTransmissionSystems(FACTS)*,InstitutionofElectricalEngin eersPress,London.
2. Hingorani,L.Gyugyi,*ConceptsandTechnologyofFlexibleACTransmissionSystem*,IEEEPressNewYork, 2000.
3. Padiyar,K.R.,*HVDCTransmissionSystems*,WileyEasternLtd.,2010.
4. MohanMathurR.andRajivK.Varma,*ThyristorbasedFACTSControllersforElectricalTransmissionsystem s*,IEEEpress,WileyInterscience,2002.

5. PadiyarK.R.,*FACTScontrollersforTransmissionandDistributionsystems,*NewAgeInternationalPublishers,1stEdition,2007.
6. *EnriqueAcha,ClaudioR.Fuerte-Esqivel,HugoAmbriz-Perez,CesarAngelesCamachoFACTS–ModelingandsimulationinPowerNetworks*JohnWiley&Sons,2002.

CourseCode	CourseTitle						Core/Elective
PE507EE	**ElectricDistributionSystems** **(ProfessionalElective-III/IV)**						**Elective**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

CourseObjectives

Theobjectivesofthiscourseistoimpartknowledgeof

➢ TounderstandtheconceptsandImportanceofdifferentloadscharacteristics,DesignofSub-Transmission Lines,Sub-Stationsand Feeders.
➢ TomakethestudentsunderstandaboutimportanceofPowerQualityandApplicationsofcapacitorsindistributionsystems.

CourseOutcomes

Aftercompletingthiscourse,thestudentwillbeableto:

1. Understandtheconceptofdifferentfactorsusedindistributionsystem.
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,Loadcharacteristics.Diversifieddemand.Non-coincidencedemand.Coincidencefactor,contributionfactorProblems.Ratestructure,customerbilling,typesofdistributiontransformers.

UNIT-II

Design of Sub-transmission lines and distribution sub-stations. Substation bus schemes, rating of distributionsubstation,serviceareawithmultiplefeeders,percentvoltagedropCalculations.

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. Secondarybanking.Secondarynetworks.Networktransformers,unbalancedloadsandvoltages.

UNIT-IV

Voltage dropand power loss calculations.MethodsofloadflowofDistributionSystems-forwardsweepandbackwardsweepmethods.

UNIT-V

Applicationofcapacitorstodistributionsystems.Effectofseriesandshuntcapacitors,powerfactorcorrection,economicjustificationforcapacitors.Bestcapacitorlocation-Algorithm.DistributionAutomation:Definitions,ComponentsofdistributionSCADA.AdvancedMeteringInfraandAutomaticMeteringReading.

SuggestedReadings:

1. V. Kamaraju, *Electrical Power Distribution System*, TataMcGrawHillPublishingCompanyLtd.
2. TuranGonen,*ElectricPowerDistributionEngineering,*McGrawHillBookCo.,InternationalStudentEdition.1986.
3. A.S.Pabla,*ElectricPowerDistribution,*TataMcGrawHillPublishingCompanyLtd.,1997

CourseCode	CourseTitle						Core/Elective
PE508EE	**UtilizationofElectricalEnergy** **(ProfessionalElective-III/IV)**						**Core**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

CourseObjectives
➢ TointroducethestudentsandunderstandUtilizationofelectrical energyforvariousapplicationslikeindustrialheating,weldingetc.,
➢ Tounderstandtheconceptofillumination,andknowtheapplicationsofvariouslampstofactorylighting,str eetlightingetc.
➢ Tounderstandtheconceptofelectrificationoftractionsystem.

CourseOutcomes
Aftercompletingthiscourse,thestudentwillbeableto
1. Understand electrical heating and welding forindustrialapplications.
2. Explain the control methods of induction and synchronous motors.
3. Designilluminationfordifferentapplication.
4. Understand the traction mechanics.
5. Understandthecharacteristics of traction motors.

UNIT-I
IndustrialHeating: Advantagesand methodsofelectricheating.Description,operationandperformanceofresistanceovens.Designofelements.Corety pefurnace,Corelesstypefurnace,Highfrequencyeddycurrentheating, Dielectric heating, Arc furnace. Electric Welding: Resistance welding, Welding transformer and itsrating.VarioustypesofElectricarcweldingandElectricresistancewelding.

UNIT-II
SchematicUtilizationandConnectionDiagramforMotorControl:
Two supply sources for 3-phase Induction motors. Direct reversing, remote control operation, Joggingoperation of induction motor. Contactor control circuit. Pushbutton control stations. Over load relays, limitswitches, Float switches. Interlocking methods for reversing control.Starting of Synchronous motor andmotorprotection.

UNIT-III
Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inversesquarelawandcosinelaw,Solidangle,lightingcalculations,determinationofM.S.C.P,Rousseau'sconstruc tion, Discharge lamps, Sodium vapour lamps, Mercury vapour lamps, Fluorescent lamps, Startingandpower factorcorrections, Stroboscopic effects,Neonsigns, Application tofactorylighting, StreetlightingandFloodlighting.

UNIT-IV
ElectricTraction: Systemof ElectricTraction,transmissionof Drive,systemof trackelectrification,Tractionmechanics,Speedtimecurves,tractiveeffort,PowerofTractionmotor,Specificenerg yconsumption,Mechanicsoftrainmovement,Coefficientofadhesion.

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.

