Shirpur Education Society's

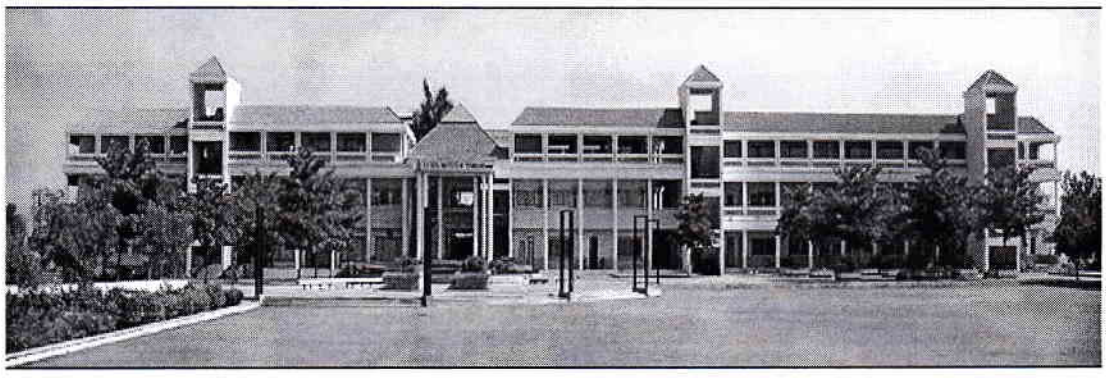
R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure

Third Year B.Tech (Electrical Engineering)

with efffect from Year 2022-23



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Semester-V (w.e.f. 2022-23)												
SN	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme (CA)				ESE	Total	Credit
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of TT1 / TT2			
							[A]			[B]	[C]	[A+B+C]	
1	PC	PCEE5010T	Electrical Machines-II	3			20	15	15	15	65	100	3
2	PC	PCEE5010L	Electrical Machines-II Laboratory			2	25				25	50	1
3	PC	PCEE5020T	Power System Analysis	3			20	15	15	15	65	100	3
4	PC	PCEE5020L	Power System Analysis Laboratory			2	25				25	50	1
5	PC	PCEE5030T	Electromagnetic Engineering	3	1		20	15	15	15	65	100	4
6	PC	PCEE5040T	Electric Traction and Utilization	3			20	15	15	15	65	100	3
7	PE	PEEE505-T	Professional Elective Course	3			20	15	15	15	65	100	3
8	PE	PEEE505-L	Professional Elective Course Laboratory			2	25				25	50	1
9	HM	HMEE5060T	Professional & Business Communication	2			50					50	2
10	PJ	PJEE5070L	Semester Project-III			2	25				25	50	1
11	HM	HMEE5080L	Employability Skill Development Program-II			2	50					50	1
			Total	**17**	**1**	**10**	**300**	**75**	**75**	**75**	**425**	**800**	**23**

Semester-V-Professional Elective Courses					
Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
PEEE5051	Solar Power Plant Design & Installation	PEEE5052	IoT & Its Applications in Electrical Engineering	PEEE5053	Digital Signal Processing

Semester-VI(w.e.f. 2022-23)

SN	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme (CA)				ESE	Total	Credit
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of TT1 / TT2			
							[A]			[B]	[C]	[A+B+C]	
1	PC	PCEE6010T	Control Systems	3	1		20	15	15	15	65	100	4
2	PC	PCEE6010L	Control Systems Laboratory			2	25				25	50	1
3	PC	PCEE6020T	Power Electronics	3			20	15	15	15	65	100	3
4	PC	PCEE6020L	Power Electronics Laboratory			2	25				25	50	1
5	PC	PCEE6030T	Electrical Machine Design	3	1		20	15	15	15	65	100	4
6	PC	PCEE6030L	Electrical Machine Design Laboratory			2	25				25	50	1
7	PC	PCEE6040T	Testing and Maintenance of Electrical Equipment	3			20	15	15	15	65	100	3
8	PE	PEEE605-T	Professional Elective Course	3			20	15	15	15	65	100	3
9	PJ	PJEE6060L	Project Stage – I			4	25				25	50	2
10	PC	PCEE6070L	PLC Simulation Laboratory			2	25				25	50	1
11	MC	MCEE6080T	Environmental Engineering	1									Audit Course
			Total	**16**	**2**	**12**	**225**	**75**	**75**	**75**	**450**	**750**	**23**

Semester-VI-Professional Elective Courses

Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
PEEE6051	Energy Audit & Management	PEEE6052	Industrial Automation & Control	PEEE6053	Electrical Mobility

Prepared by | Checked by | BOS Chairman | Dean Academic/Dy. Director | C.O.E. | Director

Electrical Machines-II (PCEE5010T)

Teaching Scheme
Lectures : 03 Hrs./week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites:

1. Knowledge of Electrical Machine-I.

Course Objectives

1. To introduce the constructional and operational details of cylindrical and salient pole rotor type Synchronous machines working in generator and motor modes.
2. To present the procedure for analysis of synchronous generator and synchronous motor during the (a) steady state, (b) transient state (3-phase short-circuit) and (c) unbalanced operating conditions using Phasor diagrams and machine equations.
3. To introduce the methods of synchronization and analysis when alternators are connected to Infinite bus and in parallel with each other.
4. Determine the performance indices of AC series and single phase motors by experimentation.
5. Study the applications of different machines in industrial, commercial and social sectors.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To Apply basic knowledge of science and engineering to understand electrical machines.	L3	Apply
CO2	To Understand construction, concepts, and principles of operation, testing and application of Synchronous machines, induction motor and special function motors.	L2	Understand
CO3	To Understand the behavior of synchronous machine on infinite bus and analyze data for qualitative and quantitative parameters to determine characteristics of machines by performing practical.	L2	Understand
CO4	To analyze and perform professional duties in team of manufacturing, testing, operation and Maintenance with the sense of safety precautions.	L4	Analyze
CO5	To Apply knowledge for technological subjects such as utilization of electrical energy, Switchgear and machine design for economical and sustainable developments.	L3	Apply

Course Contents

Unit-I Synchronous Generator 8 Hrs.

Principle of generator, construction, excitation system, rotating MMF waves in A.C. Machines, E.M.F. equation, winding factors, alternator on- load. Synchronous reactance and synchronous impedance,armature reaction and its effect under different load power factors, Voltage regulation of non-salient pole alternator.

Unit-II Synchronous Generator Analysis 8 Hrs.

Two reaction theory for salient pole machines, slip test for finding xd, xq. Parallel operation of alternator,effect of changing mechanical torque and excitation on alternator,load sharing between two parallel connected alternators. Alternator on an infinite bus, induction generator.

Unit-III Synchronous Motors 8 Hrs.

Principle of operation of Synchronous Motor, Power develop in Synchronous motor, Operation of 3-phase Synchronous motor with constant load and variable excitation, Operation with const. excitation and variable load, 'V' curves and 'inverted V' curves. Synchronous condenser, Phenomenon of hunting and its remedies, applications of 3-phase synchronous motors.

Unit-IV Poly Phase Induction Machines 8 Hrs.

Construction and principle of operation of squirrel cage and slip ring Induction motor Slip. Steady state analysis: Torque -speed characteristics, Torque -slip characteristics, maximum torque, and starting torque, Power stage in induction motor. Losses and efficiency, Methods of starting of slipping and cage rotor induction motor ,varies types of starters, Circle diagram and computation, Double squirrel cage motors, cogging, crawling of induction motor, Speed control of induction motor,Comparison of 3 phase synchronous motor with 3-phase induction motor.

Unit-V Introduction to Special Machines 8 Hrs.

Single phase induction motor: - Construction of single phase induction motor, double field revolving theory. Equivalent circuit and torque-slip characteristics on the basis of double revolving field theory, Type of 1 phase IM. Special Machines: hysteresis motor, Repulsion motor. Linear Induction Motor, A.C. Servomotors A.C. series motor.

Text Books

1. Ashfaq Hussain, "Electrical Machines",Dhanpat Rai and Co. (P) Limited, 3rd edition, 2016.
2. I. J. Nagrath and D. P. Kothari, "Electrical Machinery", Tata McGraw-Hill Education, 5th edition, 2020.
3. M V Deshpande, "Electrical Machines", Prentice Hall of India,2011
4. V. K. Mehta and Rohit Mehta, "Principles of Electrical Machines" S Chand Publication, 1st Edition, 2014.

Reference Books

1. Bimbhra P.S., "Generalized Theory of Electrical Machines", Khanna Publisher, 7th Revised Edition, 2021.
2. M.G. Say, "Theory and Performance and Design of A.C. Machines", ELBS London, 2002.
3. J B Gupta,"Theory and performance of Electrical Machines", S K Kataria Publications, 1st Edition, 2015

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Electrical Machines-II Labaratory (PCEE5010L)

Teaching Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisites: Electrical Machine-I

Course Objectives

1. To perform load test on three phase induction motor.
2. To observe the effect of rotor resistance and supply voltage on torque speed characteristic of induction motor.
3. To study and evaluation of Voltage Regulation for synchronous generator.
4. To conduct experiment to draw V and inverted V curves for synchronous motor.
5. To calculate Xd and Xq of a salient pole synchronous machine.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To apply the load test on three phase induction motor and understand variation in torque speed characteristics with different parameters.	L3	Apply
CO2	To analyze the Performance of synchronous machines.	L4	Analyze
CO3	To understand the voltage regulation in synchronous generator and different methods to find it.	L2	Understand
CO4	To analyze the V curve and inverted V-curve for synchronous motor under various load conditions.	L4	Analyze
CO5	To analyze find the magnetic axis of salient pole synchronous machines.	L4	Analyze

List of the Experiments

Perform 10 experiments from the following list of experiments. (8– Hardware, 1 – Simulation and 1 – Innovative)

1. Determination of voltage regulation and efficiency of three phase alternator by direct load test.
2. Open and short circuit test on three phase alternator: determination of its regulation by e.m.f. method and m.m.f. method.
3. Zero power factor test on three phase alternator: determination of regulation by Potier trangle method.
4. Determination of direct axis and quadrature axis reactance by slip test on synchronous machine.
5. Synchronizing alternators: lamp methods and use of synchroscope.
6. Synchronous alternator on infinite bus: behavior of machine under change in mechanical power and excitation.
7. Characteristic of synchronous motor at constant load and variable excitation.
8. Characteristic of synchronous motor at constant excitation and variable load.
9. Determination of performance of three phase induction motor by direct load test.
10. Load test on single phase induction motor.
11. Simulation of Speed control of three phase Slip Ring Induction Motor.
12. Simulation of three phase induction motor on MATLAB to obtain its performance.

Text Books

1. Ashfaq Hussain, "Electrical Machines",Dhanpat Rai and Co. (P) Limited, 3rd edition, 2016.
2. I. J. Nagrath and D. P. Kothari, "Electrical Machinery", Tata McGraw-Hill Education, 5th edition, 2020.
3. M V Deshpande, "Electrical Machines", Prentice Hall of India,2011
4. V. K. Mehta and Rohit Mehta, "Principles of Electrical Machines" S Chand Publication, 1st Edition, 2014.