SuggestedReadings:

1. PartabG,"*ArtandScienceofUtilizationofElectricPower*",publisherDhanpatrai&Sons,1990.
2. RainaK.B&BhattacharyaS.K.,"*ElectricalDesign,EstimatingandCosting*",publisher,WileyEasternLtd.,1991.
3. DubeyG.K.,"*FundamentalsofElectricDrives*",publisher,NarosaPublicHouse,Delhi,2001.
4. OpenshawTaylor,"*UtilizationofElectricalEnergy*".
5. WadhwaC.L.,"*Generation,Distribution&UtilizationofElectricalEnergy*",publisher,Wiley,1989

CourseCode	CourseTitle						Core/Elective
PE509EE	**PowerQualityEngineering** **(ProfessionalElective-III/IV)**						**Elective**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

CourseObjectives

The student able tolearnandunderstand the importance ofpower quality, different power qualityissuesandtheireffectsinpowersystemnetwork

CourseOutcomes

Aftercompletingthiscourse,thestudentwillbeableto

1. DescribethedifferentPQdisturbancesandstateremediestoimprovePQ.
2. Determinevoltagesagfordifferentnetworkconfigurations.
3. Explain theeffectofASDsystemsonpowerqualityandtheeffectofvoltagesagsonoperationofvariouselectrical machines.
4. Analyze the harmoniclevelsin industrialdistributionsystems.
5. Describepowerqualitymonitoringandmeasuringtechniques.

UNIT-I

Introduction:Introductionof thePowerQuality(PQ)problem,Termsusedin PQ: VoltageSag,Swell,Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of powerquality phenomenon, Remedies to improve power quality, power quality monitoring. Power Quality Data:Datacollection,Dataanalysis,Databasestructure,CreatingPQdatabases,ProcessingPQdata.

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 anglejumpsforthreephaseunbalancedsags,loadinfluenceonvoltagesags.

UNIT-III

PQConsiderationsinIndustrialPowerSystems: Adjustablespeeddrive(ASD)systemsand

applications,mitigation of harmonics. Characterization of voltage sags experienced by three-phase ASD systems: Typesof sags and phase - angle jumps. Effects of momentary voltage dips on the operation of induction andsynchronousmotors.Voltagesagcoordinationforreliable plantoperation.

UNIT-IV

Effects of Harmonics on Power Quality: Harmonic analysis of industrial customers, technical barriers inASDs. Methods of evaluation of harmonic levels in industrial distribution systems.Harmonic effects ontransformers.ImpactofdistributionsystemcapacitorbanksonPQ.Guidelinesforlimitingvoltageharmonics.

UNIT-V

PowerQualityMonitoring: Introduction,sitesurveys,Transducers,IECmeasurementtechniquesforHarmonics,Flicker,IECFlickermeter.

SuggestedReadings:

1. MathH.J.Bollen,*UnderstandingPowerQualityProblems*,IEEEPress,1999.
2. RogerC.Dugan, MarkF. McGranaghan, Surya Santoso, H.WayneBeaty, *ElectricalPower SystemsQuality*,SecondEdition,TataMcGraw-HillEdition.
3. C.Sankaran,*PowerQuality*,CRCPress,200.

CourseCode	CourseTitle						Core/Elective
PE510EE	**EnergyManagement Systems andSCADA(ProfessionalElective-III/IV)**						**Elective**
Prerequisite	ContactHoursperWeek				CIE	SEE	**Credits**
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

CourseObjectives

➢ Outlineenergymanagementsystemsandunitcommitmentanditssolutiontechniques.

➢ Discusspowergenerationschedulingwithlimitedenergy.

➢ Describethearchitecture,functionsandapplicationsofsupervisorycontrolanddataacquisition(SCADA) andapplySCADAinpowersystemautomationandcommunications.

CourseOutcomes

Aftercompletingthiscourse,thestudentwillbeableto

1. Understandenergymanagementcenters.
2. Explain theprinciplesofpowergenerationscheduling.
3. Understand thecomponents ofSCADA.
4. Explain the configurations of SCADA and its application in Power System.
5. Understand the SCADA communication protocols.

UNIT-I

EnergyManagementCenters: Introduction,Energymanagementcentersandtheirfunctions,architectures,recent developments, characteristics of power generating units and economic dispatch, unit commitment(spinningreserve,thermal,hydroandfuelconstraints),solutiontechniquesofunitcommitment.

UNIT-II

GenerationScheduling: Generationschedulingwithlimitedenergy,energyproductioncostmodels,budgeting and planning, practical considerations, interchange evaluation for regional operations, types ofinterchanges,exchangecostingtechniques.

UNIT-III

Supervisory Control And Data Acquisition: Introduction to supervisory control and data acquisition,SCADA functional requirements and components. SCADA Application: General features, functions andapplications,benefitsofSCADA,architecturesofSCADA,applicationsofSCADA.

UNIT-IV

SCADA and Power Systems: Configurations of SCADA, RTU (remote terminal units) connections, powersystemsSCADAandSCADAinpowersystemautomation.

UNIT-V

SCADAandCommunication:SCADAcommunicationrequirements,SCADAcommunicationprotocols:past presentandfuture,structureofaSCADAcommunicationsprotocol.

SuggestedReadings:

1. John D Mc Donald, Mini S. Thomas, *Power System SCADA and Smart Grids,* CRC Press, 2015
2. HandschinE,*EnergyManagementSystems*,SpringerVerlag,1stEdition,1990.
3. JohnDMcDonald,*ElectricPowerSubstationEngineering*,CRCpress,1stEdition,2001.
4. Wood,AJandWollenberg,BF,*PowerGenerationOperationandControl*,JohnWileyandSons,2ndEdition2003.
5. Bisht T.K. , *SCADA and Energy Management System,* S K Kataria and Sons 2013
6. Green,JNWilson,R,*ControlandAutomationofElectricPowerDistributionSystems*,TaylorandFrancis,1stEdition,2007.
7. Turner,WC,*EnergyManagementHandbook*,FairmontPress,5thEdition,2004.