Reference Books

1. Bimbhra P.S., "Generalized Theory of Electrical Machines", Khanna Publisher, 7th Revised Edition, 2021.
2. M.G. Say, "Theory and Performance and Design of A.C. Machines", ELBS London, 2002.
3. J B Gupta,"Theory and performance of Electrical Machines", S K Kataria Publications, 1st Edition, 2015

Evaluation Scheme

Laboratory

Continuous Assessment (TA):

Laboratory work will be based on PCEE5010L and subject specific lab assignment/case study. The distribution of marks for term work shall be as follows:

- Performance in Experiments: 05 Marks
- Journal Submission: 05 Marks
- Viva-voce: 05 Marks
- Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

Power System Analysis (PCEE5020T)

Teaching Scheme
Lectures : 03 Hrs./week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Fundamental of Electrical Energy Generation System, Power System Transmission and Distribution

Course Objectives

1. To understand the concepts of per-unit system and modeling of power system.
2. To understand and analyze the different types of faults in Power system.
3. To understand basic electricity market principles and power exchange.
4. To study concept of power system stability and its analysis.
5. To understand and study the modern power system concepts like SCADA, PMU, Security analysis.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To analyze three phase fault for small power systems.	L4	Analyze
CO2	To apply the concept of symmetrical components and evaluate the symmetrical components under fault conditions.	L3	Apply
CO3	To analyze unsymmetrical faults for small power networks.	L4	Analyze
CO4	To understand Electricity market concepts of deregulated power system and demand side management.	L2	Understand
CO5	To apply the knowledge for stable operation of power system and analyze the stability of power system.	L3	Apply

Course Contents

Unit-I Representation of Power System 8 Hrs.

Representation of power system components , per unit quantities – single phase and three phase selection of base quantities, advantages of PU systems, complex power, sequence networks of power system, regulating transformers, generators, transmission line, phase shift in star-delta transformer, sequence impedance of transmission line, transformer and generators.

Unit-II Symmetrical Fault Analysis and Components 8 Hrs.

Transient on a transmission line, Symmetrical fault analysis without and with pre-fault load currents, selection of circuit Breakers ratings, current limiting reactors, Symmetrical Component transformation, Operator a, Three phase power in unbalanced circuit in terms of symmetrical component, formation of sequence network of power system.

Unit-III Unsymmetrical Fault Analysis 8 Hrs.

Introduction, Single line to ground fault (LG) on an unloaded generator, line to line fault (LL) on an unloaded generator, double line to ground fault (LLG) on an unloaded generator, unsymmetrical fault on power systems, Single line to ground fault (LG) on a power system, line to line fault (LL) on a power system , double line to ground fault(LLG) on a power system, Shunt type and series type faults.

Unit-IV Load Flow Analysis 8 Hrs.

Introduction, Analysis of power flows, Network model formation, Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations, Comparison of load flow studies, Computational Issues in Large-scale Power Systems.

Unit-V Power System Economics, Stability and Management 8 Hrs.

Basic Pricing Principles, Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing, Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services, Regulatory framework.

Concepts of Stability, classification of Power System stability, Dynamics of a synchronous machine, Importance of Stability analysis in power system planning and operation, angle and voltage stability, Transient stability analysis, factor affecting transient stability, Methods to Improve transient stability, Single Machine Infinite bus (SMIB), Swing equation and its expression.

Text Books

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
2. C. L. Wadhwa, "Electrical Power System" New Age International Publishers, 2017.
3. V. K. Mehta, Rohit Mehta, "Principles of Power System", S.Chand Publications, 4th Edition , 2021.

Reference Books

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis" Pearson Education Inc., 1999.
4. Hadi Sadat, "Power System Analysis" Tata McGraw Hill, 3rd Edition, 2016
5. L. P. Singh, "Advanced Power System Analysis and Dynamics" New Age International, 2006.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Power System Analysis Laboratory (PCEE5020L)

Teaching Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisites: Fundamental of Electrical Energy Generation System, Power System Transmission and Distribution

Course Objectives

1. To analyze the performance of power system networks by conducting various experiments.
2. To present a problem oriented knowledge of power system analysis methods.
3. To develop computer programs for analysis of power systems.
4. To analyze power system operation and stability control.
5. To identify and formulate solutions to relevant problems of power system using software tools.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	The students should be able Evaluate reactance of synchronous machine on no load and loaded condition.	L3	Apply
CO2	The students should be able Analyze the effects of symmetrical fault on power system.	L4	Analyze
CO3	The students should be able Analyze the effects of unsymmetrical faults on power system.	L4	Analyze
CO4	The students should be able Compute the Y-bus and Z-bus matrix for a given system.	L4	Analyze
CO5	The students should be able Determine the power flow for a given system	L3	Apply

List of the Experiments

Perform 10 experiments from the following list of experiments. (1– Hardware, 8 – Simulation and 1 – Innovative)

1. To study the effect of VAR compensation on voltage profile of transmission line using capacitor bank.
2. Load Flow Analysis using Newton Raphson (NR) Method Experiment.
3. Load Flow Analysis using Fast Decoupled (FD) Method.
4. Load Flow Analysis using Gauss Seidel (GS) Method.
5. Measurement of Direct axis and Quadrature axis reactance of synchronous machine.
6. Formation and calculation of Y BUS .
7. Formation and calculation of Z BUS .
8. Simulation and analysis for a symmetrical three phase fault.
9. Simulation and analysis of unsymmetrical fault LL.
10. Simulation and analysis of unsymmetrical fault LG.
11. Simulation and analysis of unsymmetrical fault LLG.
12. To study Transient and small signal stability analysis of Single Machine connected to infinite bus.

Reference Books

1. Hadi Sadat, "Power System Analysis" Tata McGraw Hill, 3rd edition, 2016.

Evaluation Scheme

Laboratory

Continuous Assessment (TA):

Laboratory work will be based on PCEE5020L and subject specific lab assignment/case study. The distribution of marks for term work shall be as follows:

- Performance in Experiments: 05 Marks
- Journal Submission: 05 Marks
- Viva-voce: 05 Marks
- Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

Electromagnetic Engineering (PCEE5030T)

Teaching Scheme
Lectures : 03 Hr/week
Tutorial : 01 Hr/week
Credit : 04

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Engineering Mathematics, Basic Electrical and Electronics Engineering.

Course Objectives

1. To introduce the beginner level mathematical concepts in the Electromagnetic Engineering.
2. To understand basic concepts of static electric field and its associated quantities.
3. To understand the boundary condition particularly a boundary between conducting material and free space.
4. To understand the magneto static fields, magnetic flux density, vector potential and its applications.
5. To understand emf generation methods and Maxwell's equations

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To apply the basic concept of mathematics and laws of electro-magnetism to solve the complex engineering problem.	L3	Apply
CO2	Learn the basic concept of electrostatic fields and their application.	L2	Understand
CO3	Apply knowledge of Electric and magnetic fields to solve boundary conditions problems.	L3	Apply
CO4	Understand the magneto-static fields and their application.	L2	Understand
CO5	Apply knowledge of numerical methods to solve electromagnetic field problems.	L3	Apply

Course Contents

Unit-I Electrostatics 8 Hrs.

Vector algebra, Components of vectors, three orthogonal coordinate systems (rectangular, cylindrical and spherical), Conversion of a vector from one coordinate system to another, Charge and Coulomb's Law, Electric Field and Electric Field Intensity, Line, Surface and Volume charge distributions, Electric Flux and Electric Flux Density, Gauss law and applications.

Unit-II Applied Electrostatics 8 Hrs.

Work done, Electrostatic Potential and Potential difference, Potential Gradient and Relation between E and V, Electric Dipole, Capacitor and Capacitance, Parallel plate, co-axial, spherical capacitor, Capacitance of a two wire line,

Unit-III Conductors and Dielectrics 8 Hrs

Current and Current Density, Poisson and Laplace Equation, Energy Stored in Electrostatic Field, Conductors and their properties, Dielectric strength and dielectric breakdown, Boundary conditions in electrostatics.

Unit-IV Magnetostatics 8 Hrs

Magnetic Field and Magnetic Field Intensity, Biot-Savart Law, Amperes Law, Relation between H and J and Strokes Theorem, Magnetic Flux Density and Permeability, Magnetic Scalar and Vector Potentials, Forces in Magnetic Field, Boundary conditions in magnetostatics.

Unit-V Time Varying Fields and Finite Element Method 8 Hrs.

Faradays Law, Displacement current and displacement current density, Maxwell's equations, Power and Pointing Theorem, Phasor form of harmonic fields, Uniform Plane Wave, Method of Moments, Finite Element Method.

Text Books

1. Matthew N. O. Sadiku, S. V. Kulkarni, "Principles of Electromagnetics", Oxford University Press, 6th Edition, 2015 .

Reference Books

1. Edminister J. A., "Electromagnetics", Tata McGraw-Hill, 2017.
2. W. H. Hayt and J. A. Buck, "Engineering Electromagnetics", Tata McGraw-Hill, 7th Edition, 2006.
3. Vijay K. Garg, "Wireless Communications and Networking", Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.
4. Bhag Singh Guru, Hüseyin R. Hiziroglu, "Electromagnetic Field Theory Fundamentals", Cambridge University Press, 2nd Edition, 2009.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Tutorial

Minimum eight tutorials shall be conducted.

Electric Traction and Utilization (PCEE5040T)

Teaching Scheme
Lectures : 03 Hr/week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Basics of Electrical Engineering and Electrical Machine-I.

Course Objectives

1. To understand energy conversion process.
2. To impart knowledge of principles of electrical traction .
3. To explore various electrical subsystems of traction .
4. To possess knowledge of advanced and emerging topics in traction mechanism and applications.
5. To meet desired needs of locomotive industry within realistic constraints.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To understand types of Traction System.	L2	Understand
CO2	Interpret Various Power supply in Electric Traction.	L2	Understand
CO3	Analyze Various Traction Motors	L4	Analyze
CO4	Analyze methods of Traction motor Control.	L4	Analyze
CO5	Evaluate Train movement and Breaking in Traction system.	L5	Evaluate

Course Contents

Unit-I Electric Traction System 8 Hrs.

Requirements of Ideal Traction Systems. Types of eclectic drives, choice of motors, classification of loads. Electrical transmission system supplying traction motors, Advantages of electric traction over other systems of traction, Ideal choice of traction system. Track electrification: D.C. System, single phase low frequency A.C. system, single phase high frequency A.C. system, 3 phase A.C. system and composite system, Latest Developments with special reference to locomotives.

Unit-II Power Supply for Electric Traction 8 Hrs.

Current collection system, current collectors for Over Head Systems, Overhead construction for Tramways and trolley buses and railways, Traction substations, location of substations, feeding and distributing system, substation equipment's. Block Diagram of AC Electric locomotive, Signaling.

Unit-III Traction Motors 8 Hrs

Characteristics of traction motors, straight D.C. series motor, suitability of series motor for traction duty, constructional details of D.C. Traction Motors, suitability of shunt motor for traction duty, single phase series motors, Three phase Induction motor , Linear Induction motor.

Unit-IV Traction Control 8 Hrs

Traction control: Duty cycle, Methods of traction motor control, series-Parallel and other types of controllers, use of interlocks, run back prevented, multiple unit control, Master controllers, and use of Metadyne..

Unit-V Train Movement and Braking 8 Hrs.

Speed time curve for different services, schedule speed and factors affecting it, train resistance and its components. Tractive effort calculations, average acceleration and speed, energy output and consumption. Mechanical versus electric breaking, Plugging, Rheostatic braking, Regenerative braking method and energy saved in the process, Magnetic track brakes.

Text books

1. C. L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age international Publishers, 2015.
2. Gonzalo Abad, "Power Electronics and Electric Drives for Traction Applications", Wiley, 2016.
3. E. Openshaw Taylor, "Utilization of Electric Energy", Orient Longman,2006.

Reference Books

1. J. B. Gupta, "Utilization of Electrical Power and Electic Traction", Kataria & Sons, 2013.
2. H. Partab, "Modern Electric Traction", Dhanpat Rai & Company, 2017.
3. Edward P. Burch, "Electric Traction for Railway Trains", McGraw Hill Book Company, 2007.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Solar Power Plant Design and Installation (PEEE5051T)

Teaching Scheme
Lectures : 03 Hrs./week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites:

1. Knowledge of Basics of materials science and engineering.

Course Objectives

1. To Acquire knowledge on solar radiation principles with respect to solar energy estimation.
2. To familiarize the students with design methods of solar thermal and photovoltaic systems.
3. To Identify various energy technologies, codes, certifications and their relationship with solar photovoltaic system.
4. To learn the fundamentals, design and application of solar photovoltaic systems for power generation on small and large scale electrification.
5. To Analyze solar photovoltaic system energy and building resources.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To understand the solar radiation Principles with respect to solar energy estimation.	L2	Understand
CO2	To understand the design methods of solar thermal and photovoltaic systems.	L2	Understand
CO3	To understand various energy technologies, codes, certifications and their relationship with solar photovoltaic system.	L2	Understand
CO4	To analyze the design and application of solar photovoltaic systems for power generation on small and large scale electrification.	L4	Analyze
CO5	To analyze and Compare solar photovoltaic system materials and methods.	L4	Analyze

Course Contents

Unit-I Basics of Solar Cell 8 Hrs.

Photovoltaic effect - Principle of direct solar energy conversion into electricity in a solar cell. Fundamental of semiconductor, Charge Carries and their motion in Semiconductor, Semiconductor properties, energy levels, basic equations. P N Junction Diode.

Unit-II Design of Solar Cells 8 Hrs.

Upper limits of cell parameters, Losses in Solar cell, Solar cell design, Design for High Isc, Design for high Voc. Design for high FF, Analytical Techniques.

Unit-III Solar Cell Technologies 8 Hrs.

Production of Si, Si Water based solar cell technology-Processes used in solar cell technology, High efficiency si solar cells. Thin film solar cell technologies –generic advantages of thin film technologies, Materials for thin film technologies. Microcrystalline si thin film technology.

Unit-IV Photovoltaic System Design 8 Hrs.

Stand Alone PV System Configurations, Design Methodology of PV System, wire sizing in PV System, Hybrid PV System, Grid Connected PV System, and Lifecycle Costing.

Unit-V Solar Photovoltaic Applications 8 Hrs.

Solar Radiation-the sun and earth movement, Angle of Sunrays on solar collector, Sun Tracking, Solar Photovoltaic Modules: Solar PV Modules from solar cell, Design and structure of PV Modules. PV Module Power Output.

Text Books

1. D. Yogi Goswami, "Principles of Solar Engineering", CRC Pres, 3rd Edition, 2015.
2. Edward E. Anderson, "Fundamentals for Solar Energy Conversion", Addison Wesley Publication, 1983.

Reference Books

1. S. P. Sukhatme, J. K. Nayak, "Solar Energy", Tata McGraw Hill, 4th Edition, 2017.
2. G. N. Tiwari, "Solar Energy Fundamentals, Design, Modeling and Applications, Narosa Publication, 2005.
3. Chetan Singh Solanki,"Solar Photovoltaics Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd, 3rd Edition, 2015.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Solar Power Plant Design and Installation Laboratory (PEEE5051L)

Teaching Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisites: Electrical Engineering Material

Course Objectives

1. To familiarize the students with design methods of solar thermal and photovoltaic systems.
2. Identify various energy technologies, codes, certifications and their relationship with solar photovoltaic system.
3. To Study the Series parallel connections of solar panels and effect of shading.
4. To provide knowledge about development of Solar Power plant and various operational as well as performance parameters.
5. To recognize current and possible future role of Renewable energy sources.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To understand the solar radiation Principles with respect to solar energy estimation.	L2	Understand
CO2	To analyze design methods of solar thermal and photovoltaic systems.	L4	Analyze.
CO3	To understand Series parallel connections of solar panels.	L2	Understand
CO4	To understand various energy technologies, codes, certifications and their relationship with solar photovoltaic system.	L2	Understand
CO5	To apply the fundamentals, design and application of solar photovoltaic systems for power generation on small and large scale electrification.	L3	Apply

List of the Experiments

Perform 10 experiments from the following list of experiments. (8– Hardware, 1 – Simulation and 1 – Innovative)

1. Simulation study on Solar PV Energy System.
2. Simulation On Vi-Characteristics And Efficiency Of 1kwp Solar Pv System.
3. Effect of shading on solar pannel performance.
4. Effect of temperature and tilt angle on solar panel.
5. To demonstrate the I-V and P-V characteristics of PV module with varying radiation and temperature level of series and parallel combination of PV modules.
6. To demonstrate the effect of variation in tilt angle and shading on PV module.
7. To demonstrate the working of diode as bypass diode and blocking diode.
8. Workout power flow calculations of stand-alone PV system with combined DC and AC load with battery.
9. To draw the charging and discharging characteristics of battery.
10. Evaluate the efficiency of charge controller.
11. Find out the start up speed and cut -in speed of wind turbine and also find Tip Speed ratio (TSR) at different wind speeds.
12. Evaluate the coefficient of performance of wind turbine.
13. Draw the Turbine Power versus Wind Speed curve.
14. Draw the curve between TSR and coefficient of power.
15. Draw the power curve of turbine with respect to the rotational speed of rotor at fix wind speeds.
16. Demonstrate the power analysis at different branches of wind turbine energy system (at high frequency) with AC load and DC load.

Text Books

1. D. Yogi Goswami, "Principles of Solar Engineering", CRC Pres, 3rd Edition, 2015.
2. Edward E. Anderson, "Fundamentals for Solar Energy Conversion", Addison Wesley Publication, 1983.

Reference Books

1. S. P. Sukhatme, J. K. Nayak, "Solar Energy", Tata McGraw Hill, 4th Edition, 2017.
2. G. N. Tiwari, "Solar Energy Fundamentals, Design, Modeling and Applications, Narosa Publication, 2005.
3. Chetan Singh Solanki,"Solar Photovoltaics Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd, 3rd Edition, 2015.

Evaluation Scheme

Laboratory

Continuous Assessment (TA):

Laboratory work will be based on PEEE5051L and subject specific lab assignment/case study. The distribution of marks for term work shall be as follows:

- Performance in Experiments: 05 Marks
- Journal Submission: 05 Marks
- Viva-voce: 05 Marks
- Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

IoT and Its Applications in Electrical Engineering (PEE5052T)

Teaching Scheme
Lectures : 03 Hr/week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Basic Electrical and Electronics Engineering,Electrical Measurement.

Course Objectives

1. Provide an overview of concepts, trends and challenges of Internet of Things.
2. Impart the knowledge of sensors and embedded systems.
3. Describe IoT deployment levels and M2M technologies.
4. Facilitate use of hardware and software technologies related to Internet of Things.
5. Provide the knowledge of IoT communication models and protocols.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Gain knowledge of sensors and embedded systems.	L2	Understand
CO2	Understand the different IoT processors and controllers.	L2, L3	Understand, Apply
CO3	Understand and apply the basic sensor network concepts to IoT.	L2, L3	Understand, Apply
CO4	Understand the IoT communication models and protocols.	L2	Understand
CO5	Design and develop small IoT applications to create smart objects.	L4, L5, L6	Analyse, Evaluate, Create

Course Contents

Unit-I Transducers, Sensors and Actuators 8 Hrs.

Introduction and classification of Transducers, Sensors and Actuators, Types of Sensors: Motion Detectors, Force Sensors, Temperature and Humidity Sensors, Light Sensor, Level Sensor, Ultrasonic Sensor, Current and voltage Sensor, Types of Actuators, Solenoid, DC Motor, AC Motor and Stepper motor.

Unit-II Introduction to Arduino and Raspberry Pi 8 Hrs.

Arduino : Pin configuration and architecture, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board and its types, Arduino platform

Raspberry Pi: Introduction to Raspberry Pi, Comparison of various Rpi Models, Understanding SoC architecture and SoCs used in Raspberry Pi, Pin Description of Raspberry Pi, On-board components of Rpi

Unit-III Introduction to WSN and IoT 8 Hrs.

Introduction to WSN and its Technologies, Architecture and characteristics of WSN, Scalability issues and challenges of a Wireless Sensor Network.

Introduction to Internet of Things, Characteristics and applications of IoT, IoT Reference Model, Security issues in the IoT, Disambiguation of IoT vs IoE vs M2M vs others.

Overview of Cloud and Fog Computing, Definition, Difference between Fog and Cloud.

Unit-IV IoT Communication Technologies and protocols 8 Hrs.

Introduction to communication Technologies like Wi-Fi, Bluetooth, RFID, Z-Wave, Zigbee.

IoT Levels and Deployment Templates, Various operating systems, TinyOS, Contiki OS, Protocol Classification, MQTT, XMPP, DDS, AMQP, COAP, REST, IPv6, 6LoWPAN, Comparison of protocols.

Unit-V IoT applications 8 Hrs.

Reading sensor data and sending it to cloud platform, Visualization and analysis of the data on cloud,actuation and control, case study - Home automation, smart grid .

Text books

1. Srinivasa K. G., Siddesh G. M., Hanumantha Raju R., "Internet of Things", CENGAGE Publication, 1st Edition, 2018.
2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willy Publications, 2013.
3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011.
4. Parikshit N. Mahalle and Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, 2015.

IoT and Its Applications in Electrical Engineering Laboratory (PEEE5052L)

Teaching Scheme
Practical : 02 Hr/week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Course Objectives

1. To study and install IDE for arduino.
2. To study the basic components IoT sensors.
3. Understand the sensors for IoT application.
4. Use of IoT processors and controllers for various applications.
5. To understand the application of IoT application in Electrical Engineering.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To study the various sensors used in IoT .	L2	Understand
CO2	To understand the use of IoT sensors for electrical applications	L2	Understand
CO3	Understand the various modules and cloud used for IoT applications	L2	Understand
CO4	Design and implementation of various IoT applications using Arduino	L4, L5, L6	Analyse, Evaluate, Create
CO5	Apply IoT domain for automation of various applications	L3	Apply

List of the Experiments

Perform any 10 experiments from the following list of experiments

1. Study and Install IDE of Arduino and different types of Arduino.
2. Write program using Arduino IDE for Blink LED.
3. Write program to monitor temperature and humidity using Arduino.
4. Design of digital dc voltmeter and ammeter.
5. Design of digital ac voltmeter and ammeter.
6. Design of digital frequency meter.
7. Measurement of power and energy.
8. Traffic signal control.
9. Railway gate control by stepper motors.
10. Direction and Speed control of DC motor.
11. Over/under voltage protection of home appliances.
12. Reading sensor data and sending it to cloud platform for temperature and humidity sensor.

Lab Tools: Arduino IDE, Raspberry Pi OS

Reference Books

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", Universities Press, 1st edition, 2014.
2. Raj Kamal, "Internet of Things : Architecture and Design Principles", McGraw Hill Education, 1st edition, 2017.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Willy Publications, 2nd Edition, 2012.
4. Fang Zhaho, Leonidas Guibas, "Wireless Sensor Network: An Information Processing Approach", Elsevier, 1st Edition, 2014.
5. https://www.arduino.cc/

Evaluation Scheme

Laboratory

Continuous Assessment (TA):

Laboratory work will be based on PEEE5052L and subject specific lab assignment/case study. The distribution of marks for term work shall be as follows:

- Performance in Experiments: 05 Marks
- Journal Submission: 05 Marks
- Viva-voce: 05 Marks
- Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

Digital Signal Processing (PEEE5053T)

Teaching Scheme
Lectures : 03 Hr/week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Signals and System, Engineering Mathematics.

Course Objectives

1. To develop a thorough understanding of DFT and FFT and their applications.
2. To teach the design techniques and performance analysis of digital filters.
3. To design the IIR and FIR filters.
4. To understand the use of digital signal processing in electrical engineering.
5. To introduce the students to digital signal processors and its applications.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the efficient computing algorithms of DFT and FFT in finding the response of the system.	L2	Understand
CO2	Design different types of IIR and FIR filters.	L6	Create
CO3	Evaluate the effects of Poles and Zeros in design of digital filters	L5	Evaluate
CO4	Understand the architecture of DSP Processors.	L2	Understand
CO5	Explain the applications of Digital Signal Processing in Electrical Engineering.	L2	Understand

Course Contents

Unit-I Discrete Fourier Transform and Fast Fourier Transform 8 Hrs.