CourseCode	CourseTitle						Core/Elective
OE603EE	**Non-ConventionalEnergySources(OpenElective–II)**						**OpenElective**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

CourseObjectives

To impart the knowledge of basics of different non-conventional types of power generation & power plantsin detail so that it helps them in understanding the need and role of Non-Conventional Energy sourcesparticularlywhentheconventionalsourcesarescarceinnature

CourseOutcomes

Aftercompletingthiscourse,thestudentwillbeableto

1. Understandthedifferentnonconventionalsourcesand thepowergenerationtechniquestogenerateelectricalpower.
2. ExplaintheSolarenergypowerdevelopmentanddifferentapplications.
3. Explain differentwindenergypowergenerationtechniquesandapplications.
4. Understandpowergeneration using OTEC and Geothermal energy.
5. Explain powergeneration from Bio-mass.

UNIT-I

ReviewofConventionaland Non-Conventionalenergysources-Needfornon-conventionalenergysourcesTypesofNon-conventionalenergysources-FuelCells-PrincipleofoperationwithspecialreferencetoH$_2$O$_2$ Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonatecells-Solidoxideelectrolytecells-Regenerativesystem-RegenerativeFuelCell-AdvantagesanddisadvantagesofFuelCells-Polarization-Conversion efficiency andApplications ofFuelCells.

UNIT-II

Solarenergy-Solarradiationanditsmeasurements-SolarEnergycollectors-SolarEnergystoragesystems-SolarPond-ApplicationofSolarPond-Applicationsofsolarenergy.

UNIT-III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basiccomponents of WECS -Classification of WECS -Site selection considerations -Advantages and disadvantages ofWECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmentalaspects.

UNIT-IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal powergeneration -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversiondevices -Advantages and disadvantages of wave energy - Geo-Thermal Energy - Types of Geo-Thermal EnergySystems-ApplicationsofGeo-ThermalEnergy.

UNIT-V

EnergyfromBiomass-Biomassconversiontechnologies/processes-Photosynthesis- Photosyntheticefficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details ofcommonlyusedBiogasplantsinIndia-AdvantagesanddisadvantagesofBiogasgeneration-Thermalgasificationofbiomass-Biomassgasifiers.

SuggestedReadings:

1. RaiG.D,*Non-ConventionalSourcesofEnergy,*KhandalaPublishers,NewDelhi,1999.
2. M.M.El-Wakil,Power*PlantTechnology.*McGrawHill,1984.

CourseCode	CourseTitle						Core/Elective
OE604EE	**TransducersandSensors(Open Elective–II)**						**OpenElective**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

CourseObjectives
➢ Toexposethestudentstovarioussensorsandtransducersformeasuringmechanicalquantities.
➢ Tounderstandthespecificationsofsensorsandtransducers.
➢ Tolearnthebasicconditioningcircuitsforvarioussensorsandtransducers.
➢ Tointroduceadvancesinsensortechnology.

CourseOutcomes:
Aftercompletingthiscourse,thestudentwillbeableto
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 theprincipleandworkingofvariousadvanced sensorsandtransducers.

UNIT-I
Introduction to measurement system (MS) static characteristics of MS: linearity, Hysteresis, Threshold,Repeatability,Reliabilityandmaintainability,Span,Calibration.
SensorFundamentals:BasicsensortechnologyandsensorsystemSensorcharacteristics,systemcharacteristics,instrumentselection,dataacquisitionandreadout,andinstallation.

UNIT-II
Resistive Transducer: Classification of transducers, Basic requirements of transducers, Variable resistancetransducers;Potentiometers,Straingauge(SG),typesofStrainGuage.

UNIT-III
Variable capacitive transducers: Capacitance, Principles, Capacitance displacement transducers, Capacitivehygrometer,andcapacitiveproximitytransducers.
Variableinductivetransducers:Linearvariabledifferentialtransformer,Rotaryvariabledifferentialtransformer.

UNIT-IV
Measurementoftemperature:Standardsforcalibrationoftemp.Temperaturemeasuringdevices,typesoffilledin system thermometers — liquid in glass, vapour pressure, bimetallic on solid rod thermometer Resistancetemperaturedetectors,thermostatthermocouple.

UNIT-V
Advance Sensors: Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamicresponse,photoelectrictransducers,Halleffectsensors,Digitaldisplacementsensors,Fibreopticsensor,SemiconductorsensorandSmartsensors.

SuggestedReading:
1. C.S.Rangan,GRSarma&VSNMani,*InstrumentationDevicesandSystems*-TMH,2ndEdition2004
2. B.Nakra&Chowdhari,*InstrumentationMeasurementandAnalysis*,TMH,2ndEdition2003
3. D.V.S.Murthy,*TransducersandInstrumentation*,PHI,19954.JohnP.Bentley,PrinciplesofMeasurementSystems,3rdEdition,PearsonEducation,2000.
4. DoebelinE.O,*MeasurementSystems-ApplicationandDesign*,4thEdition,McGraw-Hill,New
5. PatranabisD,*PrinciplesofIndustrialInstrumentation*,2ndEdition,TataMcGrawHill,NewDelhi,1997.
6. JonWilson*SensorTechnologyHandbook*,NewnessPublicationElsevier.

AUTOMOTIVE SAFETY AND ERGONOMICS

OE621AE

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,Entrepreneurshipand 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,Financialandprofitabilityanalysisand 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., 5^{lh} 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 in Non-Euclidean Space, Clustering, K-Means Algorithm, CURE Algorithm, Clustering for Streams and Parallelism

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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

OE816IT

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.