Definition and Properties of DFT, IDFT, Circular convolution of sequences using DFT and IDFT. Filtering of long data sequences: Overlap-Save and Overlap-Add Method for computation of DFT. Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT.

Unit-II IIR Digital Filters 8 Hrs.

Types of IIR Filters (Low Pass, High Pass, Band Pass, Band Stop), Analog filter approximations: Butterworth, Chebyshev I. Mapping of S-plane to Z-plane, impulse invariance method, bilinear transformation method, Design of IIR digital filters (Butterworth and Chebyshev-I) from Analog filters with numerical examples. Effect of Poles and Zeros on the Frequency Response of IIR filters. Position of Poles and Zeros of Low Pass, High Pass, Band Pass, Band Stop, All Pass filters.

Unit-III FIR Digital Filters 8 Hrs

Characteristics of FIR digital filters, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase (Type 1 to Type 4) FIR Filters. Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackman, Kaiser), Design of FIR filters using Frequency Sampling technique, Comparison of IIR and FIR filters.

Unit-IV Poles, Zeros and Filters 8 Hrs

Effects of poles and zeros in the frequency response of IIR filters (LP, HP, BP, BR/Notch, All Pass filters). Placement of zeros and design of filters in Type1 to Type 4 Linear Phase FIR filters. Finite Word Length effects in Digital Filters Quantization, truncation and rounding, Error due to truncation and rounding.

Unit-V Processor and Application in Electrical Domain 8 Hrs.

Introduction to General Purpose and Special Purpose DSP processors, fixed point and floating-point DSP processor, Computer architecture for signal processing, Harvard Architecture, Pipelining, multiplier and accumulator (MAC). Applications of Digital Signal Processing in Electrical Engineering domain.

Text books

1. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing A Practical Approach", Pearson Education, 2nd Edition, 2002.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", McGraw Hill Education Private Limited, 4th Edition, 2013.
3. Tarun Kumar Rawat, "Digital Signal Processing", Oxford University Press, 2015.
4. Paulo Fernando Ribeiro, Carlos Augusto Duque, Paulo Márcio Ribeiro, Augusto Santiago Cerqueira, "Power Systems Signal Processing for Smart Grids", Wiley, 1st Edition, 2013

Reference Books

1. Proakis J., Manolakis D., "Digital Signal Processing", Pearson Education, 4th Edition, 2007.
2. Oppenheim A., Schafer R., Buck J., "Discrete Time Signal Processing", Pearson Education, 3rd Edition, 2014.
3. B. Venkata Ramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw Hill, 2nd Edition, 2004.
4. A. Anand Kumar, "Digital Signal Processing", PHI Learning Pvt. Ltd., 2nd Edition, 2015.
5. Ramesh P. Babu, "Digital Signal Processing", SCITECH Publication, 4th Edition, 2015.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Digital Signal Processing Laboratory (PEEE5053L)

Teaching Scheme
Practical : 02 Hr/week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisites: Signals and System, Engineering Mathematics, MATLAB fundamentals.

Course Objectives

1. To plot various signals using MATLAB.
2. Interpret discrete-time signals using DFT.
3. To implement FIR and IIR filters in MATLAB.
4. Apply FFT algorithms for various signal processing operations.
5. To learn design of digital FIR and IIR filters with real-time applications in signal conditioning.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Familiarization with the MATLAB to perform digital filter design and filtering.	L2	Understand
CO2	Examine the frequency response and impulse response of discrete-time LTI systems	L4	Analyze
CO3	Interpret discrete-time signals using DFT.	L3	Apply
CO4	Apply FFT algorithms for various signal processing operations.	L3	Apply
CO5	Design digital FIR and IIR filters as per the requirements of pass-band and stopband.	L6	Create

List of the Experiments

Perform any 10 experiments from the following list of experiments

1. Plot of Discrete Time Signals.
2. Frequency response of LTI systems by DTFT .
3. To perform Discrete Fourier Transform .
4. To implement Circular Convolution of two discrete time sequences .
5. To perform Overlap Add method of DFT for long data sequence.
6. To implement the algorithm of DIT-Fast Fourier Transform.
7. To plot the FFT of Sinusoids with noise .
8. Magnitude and phase response of FIR filter .
9. Design an Analog Butterworth filter with given specifications .
10. Design a Digital IIR Butterworth filter with given specifications .
11. Design an FIR filter by window method.
12. Removal of Noise by a designed filter.

Reference Books

1. Vinay K. Ingle, John G. Proakis, "Digital Signal Processing using MATLAB", Cengage Learning, 3rd Edition, 2012. .
2. A. Anand Kumar, Digital Signal Processing, PHI Learning Pvt. Ltd., 2nd Edition, 2015.
3. Samir I. Abood, Digital Signal Processing A Primer With MATLAB, CRC Press, 1st Edition, 2020.
4. Alexander D. Poularikas, Understanding Digital Signal Processing with MATLAB and Solutions, CRC Press, 1st Edition, 2017.
5. Andre Quinquis, Digital Signal Processing Using MATLAB, Wiley, 1st Edition, 2010.
6. John W. Leis, Digital Signal Processing Using MATLAB for Students and Researchers, Wiley, 1st Edition, 2011.

Evaluation Scheme

Laboratory

Continuous Assessment (TA):

Laboratory work will be based on PEEE5053L and subject specific lab assignment/case study. The distribution of marks for term work shall be as follows:

- Performance in Experiments: 05 Marks
- Journal Submission: 05 Marks
- Viva-voce: 05 Marks
- Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

Professional and Business Communication (HMEE5060T)

Teaching Scheme
Lectures : 02 Hr/week
Credit : 02

Examination Scheme
Teacher Assessment : 50 Marks
Total Marks : 50 Marks

Prerequisites: Basic course in Effective Communication Skills.

Course Objectives

1. To inculcate professional and ethical attitude at the workplace.
2. To enhance communication and interpersonal skills.
3. To develop effective presentation skills.
4. To hone written skills for technical documentation.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Plan, organize and write technical documents like reports, proposals and research papers in the prescribed format using appropriate language and style with an understanding of ethics in written communication.	L2	Understand
CO2	Apply techniques of writing resume, participating in a group discussion and facing interviews.	L3	Apply
CO3	Develop interpersonal skills in professional and personal situations.	L4	Analyse
CO4	Understand the documentation process of meetings and conduct meetings in a professional manner.	L2	Understand
CO5	Understand communication across cultures and work ethics.	L2	Understand
CO6	Design and deliver effective presentations using Power Point	L6	Create

Course Contents

Unit-I Technical Writing 8 Hrs.

Report Writing: Types of report, parts of formal report, collection of data and survey analysis, pre-writing of report, language and style in reports, formatting of reports, referencing in report.

Proposal Writing: Types of technical proposals, format of proposal, language and style, presentation of proposal.

Technical Paper Writing: Parts of a technical paper, language and formatting, referencing in IEEE format.

Plagiarism: Types of plagiarism, consequences of plagiarism

Unit-II Employment Skills 8 Hrs.

Group Discussion: Purpose of a GD, types of GD, criteria for evaluating a GD, Dos and Don'ts of a GD, Tips to be successful in GD.

Cover Letter and Resume Writing: Format and content of cover letter, types of resume, structure,content and formatting of resume.

Interview Skills: Types and modes of interview, Preparation for interview, Dos and Don'ts of interview, frequently asked questions during interview.

Unit-III Introduction to Interpersonal Skills 5 Hrs.

Emotional Intelligence: Definition, difference between IQ and EQ, how to develop EQ .

Leadership: Types of leadership, leadership styles, case studies.

Team Building: Difference between group and team, importance of team work, strategies to be a good team player.

Time Management: Importance of time management, cultural views of time, 80/20 rule, time wasters, setting priorities and goals, .

Conflict Management: Types of conflicts, strategies to manage conflict, case studies.

Unit-IV Meetings and Documentation 4 Hrs.

Planning and preparation for meetings, strategies for conducting effective meetings, notice, agenda and minutes of a meeting, business meeting etiquettes.

Unit-V Cross-culture Communication, Ethics & Presentation Skills 5 Hrs.

Communication across cultures, professional and work ethics, responsible use of social media, introduction to Intellectual Property Rights. Presentation strategies, overcoming stage fear, techniques to prepare effective Power Point presentation.

Reference Books

1. Fred Luthans, "Organizational Behavior", McGraw Hill, 7th edition, 2010.
2. Lesiker and Petit, "Report Writing for Business", McGraw Hill, 10th edition, 1997.
3. Huckin and Olsen, "Technical Writing and Professional Communication", McGraw Hill, 2nd edition, 1990.
4. Wallace and Masters, "Personal Development for Life and Work", Thomson Learning, 12th edition, 2012.
5. Heta Murphy, "Effective Business Communication", Mc Graw Hill, 7th edition, 1997.
6. Sharma R.C. and Krishna Mohan, "Business Correspondence and Report Writing", Tata McGrawHill Education, 2017.
7. Ghosh, B. N., "Managing Soft Skills for Personality Development", Tata McGraw Hill. Lehman.
8. Bell, Smith, "Management Communication", Wiley India Edition, 3rd edition.
9. Dr. Alex, K.,"Soft Skills", S Chand and Company, 2009.
10. Subramaniam, R., "Professional Ethics", Oxford University Press, 2nd edition, 2017.

List of Assignments

1. Business Proposal (PowerPoint presentation).
2. Resume writing.
3. Interpersonal Skills (documentation of activity).
4. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings).
5. Business ethics.
6. Presentation Skills.

Evaluation Scheme

Teachers Assessment (TA):

Assessment work will be based on HMEE5060T and subject specific lab assignment/case study.The distribution of marks for term work shall be as follows:

- Assignments: 25 Marks
- Project Report and Presentation: 15 Marks
- Group Discussion: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of TA and upon fulfilling minimum passing criteria in the term work.

Semester Project- III (PJEE5070L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

Students are expected to design, simulate/implement a project based on the knowledge acquired from subject areas like Electrical Machines, Power System Analysis, Electromagnetic Engineering, Electric Traction and Utilization, Solar Power Plant Engineering, Internet of Things and Digital Signal Processing.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate various/alternate approaches to complete a project.	L2	Understand
CO2	Demonstrate the ability to work in teams and manage the conduct of the research study.	L2	Understand
CO3	Ensure a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Present their project work in the form of a technical report / paper and thereby improve the technical communication skill.	L3	Apply
CO5	Conduct a survey of several available literatures in the preferred field of study.	L4	Analyze

Semester Project:

The purpose of introducing semester project at Third Year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Third Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the department committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during current semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done(please see attached log book format).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details
- Project Outcomes
- Conclusion

Semester Project- III (PJEE5070L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

Students are expected to design, simulate/implement a project based on the knowledge acquired from subject areas like Electrical Machines, Power System Analysis, Electromagnetic Engineering, Electric Traction and Utilization, Solar Power Plant Engineering, Internet of Things and Digital Signal Processing.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate various/alternate approaches to complete a project.	L2	Understand
CO2	Demonstrate the ability to work in teams and manage the conduct of the research study.	L2	Understand
CO3	Ensure a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Present their project work in the form of a technical report / paper and thereby improve the technical communication skill.	L3	Apply
CO5	Conduct a survey of several available literatures in the preferred field of study.	L4	Analyze

- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table A.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table B.