CourseCode	CourseTitle						Core/Elective
PC465EE	**PowerSystemLab**						**Core**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
PowerSystem–I&PowerSystem-II	-	-	-	2	25	50	1

CourseObjectives
- ➢ To determine regulation & efficiency of short, medium and long transmission lines and to calculateA,B,C,Dconstants.
- ➢ TounderstandtheimportanceofprotectiverelaysinpowersystemsuchasdifferentprotectionoftransformerDMTCharacteristicsofovercurrentrelay,Buchholzrelayandstaticrelays.
- ➢ Tounderstandtheproceduretodeterminesequenceparametersoftransformerandalternator.

CourseOutcomes
1. DetermineABCDconstantsoftransmissionlinesandevaluateregulation,efficiency.
2. Acquireknowledgeinrelaysettingforsafeoperatingofpowersystem.
3. Determinesequenceparametersoftransformerandalternatoranddrawitsimportance.
4. Determinethetimeconstantofanalternator.
5. Determinethedielectricstrengthofoilandcalculatetheefficiencyofstringinsulators.

ListofExperiments:

1. Determinationofregulation&efficiencyofShort,MediumandLongtransmissionlines.

2. IDMTcharacteristicsofOver-currentrelay&StudyofBucholzrelay.

3. DeterminationofA,B,C,DconstantsofShort,MediumandLonglines.DrawingofCirclediagrams.

4. Differentialprotectionoftransformer.

5. Sequenceimpedanceof3-PhaseAlternators.

6. Determinationofpositive,negativeandzero-sequencereactanceof3-Phasetransformersusingsequencecurrentexcitationfaultcalculation.

7. Synchronousmachinereactanceandtimeconstantfrom3-PhaseS.Ctest.

8. CharacteristicsofStaticrelays.

9. StaticexcitationofSynchronousGenerator.

10. DeterminationofdielectricstrengthofoilsandstudyofMegger.

11. ParalleloperationofAlternators.

12. Measurementofcapacitanceof3-corecables.

13. FaultlocationofUndergroundcables.

14. SimulationofstringofinsulatorsfordeterminationofVoltagedistributionandStringefficiency.

Note:AtleasttenexperimentsshouldbeconductedintheSemester.

CourseCode	CourseTitle						Core/Elective
PC466EE	**ElectricalSimulationLab**						**Core**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

CourseObjectives
> Thestudentlearnsanalysisofelectricalsystemthroughcomputersimulation,usingsoftwarepackages.
> Tosimulateagivenelectricalcircuitsinanyenvironment,toanalyseitsdynamiccharacteristicsandtofigure outitsstabilityconsiderations.

CourseOutcomes
Aftercompletingthiscourse,thestudentwillbeableto
1. SimulatetheconceptsofElectricalCircuits,ControlSystemsandPowerSystemsandinterpretdata.
2. Demonstratetheknowledgeofprogrammingenvironment,compiling,debugging,linkingandexecutingv arietyofprogramsinMATLAB.
3. DemonstrateabilitytodevelopSimulinkmodelsforvariouselectricalsystems.
4. Validatesimulatedresultsfromprograms/Simulinkmodelswiththeoreticalcalculations.

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

1. VerificationofNetworktheorems
   a. Thevinin'stheorem
   b. Superpositiontheorem
   c. Maximumpowertransfertheorem.
2. TransientresponsesofSeriesRLC,RLandRCcircuitswithSineandStepinputs.
3. SeriesandParallelresonance.
4. Bodeplot,Root-LocusplotandNyquistplot.
5. Transferfunctionanalysis
   (i) TimeresponseforStepinput
   (ii) FrequencyresponseforSinusoidalinput.
6. DesignofLag,LeadandLag-Leadcompensators.
7. Loadflowstudies.
8. Faultanalysis.
9. Transientstabilitystudies.
10. EconomicPowerScheduling
11. Designoffilters(Lowpassfilter).
12. Chopperfeddcmotordrives.
13. VSI/CSIFedinductionmotorsdrives.DoublyfedInductionmotor.
14. PhaseControlofDCmotorDrives.
15. ControlofBLDCmotor.

Note: Atleasttenexperimentsshouldbeconducted.

CourseCode	CourseTitle						Core/Elective
PW702EE	**ProjectWorkPhase–I**						**Core**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	6	50	-	**3**

CourseObjectives
- ➢ Toenhancepracticalandprofessionalskills.
- ➢ Tofamiliarizetoolsandtechniquesofsystematicliteraturesurveyanddocumentation
- ➢ Toexposethestudentstoindustrypracticesandteamwork.
- ➢ Toencouragestudentstoworkwithinnovativeandentrepreneurialideas

CourseOutcomes
1. Demonstratetheabilitytosynthesizeandapplytheknowledge andskillsacquiredintheacademicprogramtothereal-worldproblems.
2. Evaluatedifferentsolutionsbasedoneconomicandtechnicalfeasibility
3. Effectivelyplanaprojectandconfidentlyperformallaspectsofprojectmanagement
4. Demonstrateeffectivewrittenandoralcommunicationskills

ThedepartmentcaninitiatetheprojectallotmentprocedureattheendofVIsemesterandfinalizeitinthefirsttwoweeksofVII semester.
Thedepartmentwillappointaprojectcoordinatorwhowillcoordinatethefollowing:
Collectionofprojecttopics/descriptionsfromfacultymembers(Problemscanalsobeinvitedfromtheindustries).
Groupingofstudents(max3inagroup)Allot
mentofprojectguides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtainedindifferentcourses,newtechnologiesandcurrentindustrypractices.Thisrequiresstudentstounderstandcurrent problems in their domain and methodologies to solve these problems. To get awareness on current problems andsolution 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 andR&D institutions. After completion of these seminars each group has to formalize the project proposal based ontheirownideaorassuggestedbytheprojectguide.
Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week ofthesemesterwhichshouldbestrictlyadheredto.

Eachgroupwillberequiredto:
1. Submitaone-pagesynopsisbeforetheseminarfordisplayonnoticeboard.
2. Givea30minutes'presentationfollowedby10minutes'discussion.
3. Submitatechnicalwrite-uponthetalk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessionalmarkswhichwillbeonthebasisofperformanceinallthe3itemsstatedabove.

Theseminarpresentationshouldincludethefollowingcomponentsoftheproject:
- ➢ Problemdefinitionandspecification
- ➢ Literaturesurvey
- ➢ Broadknowledgeofavailabletechniquestosolveaparticularproblem.
- ➢ Planningofthework,preparationofbar(activity)charts
- ➢ Presentation-oralandwritten.

CourseCode	CourseTitle						Core/Elective
PW701EE	**SummerInternship**						**Core**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	-	50	-	1

CourseObjectives
- ➢ Produceanaccuraterecordofworkperformedduringthe Internship/Co-op
- ➢ Applyengineeringknowledgetoaprobleminindustry
- ➢ Produceatechnicalreport
- ➢ Discussworkinateamenvironment,ifrelevanttotheproject
- ➢ Conductherself/himselfresponsibly,safely,andethicallyinaprofessionalenvironment

CourseOutcomes
Aftercompletingthiscourse,thestudentwillbeableto
1. GetPracticalexperienceofsoftwaredesignanddevelopment,andcodingpracticeswithinIndustrial/R&D Environments.
2. GainworkingpracticeswithinIndustrial/R&DEnvironments.
3. Preparereportsandotherrelevantdocumentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems ofinterest to industries. A batch of three students will be attached to a person from the Government or PrivateOrganisations/Computer Industry/Software Companies/R&D Organization for a period of 4-6 weeks. Thiswillbeduringthesummer vacationfollowingthecompletionof theIII-yearCourse.Onefacultycoordinatorwill also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate(personfromindustry).

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

- Overviewofcompany/project
- Safetytraining
- Discussionswithprojectteams
- Backgroundresearch,reviewofdocuments,whitepapers,andscientificpapers
- Planning,designing,andreviewingtheplannedwork
- Executingtheplans
- Documentingprogress,experiments,andothertechnicaldocumentation
- Furtherteamdiscussionstodiscussresults
- Finalreportwritingandpresentation

Afterthecompletionoftheproject,eachstudentwillberequiredto:
1. Submitabrieftechnicalreportontheprojectexecutedand
2. Presenttheworkthroughaseminartalk(tobeorganizedbytheDepartment)

Award of sessionals are to be based on the performance of the students at the workplace and awarded byindustry guide and internal guide (25 Marks) followed by presentation before the committee constituted bythe department (25 Marks). One faculty member will co-ordinate the overall activity of Industry AttachmentProgram.

Note: Studentshavetoundergosummerinternshipof4-6weeksat theendofsemesterVIandcreditswillbeawardedafterevaluationinVIIsemester.

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

S.No.	CourseCode	CourseTitle	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
TheoryCourses										
1	PE5EE	ProfessionalElective-V	3	-	-	3	30	70	3	3
2	PE5EE	ProfessionalElective-VI	3	-	-	3	30	70	3	3
3	OE6EE	OpenElective-III	3	-	-	3	30	70	3	3
Practical/LaboratoryCourses										
4	PW703EE	ProjectWorkPhase-II	-	-	16	16	50	100	-	8
Total			**09**	**-**	**16**	**25**	**140**	**310**	**-**	**17**

ProfessionalElective–V&VI		
1.	PE511EE	AITechniquesinElectricalEngineering
2.	PE512EE	AdvancesinPowerElectronics
3.	PE513EE	GridIntegrationofRenewableEnergySystems
4.	PE514EE	SmartGridTechnology

OpenElective–III		
1.	OE605EE	SmartBuildingSystems(NotforEEE&EIE)
2.	OE606EE	ProgrammableLogicControllers(NotforEEE&EIE)
3.	OE631AE	AutomotiveMaintenance(NotforMech./Prod./Auto.Engg.students)
4.	OE631ME	Mechatronics(NotforMech./Prod./Auto.Engg.students)
5.	OE603CE	RoadSafetyEngineering(NotforCivilEngg.Students)
6.	OE604IT	SoftwareEngineering(NotforITStudents)

HS:HumanitiesandSocialSciences   BS:BasicScience   ES: Engineering
ScienceMC:MandatoryCourse   PC:ProfessionalCore   PE:ProfessionalElective
L:Lecture   T:Tutorial   P:Practical   D:Drawing
CIE:ContinuousInternalEvaluation   SEE:SemesterEndEvaluation(Univ.Exam)   EE:ElectricalEngg.

Note:
1. Eachcontacthourisaclockhour
2. Thedurationofthepracticalclassistwohours,howeveritcanbeextendedwherevernecessary,toenablethestudenttocompletetheexperiment.

CourseCode	CourseTitle						Core/Elective
PE511EE	**AITechniquesinElectricalEngineering(ProfessionalElective–V/VI)**						**Core**
Prerequisite	ContactHoursperWeek				CIE	SEE	
	L	T	D	P			Credits
-	3	0	0	0	30	70	3

CourseObjectives
➢ TobeabletounderstandbasicsofANN&Fuzzybasedsystems.
➢ TomakethestudentstounderstandtheANNbasedsystemsforfunctionapproximationusedinloadforecasting.