Each group shall present/publish a paper based on the semester project in reputed/peer reviewed Conference/Journal/TechFest/Magazine/ before the end of the semester.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Table A

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 3: Table B

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Simulation/ Logic	PCB/ hardware/ programming	Result Verification	Presentation	Total
			5	5	5	5	5	25

Employability Skill Development Program-II (HMEE5080L)

Teaching Scheme	Examination Scheme
Practical : 02 Hr/week	Teacher Assessment : 50 Marks
Credit : 01	Total Marks : 50 Marks

Prerequisites: Basic Mathematics, Basic knowledge of C programming

Course Objectives

1. To enhance the problem solving skills with real life examples.
2. To enable the students to express their thoughts and knowledge on various platforms.
3. Able to describe the basic database management system.
4. Able to implement basic programming project using python.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze and solve the logical problem based on words, venn diagram etc.	L4	Analyze
CO2	Understand and solve the English comprehension, Sentence completion, Sentence Correction problems.	L2, L4	Understand, Apply
CO3	Understand and illustrate the concept of Exception Handling, Garbage collection.	L2, L3	Understand, Apply
CO4	Understand and describe the fundamental of DBMS, NoSql, MongoDB	L2	Understand

Course Contents

Unit-I — 10 Hrs.

Reasoning : Data sufficiency, Logical Deductions, Logical Sequence of Words, Logical Venn Diagrams, Statement and Arguments, Statement and Assumptions, Statement and Conclusions Syllogism.

English: Reading Comprehension, Para Jumbles, Cloze Test, Tenses/ Voice/ Speech, Prepositions/ SVA/ Articles, Vocab /Verbal Analogy, Sentence completion, Sentence Correction.

Unit-II — 10 Hrs.

Modules Introduction, Importance of Modularity programming, Import keyword, User defined modules creation, Function based modules, Classes based modules, Connecting modules, 'from' keyword.

Files Handling Reading file char by character, Reading file line by line, Modes of files, Writing into file, Append data to a file, Reading CSV file, Pickling and Un pickling

Garbage collection Introduction, Importance of manual GC, Self-referenced objects, 'gc' module, Collect() method, Threshold function

Unit-III — 8 Hrs.

Collections Framework Introduction to collection of data types, Importance of Data processing, DS algorithms introduction.

List Create a list, Adding elements, Deleting elements, Pre-defined functionality of List, Nested List, Immutability and Mutability of List.

Set The functionality of Set object, Frozen set, Dictionaries, Create a dictionary, Adding elements

Dict Pre-defined functions of Dict class, Programs using Collection types .

Unit IV — 8 Hrs.

Tkinter – GUI Types of Layouts , Create Labels and Display images, Create Buttons, Create Events, StringVar class, Calculator program using GUI.

Basic ML AI including Projects Iterators, Nested functions, Generators, Closures, Decorators, Basic ML and AI, PIP, Visualization etc.

Project Domain(Per domain 1 or 2 project)

- ML/AI Based Projects
- Data Analysis Based projects
- Test Summarization based projects
- Web scrapping and crawling

Unit V

10 Hrs.

DBMS Using Python Introduction to Mysql, Mysql – Python connectivity, DDL, DRL, DML, Transaction management examples (rollback and commit), GUI - Database connectivity.

NoSql Using Python Installation and Configuration, MongoDB Tools, Collection and Documents, CRUD and the MongoDB Shell, Introduction to CRUD, Introduction to the MongoDBAPI, Creating a Database, Collection and Documents.

Data Modelling and Schema Design MongoDB Database References Model Tree Structures, MongoDB Analysing Queries, Atomic Operations, Map Reduce, Text Search, Regular Expression, Capped Collections.

Administration MongoDB Deployment and Cluster setup, MongoDB GridFS, Trident Spout, Working with Replica Sets, MongoDB Sharding.

Reference books

1. Dr. R S Aggarwal, "Quantitative Aptitude for Competitive Examinations", S Chand Publication.
2. M. G. Venkateshmurthy, "Programming Techniques through C", Pearson Publication, 1st edition, 2002.
3. Behrouz Forouzan, "A Computer Science Structure Programming Approaches using C", Cengage Learning, 3rd edition, 2007.

Evaluation Scheme

Continuous Assessment (TA):

Teacher's Assessment (TA) will carry weightage of 50 marks. The components of TA are

The distribution of marks for term work shall be as follows:

- MCQ Test based on Aptitude: 20 Marks
- MCQ Test based on Programming skills: 30 Marks
- Total Marks 50 Marks

Any other component recommended by BOS and approved by Dean Academics.

Control System (PCEE6010T)

Teaching Scheme
Lectures : 03 Hr/week
Tutorial : 01 Hr/week
Credit : 04

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Electrical Measurement, Signal and System

Course Objectives

1. Students will able to know different basic concepts and components of a control system..
2. Students will able to model physical systems mathematically.
3. Students will able to derive transfer functions of basic control system components.
4. Students will able to perform stability analysis using time domain and frequency domain response on a given system.
5. To learn the various approach for the state space analysis.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the basic concepts of control system and derive the mathematical model of different type of the systems.	L2	Understand
CO2	Solve transfer function for a given control system using block diagram reduction techniques and signal flow graph method.	L3	Apply
CO3	Determine time response of systems for a given input and perform analysis of first and second order systems using time domain specifications.	L4	Analyze
CO4	Analyze the stability of a system in the time domain using Routh-Hurwitz criterion and Root-locus technique.	L4	Analyze
CO5	Analyse the stability of a system in the frequency domain using Nyquist and bode plots.	L4	Analyse
CO6	Solve various transfer functions of digital control system using state variable models.	L3, L4	Apply, Analyze

Course Contents

Unit-I Mathematical Modeling of Control Systems 8 Hrs.

Introduction: Concept of open and closed loop control system, Transfer Function: a) Concept of system: physical system, Physical model, Linear and nonlinear systems, Time variant and invariant system. b) Equations of physical systems (Mass-Spring-Dashpot system, R-L-C series and parallel circuit) transfer function, transfer function of DC servo motor – AC servo motor – synchro, transmitter and receiver.

Unit-II Block diagrams and Signal Flow Graphs 8 Hrs.

a) Block diagram, Block Diagram reduction, and Numerical examples. b) Signal flow graph; Masons gain formula for deriving overall transfer function of systems. Feedback characteristics of control system: Concept of negative and positive feedback, Sensitivity of the system to parameter variation, using negative and positive feedback.

Unit-III Time Domain Analysis and Stability of System 8 Hrs.

Time domain analysis: Typical test signals, Time domain specifications, Steady state response, Types of system, Steady state error constants and steady state error, Numerical examples, transient response, Numericals, Concept of stability.

Stability : Definition of stability, Routh - Hurwitz criterion. Definition of Root Locus, Construction of root locus, and Stability from root locus plots, Root counters, Effect of addition of poles and zeros on root locus plots.

Unit-IV Frequency domain analysis 8 Hrs.

Introduction to frequency response, Advantages of frequency domain analysis, Bode plots, Nyquist criterion, Relative stability from Nyquist criterion, Numericals. .

Unit-V State Space Analysis of LTI Systems 8 Hrs.

Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State Transition Matrix and it's Properties, concepts of controllability and observability.

Text books

1. K. A. Tsuhiko Ogata, "Modern Control System Engineering", Prentice Hall, 5th Edition, 2010.
2. I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 6th Edition, 2017.
3. R. Anandanatrajan and P. Ramesh Babu, "Control Systems Engineering", Scitech Publication,3rd Edition, 2011

4. R. V. Jalgaonkar, Sisir Mazumder, "Feedback Control System", Everest Publishing House, Kolkata, 12th Edition, 2004.

Reference Books

1. B. C. Kuo, "Automatic Control System", Wiley India, 8th Edition, 2003.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control System", Pearson Education, 12th Edition, 2011.
3. D. Roy Choudhary, "Modern Control Engineering", PHI Learning Pvt. Ltd., 2005
4. B. Wayne Bequette, "Process Control: Modeling, Design and Simulation", PHI, 2003.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Tutorial

Minimum eight tutorials shall be conducted.

Control System Laboratory (PCEE6010L)

Teaching Scheme
Practical : 02 Hr/week
Credit : 01

Examination Scheme
Teacher Assessment : 25
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisites: Electrical Measurement, Signal and System, MATLAB fundamentals.

Course Objectives

1. Students will able to understand the performance of basic electrical control system components.
2. Students will able to explain the basic mathematical modeling of control system.
3. Students will able to understand and be able to use the MATLAB tool for control system.
4. Students will able to demonstrate the time domain and frequency domain analysis for linear time invariant systems.
5. Students will able to construct Simulink model for given system.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To study the basic electrical components of control system.	L2	Understand
CO2	To understand and apply the basic mathematical modelling concept of control system.	L2, L3	Understand, Apply
CO3	Demonstrate the response of first order and second order systems with various standard test signals.	L3	Apply
CO4	To Analyze the transfer function and examine the stability of the control system using various methods	L4	Analyze
CO5	Outline the effect of various types of inputs applied to a system for open loop and closed loop system	L3	Apply
CO6	Demonstrate and Analyse the system analysis using MATLAB and SIMULINK tools	L3, L4	Apply, Analyze

List of the Experiments

Perform any 10 experiments from the following list of experiments **(4 - Hardware, 5 - Simulation and 1 - Innovative))**

1. To determine Speed-Torque characteristics of an ac servomotor.
2. To determine an error using Potentiometer.
3. Experimental analysis of D.C. Motor Position control System.
4. Obtain output vs input characteristics for synchro-transmitter and receiver.
5. Experimental analysis of Stepper Motor.
6. To determine time domain response of a second order systems for step input and obtain performance parameters by using Matlab
7. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability by using Matlab.
8. To plot a Bode diagram of an open loop transfer function by using Matlab.
9. To draw a Nyquist plot of an open loop transfer function and examine the stability of the closed loop system by using Matlab.
10. Construct a Simulink diagram to calculate the response of the Mass-Spring system.
11. Study the effect of addition of zeros to the forward path transfer function of a closed loop system.
12. Simulink based control system mini project.**(Innovation)**

Lab Tools: MATLAB

Reference Books

1. B. C. Kuo, "Automatic Control System", Wiley India, 8th Edition, 2003.
2. Richard C Dorf and Robert H Bishop, "Modern control system", Pearson Education, 12th edition, 2011.
3. D. Roy Choudhary, "Modern Control Engineering", PHI Learning Pvt. Ltd., 2005
4. B. Wayne Bequette, "Process Control: Modeling, Design and Simulation", PHI, 2003.
5. www.mathworks.com

Evaluation Scheme

Laboratory

Continuous Assessment (TA):

Laboratory work will be based on PCEE6010L and subject specific lab assignment/case study. The distribution of marks for term work shall be as follows:

- Performance in Experiments: 05 Marks
- Journal Submission: 05 Marks
- Viva-voce: 05 Marks
- Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

Power Electronics (PCEE6020T)

Teaching Scheme
Lectures : 03 Hrs./week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites:

1. Knowledge of semiconductor material, basic electronics, diode, BJT, UJT, FET and its characteristics.
2. Working of Diode based rectifier, concept of RMS and average value.
3. Use square notebooks for notes and plotting of waveforms.

Course Objectives

1. Students will able to extend simple power electronic converters to realize rectifiers and inverters.
2. Students will able to develop and quantify common performance objectives for power electronic circuits such as efficiency, power factor, etc.
3. Students will able to analyze and design DC-DC converter (chopper) circuits.
4. Students will able to analyze and evaluate the operation of cyclo-converters and voltage controllers.
5. Students will able to outline operating principles of application of power electronic circuits as motor drives, UPS systems, etc.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To apply the basic principle, characteristics and applications of power electronic and switching devices.	L3	Apply
CO2	To analyze study of different types of Power Converter systems.	L4	Analyze
CO3	To evaluate the numerical problems on semiconductor switches, rectifier, converter, inverter, choppers and cycloconverter, circuits.	L5	Evaluate
CO4	To analyze the DC-DC and DC-AC converters	L4	Analyze
CO5	To apply various Pulse Width Modulation Techniques.	L3	Apply

Course Contents

Unit-I Power Semiconductor Devices 8 Hrs.

BJT, MOSFET, IGBT: Construction, working, Steady state, Switching Characteristics, Ratings and applications.

Thyristor: V-I, dynamic and gate Characteristics, Turn ON Methods, Ratings, R, R-C, UJT firing circuits, Protection Circuits, Commutation Techniques. **GTO Thyristor:** Construction, Working and Application, TRIAC- four mode operation, triggering of TRIAC using DIAC, SITH.

Unit-II Single and Three Phase AC-DC Converter 8 Hrs.

Single phase Converter: Fully controlled converter, Half controlled converter (Semi converter): Operation of all converters with R and RL load, derivation of Average and RMS output voltage, power factor, THD, TUF. Single phase dual converter.

Three phase Converter: Fully controlled converter, Half controlled converter (Semi converter)-Operation of all converters with R, RL load, derivation of Average and RMS output voltage, Three phase dual converter.

Unit-III DC-DC Converter 8 Hrs.

Classification of choppers, Basic Chopper operation: Step up and step down , types of chopper circuits and their operation: Class A, B,C,D and E, Chopper control techniques: Time ratio control, current limit control, Thyristor Chopper Circuits: Voltage, current, load commutated chopper, Series Turn OFF , Single SCR Chopper, Morgan and Jones Chopper Multiphase Choppers, AC Chopper.

Unit-IV DC-AC and AC-AC Converter 8 Hrs.

DC-AC Converter: Single phase inverters- series, parallel and bridge configurations with R load, PWM inverters. Three phase inverters: 120° and 180° conduction with R and load RL, voltage control methods, PWM Techniques and harmonic reductions.

AC Voltage Regulator: Single phase AC Voltage regulator; operation with R and RL Load, derivation of Average and RMS output voltage. Concept of two stage AC voltage regulator.

Cyclo-Converters: single phase and three phase Cyclo-Converters.

Unit-V Applications of Power Electronic 8 Hrs.

UPS and SMPS, Smart Grid, Micro Grid, Energy Storage and Management systems, Hybrid Electric Vehicle, Solar Energy Systems.

Text Books

1. Dr. P. S. Bimbhra, "Power Electronics", Khanna Publishers, Reprint, 2017.
2. Deodatta Shingare, "Industrial and Power Electronics", Electrotech Publication, 2nd Edition, 2004.
3. Mohan, Undeland and Robins "Power Electronics, Converter Applications and Design", John Wiley and Sons, 4th Edition, 2017.

4. M. H. Rashid, "Power Electronics, Circuits, Devices and Applications", Pearson Education, 4th Edition, 2017.

5. Ashfaq Ahmed, "Power Electronics for Technology", Pearson Education, 1998.

6. K. Hari Babu, "Power Electronics", Scitech Publication, Revised Edition, 2009.

Reference Books

1. Vedam Subramanyam, "Power Electronics", New Age International Publication, Revised 2nd Edition, 2006.

2. P. C. Sen, "Power Electronics" , Tata McGraw-Hill Publications, 2017.

3. M. D. Singh and K. B. Khanchandani, "Power Electronics", Tata McGraw-Hill, Revised 2nd Edition, 2017.

4. Dubey, Donalda, Joshi, Sinha, "Thyristorised Power Controllers", New Age International Publication, 2012.

5. B. K. Bose, "Modern Power Electronics and A. C. Drives", Pearson Education, 2015.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Power Electronics Laboratory (PCEE6020L)

Teaching Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisites: Basic knowledge of Electrical and Electronics engineering, analog and Digital electronics.

Course Objectives

1. The Student will able to understand the study different power electronic devices.
2. Students will able to extend simple power electronic converters to realize rectifiers and inverters.
3. Students will able to develop and quantify common performance objectives for power electronic circuits such as efficiency, power factor, etc.
4. Students will able to analyze and design DC-DC converter (chopper) circuits.
5. Students will able to analyze and evaluate the operation of cyclo-converters and voltage controllers.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Learner will be able to understand the basic principle, characteristics and applications of power electronic and switching devices.	L2	Understand
CO2	Learner will be able to analyze study of different types of Power Converter systems.	L3	Analyze
CO3	Learner will be able to solve the numerical problems on semiconductor switches, rectifier, converter, inverter, choppers and cycloconverter, circuits.	L3	Apply
CO4	Learner will be able to simulate DC-DC and DC-AC converters	L4	Analyze
CO5	Learner will be able to apply PWM technique	L3	Apply

List of the Experiments

Perform each 05 experiments from **Group A** and **Group B** in the following list of experiments. **(Compulsory one innovative experiment)**

Group:- A (Hardware or Trainer Kits)

1. Study and Plot the V-I Characteristics of SCR and MOSFET.
2. Study and perform a SCR Gate Triggering using UJT Relaxation Oscillator.
3. Study the turn off methods of SCR (Forced Commutation)
4. Perform the single phase semi converter with R , R-L Load.
5. Perform the single phase full converter with R , R-L Load.
6. Perform the three phase full converter with R , R-L Load.
7. Study and Perform the SCR Step down Chopper circuit.
8. Study of three phase inverter (VSI).
9. Three phase voltage source inverter using 120 and 180 degree mode.
10. Single phase A.C. voltage regulator with R and RL load

Group:-B (MATLAB Simulations)

1. MATLAB Simulation of Single Phase Half wave Controlled Rectifier with R and R-L Load.
2. MATLAB Simulation of Single Phase Full wave Controlled Rectifier with R and R-L Load.
3. MATLAB Simulation of Step up chopper circuit.
4. MATLAB Simulation of Step down chopper circuit.
5. MATLAB Simulation of Single phase full bridge inverter.
6. MATLAB Simulation of Three phase 180 degree conduction mode of inverter.
7. MATLAB Simulation of AC Voltage Controller.
8. MATLAB Simulation of Step up Cyclo-Converter circuit.
9. MATLAB Simulation of Solar Power Generation for Home **(Innovative)**
10. MATLAB Simulation of Phase Locked Loop(PLL) for 3 phase grid connected inverter. **(Innovative)**

Text Books

1. Dr. P. S. Bimbhra, "Power Electronics", Khanna Publishers, Reprint, 2017.
2. Deodatta Shingare, "Industrial and Power Electronics", Electrotech Publication, 2nd Edition, 2004.
3. Mohan, Undeland and Robins "Power Electronics, Converter Applications and Design", John Wiley and Sons, 4th Edition, 2017.
4. M. H. Rashid, "Power Electronics, Circuits, Devices and Applications", Pearson Education, 4th Edition, 2017.
5. Ashfaq Ahmed, "Power Electronics for Technology", Pearson Education, 1998.
6. K. Hari Babu, "Power Electronics", Scitech Publication, Revised Edition, 2009.

Reference Books

1. Vedam Subramanyam, "Power Electronics", New Age International Publication, Revised 2nd Edition, 2006.
2. P. C. Sen, "Power Electronics" , Tata McGraw-Hill Publications, 2017.
3. M. D. Singh and K. B. Khanchandani, "Power Electronics", Tata McGraw-Hill, Revised 2nd Edition, 2017.
4. Dubey, Donalda, Joshi, Sinha, "Thyristorised Power Controllers", New Age International Publication, 2012.
5. B. K. Bose, "Modern Power Electronics and A. C. Drives", Pearson Education, 2015.

Evaluation Scheme

Laboratory

Continuous Assessment (TA):

Laboratory work will be based on PCEE6020L and subject specific lab assignment/case study. The distribution of marks for term work shall be as follows:

- Performance in Experiments: 05 Marks
- Journal Submission: 05 Marks
- Viva-voce: 05 Marks
- Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

Electrical Machine Design (PCEE6030T)

Teaching Scheme
Lectures : 03 Hrs./week
Tutorial : 01 Hr./Week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites:

1. Knowledge of Electrical Machine-I, Electrical Machine-II.
2. Knowledge of fundamentals of electrical engineering.
3. Knowledge of various materials used in electrical machines.

Course Objectives

1. To present the properties of Electrical Engineering material.
2. Design of transformer based on specifications.
3. Determine performance based on the parameters of transformer.
4. Determine performance based on the parameters of Induction motor.
5. Apply computer aided design techniques to transformer and induction motor design.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To apply knowledge of mathematics, science, and engineering for design of electrical machines.	L3	Apply
CO2	To understand the electrical engineering material characteristic for designing an energy efficient electrical machine.	L2	Understand
CO3	To analyze the temperature rise in electrical machines and impact on rating and duty of machines.	L4	Analyze
CO4	To analyze and design an electrical machines and components to meet desired needs within realistic constraints such as economic, environmental, social, safety, manufacturability, and sustainability.	L4	Analyze
CO5	To apply Discharge duties in the field of design and manufacturing industries and able to do higher studies in optimal design and use latest software and engineering tools.	L3	Apply

Course Contents

Unit-I Fundamental Aspects of Electrical Machine Design 8 Hrs.

Design of machines: Design factors - Limitations in design - modern trends in Design of Electrical machines, Materials used in Transformers and Rotating Machines. Thermal Design aspects of Electrical machines. Design of Starters-Shunt Motors, Series Motor, Slip ring induction motor.

Unit-II Design of Transformer 8 Hrs.

Design of distribution and power Transformer,-types, Classifications, specifications, core construction, transformer winding, design of Transformer, output equation of single phase and three phase transformer , design of core, winding, overall dimension ,design of insulation, estimation of leakage reactance for H.V. and L.V. winding.

Unit-III Design Performances of Transformer 8 Hrs.

No Load Current of –single phase, Three phase, Magnetizing Volt-ampere, change of Parameters with change of frequency, Temperature rise of transformers , design of tank with tubes, transformer oil as a cooling medium, temperature rise in plain walled tanks, ,air blast cooling, forced oil circulation , thermal rating , heating time constant of transformers.

Unit-IV Design of Induction motors 8 Hrs.

Rating and dimensions of rotating Machines:symbols, factor affecting size of rotating machines, choice of specific magnetic loading , choice of specific electric loading , variation of output and losses with Linear dimensions , separation of D and L d.c. Machines, Induction Motors, Synchronous Machines, standard Frames.

Design of three phase Induction Motors: design output equation, choice of average flux density in air gap, choice of ampere conductors per meter, efficiency and power factor, main dimensions.

Unit-V Design of Windings for AC and DC Machines 8 Hrs.

D.C. Machine Windings: Types of D.C. Windings, choice and design of simplex and duplex lap and wave Windings, equalizer connections, dummy coils, concept of multiplex Windings, reason for choosing them. A.C. Machine Windings- single and double layer, single phase ac Windings with integral and fraction slots, three phase Windings.

Text Books

1. G. Upadhyay, "Design of Electrical Machines", New Age International Publication, 2011.
2. Deshpande. M. V., "A Course in Electrical Machine Design", Prentice Hall of India, 2011.
3. S. K. Sen "Principles Of Electrical Machine Design With Computer Programs", Oxford & IBH Publishing Company Pvt. Limited, 2nd Edition, 2006.

Reference Books

1. A. K. Sawhney, "Electric Machine Design", Danpat Rai and Sons, 10th Edition, 2016.
2. A. E. Clayton, "Performance and Design of DC Machine", ELBS, ISAAC Pitman Sons, 3rd Edition, 2004.
3. S. V. Kulkarni, S. A. Khaparde , "Transformer Engineering: Design and Practice", Marcel Dekker Inc., 2004.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Electrical Machine Design Laboratory (PCEE6030L)

Teaching Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisites: Basic knowledge of Electrical Machine-I and II.

Course Objectives

1. To understand the basic symbols used in electrical machine design..
2. To study about wiring diagram of residential buildings.
3. To design the starters for DC Motors.
4. To design AC machines winding.
5. To design a transformer based on various specification.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To understand the basics of electrical machine design.	L2	Understand
CO2	To design and calculate the main dimensions of single phase and three phase transformer.	L3	Apply
CO3	To analyze and design the main dimensions of three phase Induction motor.	L4	Analyze
CO4	To apply computer aided optimization techniques for design of electrical machines.	L3	Apply
CO5	To design and analyze electrical machines using finite element based software.	L3	Apply

List of the Experiments

Perform 8 experiments from the following list of experiments. (8– Hardware, 2 – Simulation and 1 – Innovative

1. To study General electrical symbol.
2. To study Electrical installation for residential building.
3. To study Design of Dc shunt motor starter.
4. To study Design of simplex lap winding.
5. To study Design of wave winding.
6. To study Design of ac lap winding.
7. To study design of Mush winding.
8. To study Design of ac wave winding.
9. Details and assembly of transformer with design report. (in CAD)
10. Assembly of three phase induction motor. (Sheet in CAD.
11. Report based on induction motor manufacturing/repairing unit.