CourseOutcomes
Attheendofthecoursestudentswillbeableto
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:definitionofAI-
differencebetweensoftcomputingtechniquesandhardcomputingsystems,expertsystemsbriefhistoryofANN,FuzzyandGA

UNIT-II:
ArtificialNeuralNetworks: Introduction,ModelsofNeuronNetwork-Architectures–
Knowledgerepresentation,Artificial Intelligence and Neural networks–Learning process-Error correction learning, Hebbian learning –Competitive learning-Boltzman learning, supervised learning-Unsupervised learning–Reinforcement learning-Learningtasks.Multi-layerperceptronusingBackpropagationAlgorithm(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,PropertiesofFuzzysets–FuzzycartesionProduct,OperationsonFuzzyrelations–Fuzzylogic–
FuzzyQuantifiers,FuzzyInference-FuzzyRulebasedsystem,Defuzzificationmethods.

UNIT-IV:
Genetic Algorithms: Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modeling –
Geneticoperators-Crossover-Singlesitecrossover,Twopointcrossover –Multipointcrossover-
Uniformcrossover,Matrixcrossover-CrossoverRate-Inversion&Deletion,Mutationoperator–Mutation–
MutationRate-Bit-wiseoperators,Generationalcycle-convergenceofGeneticAlgorithm.

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

ReferenceBooks:
1. S.Rajasekaran,G.A.Vijayalakshmi,*NeuralNetworks,FuzzylogicandGeneticAlgorithms,*PaiPHIpublicatio n,
2. KalyanmoyDe,*OptimizationforEngineeringDesign*,PHIpublication
3. KalyanmoyDeb,*Multi-objectiveOptimizationusingEvolutionaryAlgorithms*,WilleyPublications.

CourseCode	CourseTitle						Core/Elective
PE512EE	**Advances in Power Electronics(ProfessionalElective–V/VI)**						Elective
	ContactHoursperWeek				CIE	SEE	**Credits**
Prerequisite	L	T	D	P			
PC411EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

CourseObjectives
  ➢ Tomakethestudentfamiliarwiththeconceptsof
  ➢ Understandingofrequirementsofhighpowerdevices.
  ➢ Understandingtheoperationofvariouspowerconverters.
  ➢ Designconceptsofcontrollersforpowerelectronicconverters.

CourseOutcomes
Aftercompletingthiscourse,thestudentwillbeableto
  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. Galliumnitratedevices-Diodes, MOSFETs.

UNIT-II
Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of thecurrent waveform, single phase and three-phase converter systems incorporating ideal rectifiers and designexamples.Non-linearphenomenainswitchedmodepowerconverters:BifurcationandChaos.

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-resonantconvertersandLoadresonantconverters.

UNIT-V
Advance converter topologies: Multi level converters - Cascaded H-Bridge, Diode clamped, NPC, Flyingcapacitor. Modular Multi-level converters(MMC), Multi-Input DC-DC Converters, Multi pulse PWM currentsourceconverters,interleavedconverters, Z-Sourceconverters.

SuggestedReadings:
  1. AndrzejMTrzynadlowski,'IntroductiontoModernPowerElectronics,JohnWileyandsons.Inc,New York,1998
  2. L.Umanand,'PowerElectronicsEssentials&Applications',WileypublishingCompany,1stEdition,2014
  3. B.JayantBalinga,'AdvancedHighVoltagePowerDeviceConcepts',SpringerNewYork2011.
  4. BINWu,'HighPowerConvertersandACDrives',IEEEpressWileyInterscience,2006.
  5. SatishKumarPeddapelli,*PulseWidthModulation-AnalysisandPerformanceinMultilevelInverters,* De-GruyterOldenbourgPublisher,Germany,2016.

CourseCode	CourseTitle						Core/Elective
PE513EE	**GridIntegrationofRenewableEnergySystems(ProfessionalElective–V/VI)**						**Core**
Prerequisite	ContactHoursperWeek				CIE	SEE	
	L	T	D	P			Credits
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

CourseObjectives

Uponsuccessfulcompletionofthecoursethestudentswillbefamiliarwith:
- ➢ Tointroducethecharacteristicsofvarioustypesofrenewableenergysourcesandconverters.
- ➢ Toexplainthepowersystemoperation,powerquality,renewableenergygridintegrationandtypesofgrid.
- ➢ Tostudythebasicanalysisandoperationtechniquesonpowerelectronicsystems.
- ➢ Tounderstandpowercontrolandmanagementsystemsforgrid.
- ➢ Tounderstandtheissuesingridintegrationofrenewableenergysources.

CourseOutcomes

Attheendofthecourse,thestudentshouldbeableto:
1. Identifythecharacteristicsofrenewableenergysourcesandconverters.
2. Understandtheoperationofpowersystem
3. Analyzetheimportanceofpowerelectronicsystemsinrenewablepowerapplications.
4. Realizethemanagementsystemsforgridintegration.
5. Analyzethechallengesfacedbythegrid whenintegratingrenewableenergysources.

UNIT-I

Reviewofcharacteristicsofpowersources:Basicreviewofpowergenerationfromwind-SolarPV-Thermal-Smallhydro-Biomasspowerstrategiesineachoftheseenergyconversionsystems-ReviewofmaximumpowerpointtrackingtechniquesinsolarPVandwind(perturb&observe,hillclimbs,incrementalconductance).

UNIT-II

Powersystemoperation: Introductiononelectricgrid,supplyguarantees,powerqualityandstability,introduction to renewable energy grid integration, concept of mini/micro grids and smart grids; wind, solar,biomasspowergenerationprofiles,generationelectricfeatures, Loadscheduling.