Text Books

1. G. Upadhyay, "Design of Electrical Machines", New Age International Publication, 2011.
2. Deshpande. M. V., "A Course in Electrical Machine Design", Prentice Hall of India, 2011.
3. S. K. Sen "Principles Of Electrical Machine Design With Computer Programs", Oxford & IBH Publishing Company Pvt. Limited, 2nd Edition, 2006.

Reference Books

1. A. K. Sawhney, "Electric Machine Design", Danpat Rai and Sons, 10th Edition, 2016.
2. A. E. Clayton, "Performance and Design of DC Machine", ELBS, ISAAC Pitman Sons, 3rd Edition, 2004.
3. S. V. Kulkarni, S. A. Khaparde , "Transformer Engineering: Design and Practice", Marcel Dekker Inc., 2004.

Evaluation Scheme

Laboratory

Continuous Assessment (TA):

Laboratory work will be based on PEEE5052L and subject specific lab assignment/case study. The distribution of marks for term work shall be as follows:

- Performance in Experiments: 05 Marks
- Journal Submission: 05 Marks
- Viva-voce: 05 Marks
- Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of labo-ratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

Testing and Maintenance of Electrical Equipment (PCEE6040T)

Teaching Scheme
Lectures : 03 Hrs./week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Knowledge of DC and AC machines, Electrical Power System.

Course Objectives

1. The Student will able to understand the importance of testing, concept of electrical safety, electrical accidents, its causes, and prevention.
2. Students will able to know various testing of single phase, three phase induction motor.
3. Students will able to know various testing of transformer and synchronous motor.
4. Students will able to know insulation material testing, routine, preventive and breakdown maintenance of electrical machines.
5. Students will able to understand troubleshooting of electrical equipment's.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the importance of testing and an electrical safety while working in plants.	L2	Understand
CO2	Apply the various testing of induction motor like routine, type, special and supplementary test.	L3	Apply
CO3	Apply the various testing of transformer, Synchronous motor and insulation like routine, type, special and supplementary test.	L3	Apply
CO4	Analyze the various testing parameters of stationary and rotating machines like voltage, current, power, speed, torque, regulation, efficiency etc.	L4	Analyze
CO5	Analyze the trouble shooting in an electrical machine like failure, causes and remedies of an electrical machines.	L4	Analyze

Course Contents

Unit-I Importance of Testing and Safety Measures 8 Hrs.

Importance of Testing : Objectives of testing, Significance of ISS, concept of tolerance, routine test, type test, special test , Method of testing

Safety Measures and Prevention of Accidents: Concept of Electric Safety, Electric Accidents , its causes and Preventions, IE act and statutory regulations for safety of persons and equipments working with Electrical Installation, Electric Shock, Necessity and types of earthing systems.

Unit-II Testing of Induction Motor 8 Hrs.

Three Phase Induction motor testing : Insulation resistance test , High Voltage test, No load test, Blocked rotor test, reduced voltage running up test, Slip measurement, method of loss separation, temperature rise testing, momentary overload test

Single Phase Induction motor testing : Insulation resistance test, Winding Resistance, High Voltage test, No load test, Blocked rotor test, Quiet Running Test, Temperature Rise test, momentary overload test, Load test, Moisture Proofness Test, Leakage Current Test, Pull out Torque Test

Unit-III Testing of Transformer and Synchronous Motor 8 Hrs.

Transformer Testing: DC resistance measurement, Polarity and Phasing out test, open circuit test, short circuit test, vector group test, magnetic balance test, Insulation resistance test

Synchronous Motor Testing: open and short circuit test, Over Speed test, high voltage test, Dark Lamp Method of Synchronizing, zero factors test, loss measurement test, Voltage Recovery test, Retardation Test.

Unit-IV Insulation Testing and Maintenance 8 Hrs.

Testing of Insulating Material: Megger Test, testing of transformer oil as per IS 1692: flash point test, crackle test, dielectric strength test, acidity test.

Maintenance of Electric Machines: Procedure for developing preventive maintenance schedule, factors affecting preventive maintenance schedule, total productive maintenance, causes of failure of electric machines (internal and external), maintenance schedule of transformer (low and high capacity), induction motor, synchronous machines and batteries as per IS.

Unit-V Trouble Shooting of Electrical Machines 8 Hrs.

Failure and Causes in Electrical Machines:-Internal and External causes for failure and abnormal operation of equipment's, Electrical Equipment's Fault: Mechanical, Electrical, Magnetic, Faults in cables, transformer and induction motor, troubleshooting charts for DC Machines, Induction Motor, Transformer.

Reference Books

1. Sunil S. Rao, "Testing, Commissioning, Operation and Maintenance of Electrical Equipment", Khanna Publishers, 6th Edition, 1991.
2. Philip Kiameh, "Electrical Equipment Handbook: Troubleshooting and Maintenance", McGraw Hill, 2003.
3. Indian Standards (IS Code) and IEEE Standards for Installation, Maintenance and Commissioning of Electrical Equipments/Machines

Text Books

1. Singh Tarlok, "Installation, Commissioning and Maintenance of Electrical Equipment", S. K. Kataria and Sons, 2013.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Energy Audit and Management (PEEE6061T)

Teaching Scheme
Lectures : 03 Hrs./week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Knowledge of power system , power system operation and control.

Course Objectives

1. The Student will able to understand the need of energy audit and conservation , social and environmental cause as per Energy conservation Act.
2. Students will able to know the methodology of energy audit for industries and priority of action plan.
3. Students will able to understand the financial analysis for energy audit like payback period.
4. Students will able to understand scope demand side management, energy efficient motor and energy conservation in motors, lighting, furnace and refrigeration.
5. Students will be able to use the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand facts, concepts, principles of energy management and conservation in view of social and environmental cause.	L2	Understand
CO2	Apply basic knowledge of science and mathematics and engineering in energy conservation and financial.	L3	Apply
CO3	Apply Knowledge of electrical subjects for demand side management for sustainable economic deployments, social and environmental issues as life long practices	L3	Apply
CO4	Analyze the characteristics, process of operation in manufacturing, agricultural and transportation sectors to arrive fruitful suggestions for possible energy conservation.	L4	Analyze
CO5	Apply the basic principles and methodologies adopted in energy audit of any utility.	L3	Apply

Course Contents

Unit-I Energy Management 8 Hrs.

Concept of energy management -energy inputs in industrial, residential, commercial, and agricultural and public sector management of power factor, power factor improvement, power demand monitoring. Concept of demand side management (DSM), scope of DSM, DSM planning and implementation ,load management as DSM strategy Advantages of DSM to consumers, utility and society.

Unit-II Economics of Energy Conservation 8 Hrs.

Simple payback period analysis, advantages and limitations of payback period, time value of money, net present value method and internal rate of return method, Risk and sensitivity analysis, Financing options, Micro factors and macro factor Study and selection of proper tariff for particular application, fixed and variable components in tariff, impact of tariff on energy management.

Unit-III Energy Conservation 8 Hrs.

Motive power: potential for saving electrical energy in motors - over sizing or under loading, improving efficiency of an existing motor, energy efficient motors, use of variable or adjustable speed drives for energy conservation, effect of rewinding on performance and consumption. Lighting: level of illumination for different areas. Use of right source of lamp for different applications, energy efficient lamps, type of light fixtures. Heating and Cooling systems: energy saving in furnace, air conditioners and refrigeration.

Unit-IV Scope of Conservation 8 Hrs.

1. Energy conservation in industrial, agricultural, commercial, domestic and municipal sectors.
2. Energy conservation in generation, Co-generation, Waste heat recovery
3. Energy conservation in transmission and distribution

Unit-V Energy Audit 8 Hrs.

Need and concept of energy audit, pre-requisite of energy conservation, principles of energy audit, type and methodology of energy audit: preliminary energy audit and detailed energy audit, procedures of carrying out energy audit. Identification of energy conservation opportunities and priority, energy audit report writing, Instruments used for energy audit. Energy Conservation Act, Progress made in energy conservation in India.

Text Books

1. Sivaganaraju, S, "Electric Energy Generation, Utilisation and Conservation", Pearson Education, 2011.
2. H. Partab, "Art and Science of Utilization of Electrical Energy", Dhanapat Rai and Sons, 2006.
3. "Fundamentals of Electrical System" , Bureau of Energy Efficiency
4. Dr. Sanjeev Singh, Umesh Rathore, "Energy Management", S. K. Kataria and Sons, 201

Reference Books

1. S. C. Tripathy, "Electrical Energy Utilization and Conservation", Tata McGraw Hill, 1991.
2. S. Rao, "Energy Technology"' Khanna Publishers, 2010.
3. B. E. Kushare, "Hand Book on Energy Efficient Motors" , International Cooper Proposition Council.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Industrial Automation and Control (PEEE6052T)

Teaching Scheme
Lectures : 03 Hr/week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Transducers, Control System, Digital Electronics.

Course Objectives

1. To understand the automation process and its level.
2. To understand the advance control systems.
3. To apply the ladder logic for the PLC programming.
4. To understand and apply PLC for automation of industrial processes.
5. To understand the SCADA system.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the concept of automation, its terminology and basic communication protocol.	L2	Understand
CO2	Understand the special control structures.	L2	Understand
CO3	Learn about PLC, its operation and function application in automation	L2	Understand
CO4	Apply knowledge of PLC for automation in industrial application.	L3	Apply
CO5	Understand the actuators and SCADA system in industrial automation.	L2	Understand

Course Contents

Unit-I Introduction to Industrial Automation and Control 8 Hrs.

Architecture of Industrial Automation Systems, Role of automation Industry, Product life cycle, types of production system, types of automation system, Introduction to sensors and measurement systems. Overview of sensors used in automation industry.

Unit-II Process Control 8 Hrs.

Introduction to Process Control: Proportional, Integral, Derivative, Proportional-Derivative, Proportional-Integral, and Proportional Integral Derivative Controller, Controller Tuning. Implementation of PID Controllers.

Special Control Structures: Feed forward and Ratio Control. Predictive Control, Control of Systems with Inverse Response, Cascade Control, Overriding Control, Selective Control, Split Range Control

Unit-III Programmable Logic Controllers 8 Hrs

Ladder diagram examples, interlocking, latching, inter dependency and logical functions, PLC Timer and Counter functions on-delay timer, off-delay timers, retentive on-delay timers, pulse timers, timer examples, up-counter, down-counter and up-down counter, counter examples, register basics.

Unit-IV PLC Programming 8 Hrs

Ladder diagram, STL, functional block diagram, creating ladder diagram from process control descriptions, introduction to IEC61131 international standard for PLC, Case study of PLC in different industry.

Unit-V Introduction to Actuators and SCADA 8 Hrs.

Electrical Actuators: Solenoids, Relays and Contactors, AC Motor, energy conservation schemes through VFD, DC Motors, Servo Motor, Pneumatic and hydraulic actuators.

Hydraulic Actuators: Flow Control Valves. Hydraulic Actuator Systems, Principles, Components and Symbols, Hydraulic Actuator Systems: Pumps and Motors, Proportional and Servo Valves.