UNIT-III

Introduction to basic analysis and operation techniques on power electronic systems: functional analysis ofpower converters, power conversion schemes between electric machines and the grid, power systems controlusingpowerconverters;electronicconversionsystemsapplicationtorenewableenergygenerationsystems,basic schemesandfunctionaladvantages;windpowerandphotovoltaicpowerapplications.

UNIT-IV

Powercontrolandmanagementsystemsforgridintegration:islanddetectionsystems,synchronizingwiththegrid;Issuesinintegrationofconverter-basedsources;Networkvoltagemanagement;powerqualitymanagementandfrequencymanagement;InfluenceofPV/WECSonsystemtransientresponse.

UNIT-V

Issues in grid integration of renewable energy sources: Overview of challenges in integrating renewablesources to the grid - Impact of harmonics on power quality – need to maintain voltage within a band andfluctuationsinvoltagebecauseofrenewableintegration-powerinverterandconvertertechnologies-mechanismto synchronize power from renewable sources to the grid - overview of challenges faced in designing powerinjection from offshore generation sources - challenges in modeling intermittent nature of renewable power in apowersystem.

SuggestedReadings:

1. KerstingW.H.*DistributionSystemModelingandAnalysis*,SecondEdition,CRCPress,2004.
2. VittalV.andAyyanarR.*GridIntegrationandDynamicImpactofWindEnergy*,Springer,2012.
3. BollenM.H.andHassanF.*IntegrationofDistributedGenerationinthePowerSystem*,Wiley-IEEEPress,2011.
4. KeyhaniA.*DesignofSmartPowerGridRenewableEnergySystems*,Wiley–IEEEPress,2011.
5. MuhannadH.R.*PowerElectronics:Circuits,DevicesandApplications*,PearsonPrenticeHall.2004.
6. GellingsC.W.*TheSmartGrid:EnablingEnergyEfficiencyandDemandResponse*,FirstEdition,CRCPress,2009.
7. TeodorescuR.LiserreM.RodriguezP.*GridConvertersforPhotovoltaicandWindPowerSystems*,FirstEdition,Wiley-IEEEPress,2011.

CourseCode	CourseTitle						Core/Elective
PE514EE	**Smart Grid Technology(ProfessionalElective–V/VI)**						**Elective**
	ContactHoursperWeek						
Prerequisite	L	T	D	P	CIE	SEE	Credits
-	3	-	-	-	30	70	3

CourseObjectives
- ➢ Tounderstandvariousaspectsofsmartgrid
- ➢ Tostudyvarioussmarttransmissionanddistributiontechnologies
- ➢ Toappreciatedistributiongenerationandsmartconsumption
- ➢ Toknowtheregulationsandmarketmodelsforsmartgrid

CourseOutcomes
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 GridFunctions-comparison of Power Grid and Smart Grid-New Technologies for Smart Grid – Advantages – Presentdevelopment and International policies in Smart Grid, Indian Smart Grid. Key Challenges for Smart Grid.ComponentsandArchitectureofSmartGrid-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-Datacentersandinformationtechnologyloads–Futureneighborhood - Potentialfutureworkandresearch.

UNIT-III
SmartGrid Communications and Measurement Technology: Communication andMeasurement – Monitoring,SmartMeters, Automated Meter Reading, PhasorMeasurementUnit(PMU),WideareameasurementSystem(WAMS).

UNIT-IV
RenewableEnergyandStorage: IntroductiontoRenewableEnergyTechnologies-Microgrids-StorageTechnologies-ElectricVehiclesandplug-inhybrids-EnvironmentalimpactandClimateChange-EconomicIssues.Gridintegrationissuesofrenewableenergysources.

UNIT-V
SmartPowerGridSystemControl: LoadFrequencyControl(LFC)inMicroGridSystem–VoltageControlinMicroGridSystem,ReactivePowerControlinSmartGrid.

SuggestedReadings:
1. StuartBorlase,SmartGrids,Infrastructure,TechnologyandSolutions,CRCPress,2013.
2. A.G.PhadkeandJ.S.Thorp,"SynchronizedPhasorMeasurementsandtheirApplication",Springer Edition,2010.
3. IqbalHussein,"ElectricandHybridVehicle:Designfundamentals",CRCPress,2003.
4. GilMasters,RenewableandEfficientElectricPowerSystem,Wiley-IEEEPress,2004.
5. FereidoonP.Sioshansi,"SmartGrid:IntegratingRenewable,Distributed&EfficientEnergy", AcademicPress,2012.
6. JeanClaudeSabonnadiere,NouredineHadjsaid,"SmartGrids".Wiley-ISTE,IEEEPress,May2012.
7. Smart Grid Handbook for regulators and Policy Makers Nov. 2017

CourseCode	CourseTitle						Core/Elective
OE605EE	**SmartBuildingSystems** (**OpenElective-III**)						**OpenElective**
Prerequisite	ContactHoursperWeek				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

CourseObjectives
➢ TounderstandthebasicblocksofBuildingManagementSystem.
➢ Todesignvarioussubsystems(ormodularsystem)ofbuildingautomation
➢ Tointegrateallthesubsystems.

CourseOutcomes
Attheendofthecoursestudentswillbeableto
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 accesscontrolsystem
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, requirementsand design considerations and its effect on functional efficiency of building automation system, architecture andcomponentsofBMS.

UNIT-II
Fire Alarm (FA) System:concept of fire, Firemodes, History, Components, and Principles of Operation.Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the
FAsystem.FieldComponents,PanelComponents,Applications.TypesofFASArchitectures,Examples.Classification of FAS loops, Examples. FAS Design procedure in brief, NFPA 72A, BS 5839, IS, Concept of IPenabledfire&alarmsystem,designaspectsandcomponentsofPAsystem.

UNIT-III
AccessControlSystem: AccessComponents,AccesscontrolsystemDesign.
CCTV: CameraOperation&types,CameraSelectionCriteria,CameraApplications,DVRBasedsystem,DVM,Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical typesofcables,controllingsystem.CCTVApplications.

UNIT-IV
SecuritySystemsFundamentals: IntroductiontoSecuritySystems,Concepts.
PerimeterIntrusion: Concept, Components, Technology, Advanced Applications. Security system design forverticals.concept of automation in access control system for safety, Physical security system with components,RFIDenabledaccesscontrolwithcomponents,Computersystemaccesscontrol–DAC,MAC,RBAC.
EPBX System & BMS subsystem integration: Design consideration of EPBX system and its components,integrationofalltheabovesystemstodesignBMS.

UNIT-V
EnergyManagement: EnergySavingsconcept&methods,Lightingcontrol,
BuildingEfficiencyimprovement,GreenBuilding(LEED)Concept&Examples.
Building Management System: IBMS (HVAC, Fire & Security) project cycle, Project steps BMS, Advantages&ApplicationsofBMS,IBMSArchitecture,Normal&Emergencyoperation,AdvantagesofBMS.

SuggestedReading:
1. JimSinopoli,*SmartBuildings,*Butterworth-HeinemannimprintofElsevier,2nded.,2010.
2. ReinholdA.Carlson,RobertA.DiGiandomenico,*Understanding Building Automation Systems(Direct Digital Control, Energy Management,LifeSafety,Security,AccessControl,Lighting,BuildingManagementPrograms),*R.S.MeansCompanyPublishing,1991.

3. AlbertTing-PatSo,WaiLokChan,Kluwer,*IntelligentBuildingSystems*,Academicpublisher,3rded.,2012.

4. RobertGagnon,*DesignofSpecialHazardsandFireAlarmSystems*,ThomsonDelmarLearning;2ndedition,2007
.

5. Levenhagen,JohnI.Spethmann,DonaldH,*HVACControlsandSystems*,McGraw-HillPub.

6. Hordeski,MichaelF,*HVACControlintheNewMillennium*,Fairmontpress,2001.

7. BelaG.Liptak,*ProcessControl-InstrumentEngineersHandbook*,Chiltonbookco.

CourseCode	CourseTitle						Core/Elective
OE606EE	**ProgrammableLogicControllers** **(OpenElective-III)**						**Elective**
Prerequisite	ContactHoursperWeek				CIE	SEE	
	L	T	D	P			Credits
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

CourseObjectives
➢ TobeabletounderstandbasicsofProgrammablelogiccontrollers,basicprogrammingofPLC.
➢ TomakethestudentstounderstandtheFunctionsandapplicationsofPLC

CourseOutcomes
Attheendofthecoursestudentswillbeableto
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
PLCBasics: DefinitionandHistoryofPLC-PLCadvantagesanddisadvantages-OverallPLCSystems-CPUsandProgrammerMonitors-PLCinputandoutputmodels-PrintingPLCInformation-ProgrammingProcedures-ProgrammingEquipment-ProgrammingFormats-ProperConstructionofPLCDiagrams-DevicestowhichPLCinput and output modules are connected - Input on/off switching devices - Input analog devices - Output analogon/offdevicesandoutputanalogdevices.

UNIT-II
Basic PLC Programming: Programming on/off inputs to produce on/off outputs - PLC input instructions - Outputs-Operationalprocedures-Contactandcoilinput/outputprogrammingexamples-Relationofdigitalgatelogic contact / coil logic - PLC programming and conversion examples - Creating ladder diagrams from processcontroldescriptions-Sequencelistings-Largeprocessladderdiagramconstructions.

UNIT-III
Basic PLC Functions: General Characteristics of Registers - Module addressing - Holding registers - Inputregisters - output registers - PLC timer functions - examples of timer functions. Industrial applications - PLCcounterfunctions.

UNIT-IV
IntermediateFunctions:PLCArithmeticfunctions-PLCadditionsandsubtractions-ThePLCrepetitiveclock-PLC Multiplications, Division and Square Root - PLC trigonometric and log functions - Other PLC arithmeticfunctions - PLC number comparison functions. PLC basic comparison functions and applications - Numberingsystemsandnumberconversionfunctions-PLCconversionbetweendecimalandBCD-Hexadecimalsnumberingsystems.

UNIT-V
Data Handling Functions: The PLC skip and master control relay functions - Jump functions - Jump with nonreturn-Jumpwithreturn.PLCdatamoveSystems-ThePLCfunctionsandapplications.PLCfunctionsworkingwithbits-PLCdigitalbitfunctionsandapplications-PLCsequencefunctions-PLCmatrixfunctions.

SuggestedReading:
1. JohnW.Weff,RonaldA.Reis,ProgrammableLogicControllers,PrenticeHallofIndiaPrivateLimited,Fifthedition, 2003.
2. FrankD.Petruzella,*ProgrammableLogicControllers*,5ᵗʰEdition,Mc-GrawHill,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 engineIC Engine General Engine service- cooling and lubricating system, fuel system, Intake andExhaust system, electrical system - Electronic fuel injection and engine management. Service- 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 Mayo, "*Automotive Mechanics Volume 7*," 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

OE631ME

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 9

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

OE821CE

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,*
   Pearson publications, 2017.

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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
OE822IT

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.

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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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