Introduction to SCADA: Elements of SCADA, Features of SCADA, MTU, RTU Functions, Applications of SCADA, Communications in SCADA,

Text books

1. Madhuchhanda Mitra, Samarjt Sengupta, "Programmable Logic controllers and Industrial Automation", Penram International Publishing India Pvt. Ltd, 2nd Edition, 2017.
2. Gary Dunning, "Introduction to Programmable Logic Controllers ", Cengage Learning, 3rd Edition, 2007.
3. W.Boldon, "Programmable Logic Controllers", Elsevier India Pvt. Ltd., New Delhi, 5th Edition, 2011.

Reference Books

1. Parr, "Programmable Controllers: An Engineers Guide", 3rd Edition, Elsevier, Indian Reprint, 2013.
2. John R Hackworth and Fredrick D Hackworth Jr., "Programmable Logic Controllers: Programming Methods and Applications", 1st Edition, Pearson Education, 2015.
3. Webb J.W, "Programmable controllers: Principle and Applications", 5th Edition, PHI New Delhi, 1999.
4. Liptak B. G, "Process Control Handbook", vol-2, CRC Press, 3rd Edition, 2018.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Electric Mobility (PEEE6053T)

Teaching Scheme
Lectures : 03 Hr/week
Credit : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Basic concept of Batteries, Electrical Motors, Power Electronics.

Course Objectives

1. To make students understand the need & importance of Electric & Hybrid Electric vehicles.
2. To differentiate and analyze the various energy storage devices.
3. To impart the knowledge about architecture and performance of Electric and Hybrid Vehicles.
4. To study the different Charging standards used for electric vehicles.
5. To classify the different drives and controls used in electric vehicles.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the concepts of Hybrid and Electric vehicles.	L4	Analyze
CO2	Describe the different types of energy storage systems and battery charging systems.	L2, L3	Understand, Apply
CO3	Classify the different mode of operation for hybrid vehicle.	L2, L3	Understand, Apply
CO4	Apply the different Charging standards used for electric vehicles.	L3	Apply
CO5	Differentiate between Vehicle to home and Vehicle to grid concepts.	L3	Apply

Course Contents

Unit I Introduction to Hybrid and Electric Vehicles 7 Hrs.

Need and importance of Electric Vehicle and Hybrid Electric Vehicles, Environmental importance of Hybrid and Electric vehicles. Hybrid Electric vehicles: Concept and architecture of HEV drive train (Series, parallel and series-parallel). Micro Hybrid, Mild Hybrid, Full Hybrid, Plug-in Hybrid, Electric vehicles: Components, configuration, performance, tractive effort, Advantages and challenges in EV.

Unit II Energy Storage Systems and Battery Management Systems 9 Hrs.

Energy Storage Systems : Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery specifications, Battery based energy storage and its analysis, Classification of lithium-ion batteries, Aluminum Air and Aluminum ion battery. Fuel Cell based energy storage, Super Capacitor based energy storage.

Battery Management Systems: Introduction: Different Charging algorithms and Charging method, Cell Balancing methods. Battery Management System: Functions of BMS, Block diagram of BMS, SoC Estimation methods, Thermal Management of Battery.

Unit III Hybrid Power Train and Mode of Operation 8 Hrs.

Control Strategies and Design of the Major Components: Series and Parallel Hybrid Electric Drive Train. Energy Consumption in Braking, Braking Power and Energy on Front and Rear Wheels, Brake System of EVs and HEVs, Regenerative braking

Unit IV Drives and Charging Infrastructure 8 Hrs.

Selection of drives for Electric vehicle: PMSM drive and BLDC drive, Sizing of motor, Charging Levels: 01,02 and 03, Charging Standards: CCS, CHAdeMO, SAE J1772, IEC 60309, Bharat DC 001,Bharat AC 001, Electric Vehicle Supply Equipment (EVSE).

Unit V Vehicle to Home, Vehicle to Vehicle and Vehicle to Grid 8 Hrs.

Vehicle to Home: Introduction, applications, V2H with demand response, Case Study of V2H.

Vehicle to Grid: Introduction of V2G, V2G infrastructure in the smart grid, Role of aggregator for V2G, Case study of V2G.

Vehicle to Vehicle: Introduction of V2V, Concept & structure.

Text Books

1. James Larminie and John Lowry, "Electrical Vehicle", John Wiley & Sons, 2nd Edition, 2012.
2. Ronald K. Jurgen, "Electric and Hybrid-Electric Vehicles",SAE International Publisher,2011 .
3. K T Chau, "Energy Systems for Electric and Hybrid Vehicles", The institution of Engineering and Technology Publication, 2016.

4. D.A.J Rand, R Woods & R M Dell, "Batteries for Electric Vehicles", Research studies press Ltd, New York, John Willey & Sons

Reference Books

1. Mehrdad Ehsani, Yimin Gao and Ali Emadi, "Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and design", CRC Press, 2009.
2. Junwei Lu & Jahangir Hossain et al (eds), "Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", IET Digital Library,2015.
3. Tom Denton, "Automobile Electrical and Electronic systems", SAE International publications, 5th Edition, 2017.
4. C.Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2nd Edition, 2017.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best performance among the two Term Tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Project Stage- I (PJEE6060L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 02

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. To implement the solution as per the problem statement.
2. To develop the team building, writing, logical reasoning and management skills.
3. To provide the connections between the designs and concepts across different disciplinary boundaries.
4. To encourage students to become independent personnel, critical thinkers and lifelong learners.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply engineering knowledge to produce solution of a problem considering cultural, social, environmental, and economic factors using appropriate tool and method.	L4	Analyze
CO2	Demonstrate project based learning that allows students to transfer existing ideas into new applications.	L2	Understand
CO3	Develop an ability to work in teams and manage the conduct of the research study.	L3	Apply
CO4	Integrate different perspectives from relevant disciplines which help them to get internships, jobs and admission for higher studies.	L3	Apply
CO5	Present the research in the form of technical writing, understand what constitutes to plagiarism and how to use proper referencing styles.	L2	Understand

PLC Simulation Laboratory (PEEE6070L)

Teaching Scheme
Practical : 02 Hr/week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisites: Transducers, Control System, Digital Electronics

Course Objectives

1. To understand the use of PLC automation in industry.
2. To understand the ladder logic in PLC programming.
3. To apply the knowledge of ladder programming for timer based application.
4. To apply the knowledge of ladder programming for counter based application.
5. To apply and design the basic electrical industrial application using PLC.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the ladder logic of implementation.	L2	Understand
CO2	Develop the ladder programming for arithmetic and logic operations	L6	Create
CO3	Develop the ladder programming for timers based operations.	L6	Create
CO4	Develop the ladder programming for counter based operations.	L6	Create
CO5	Design ladder logic of electrical based application.	L6	Create

- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Assessment criteria for the departmental committee (including project guide) for End Semester Exam: Each review consists of 25 marks. Average of the marks scored in both the two reviews will be considered for final grading. The final certification and acceptance of TW ensures the satisfactory performance on the below mentioned aspects.

Each group will be reviewed twice in a semester by faculty guide and faculty coordinator based on the following criteria:

- Project progress
- Documentation/Technical paper writing
- Key findings
- Validation of results
- Product Development

Table 4: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 5: Continuous Assessment Sheet

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 6: Evaluation Sheet

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Simulation/ Logic	PCB/ hardware/ programming	Result Verification	Presentation	Total
			5	5	5	5	5	25

Course Contents

PLC Operations

Basic Ladder logic, logic functions (AND, OR, NOT, NAND, and NOR functions), electrical wiring diagram, scan cycle.

Converting Relay schematics and Boolean equation into PLC Ladder Programs, Writing a ladder logic program directly from a narrative description.

PLC Ladder Programming

Programming languages for PLC, PLC module addressing, registers basics, basic relay instructions, timer-counter instructions, arithmetic functions, comparison functions, data handling, and data move functions, input-output instructions, sequencer instructions, Case studies.

List of the Experiments

Perform any 10 experiments from the following list of experiments

1. Introduction to ladder programming.
2. Implementation Logic Gates .
3. Implementation of Light ON/OFF control.
4. Object detection and controlling conveyor motor using ladder programming .
5. Implementation Of DOL Starter.
6. Implementation Of On-Delay Timer.
7. Implementation Of Off-Delay Timer.
8. Implementation Of Up-Down Counter.
9. Logic implementation for traffic Control Application .
10. Logic implementation for Bottle Filling Application.
11. Design a PLC program to control the liquid level in a tank.
12. Write the PLC programming for continues box filling operation that requires boxes moving on a conveyor to be automatically positioned and filled.

Design based Problems / Open Ended Problem:

- Speed measurement using counter
- DC motor control in both direction
- Level controller of underground and overhand tank.
- Servo motor control
- Automatic Stamping machine
- Automatic Drilling machine
- Automatic painting machine
- Four-way traffic light control
- Control of robotic arm

List of Open Source Software/learning website:
http://www.plcdev.com/book/export/html/9
http://www.plcmanual.com/
http://literature.rockwellautomation.com/
http://www.automation.siemens.com/
http://nptel.ac.in/video.php
http://ial-coep.vlabs.ac.in/List%20of%20experiments.html

Reference Books

1. Madhuchhanda Mitra, Samarjt Sengupta, "Programmable Logic controllers and Industrial Automation", Penram International Publishing India Pvt. Ltd, 2nd Edition, 2017.
   item Gary Dunning, "Introduction to Programmable Logic Controllers ", Cengage Learning, 3rd Edition, 2007.

2. W.Boldon, "Programmable Logic Controllers", Elsevier India Pvt. Ltd., New Delhi, 5th Edition, 2011.

3. Parr, "Programmable Controllers: An Engineers Guide", 3rd Edition, Elsevier, Indian Reprint, 2013.

4. John R Hackworth and Fredrick D Hackworth Jr., "Programmable Logic Controllers: Programming Methods and Applications", 1st Edition, Pearson Education, 2015.

5. Webb J.W, "Programmable controllers: Principle and Applications", 5th Edition, PHI New Delhi, 1999.

Evaluation Scheme

Laboratory

Continuous Assessment (TA):

Laboratory work will be based on PEEE5053L and subject specific lab assignment/case study. The distribution of marks for term work shall be as follows:

- Performance in Experiments: 05 Marks
- Journal Submission: 05 Marks
- Viva-voce: 05 Marks
- Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (ESE):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions

Environmental Engineering (MCEE6080T)

Teaching Scheme
Lecture : 01 Hr/week

Examination Scheme
Audit Course

Course Objectives

1. Understand environmental issues such as depleting resources, pollution, ecological problems and the renewable energy scenario.
2. Familiarise environment related legislation.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand how human activities affect environment.	L1	Remember
CO2	Understand the various technology options that can make a difference	L1	Remember

Course Contents

Unit-I Social Issues and Environment 4 Hrs.

Ecological footprint and Carrying Capacity, Depleting nature of Environmental resources such as soil, water minerals and forests ,Carbon emissions and Global Warming.

Unit-II Directive Principles of State Policy 4 Hrs.

Technological growth for Sustainable Development: Social, Economic and Environmental aspects of Sustainable Development, Renewable Energy Harvesting ,Concept of Carbon credit, Green Building ,Power and functions of Central Pollution Control Board and State Pollution Control Board.

Unit-III Environmental impact due to technology 5 Hrs.

Environmental impact due to technology: Impact of Energy on Environment, Flow of Energy in Ecological system, Environment Degradation due to Energy, Control of pollution from Energy, Consumer-electronics, power saving devices, energy from waste, energy use and conservation.

Text books

1. R. Rajagopalan, "Environmental Studies From Crisis to Cure",Generic; 3rd edition, 2015.
2. Erach Bharucha, "Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education",Orient Blackswan Pvt Ltd, 3rd Edition, 2019 .
3. I.V Murali Krishna, Valli Manickam, Anil Shah, Naresh Davergave, "Environmental Management Science and Engineering for Industry", Butterworth-Heinemann, 2017.

Evaluation Scheme

1. Student should submit a report on the case study declared by teacher.
2. Audit point shall be awarded subject to submission of report of the case study declared by teacher.