Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure

Final Year B. Tech. (Electrical Engineering)

with effect from Academic Year 2023-24

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph. No.: 02563 259 802, web: www.rcpit.ac.in

Vision of the Institute

To become a leading Institute in Technical education fostering innovation, research, ethical values, and sustainable development for the betterment of society.

Mission of the Institute

To impart high quality Technical Education through:

- **M1:** Innovative and Interactive learning process and high quality, globally recognized instructional programs.
- **M2:** Fostering a collaborative scientific temper among students with ethical responsibility towards the society.
- **M3:** Preparing students from diverse backgrounds to have aptitude for employment, entrepreneurship and research with a spirit of professionalism.
- **M4:** To contribute to the nation's sustainable development.

Vision of the Electrical Engineering Department

To produce competent Electrical Engineers committed to innovation, sustainability and service to society.

Mission of the Electrical Engineering Department

- **M1:** Deliver innovative, interactive learning fostering excellence in Electrical Engineering and emerging technologies.
- **M2:** Cultivate scientific inquiry, ethical responsibility, and interdisciplinary collaboration to address energy, automation, and societal challenges.
- **M3:** Empower diverse students with skills for employment, entrepreneurship, and research, nurturing professionalism and lifelong learning.

Program Educational Objectives

The educational objectives of the Undergraduate Programmes of Electrical Engineering are:

- **PEO1:** Graduates will apply electrical engineering knowledge and innovation to solve complex industrial and societal problems.
- **PEO2:** Graduates will demonstrate ethical leadership and collaborate across disciplines to promote sustainable and inclusive development.
- **PEO3:** Graduates will pursue careers in employment, entrepreneurship, or research, embracing professionalism and lifelong learning.

Final Year B. Tech. Electrical Engineering Semester-VII (with effect from 2023-24)

S. N.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme						Credits	
							Continuous Assessment (CA)				ESE	Total		
				L	T	P	TA	Term Test-I (TT-I)	Term Test-II (TT-II)	Average of TT-I and TT-II				
							[A]			[B]	[C]	[A+B+C]		
1	PC	PCEE7010T	Switchgear and Protection	3			20	15	15	15	65	100	3	4
	PC	PCEE7010L	Switchgear and Protection Laboratory			2	25				25	50	1	
2	PC	PCEE7020T	Electrical Drives and Control	3			20	15	15	15	65	100	3	4
	PC	PCEE7020L	Electrical Drives and Control Laboratory			2	25				25	50	1	
3	PE@	PEEE7031T	Power System Operation and Control	3			20	15	15	15	65	100	3	4
		PEEE7031L	Power System Operation and Control Laboratory			2	25				25	50	1	
		PEEE7032T	Electrical Power System Design	3			20	15	15	15	65	100	3	
		PEEE7032L	Electrical Power System Design Laboratory			2	25				25	50	1	
		PEEE7033T	High Voltage Engineering	3			20	15	15	15	65	100	3	
		PEEE7033L	High Voltage Engineering Laboratory			2	25				25	50	1	
		PEEE7034T	Computer Aided Power System Analysis	3			20	15	15	15	65	100	3	
		PEEE7034L	Computer Aided Power System Analysis Laboratory			2	25				25	50	1	
		PEEE7035T	Illumination Engineering	3			20	15	15	15	65	100	3	
		PEEE7035L	Illumination Engineering Laboratory			2	25				25	50	1	
4	OE#	OEEE7041T	Product Life Cycle Management	3			20	15	15	15	65	100	3	3
		OEEE7042T	Management Information System	3			20	15	15	15	65	100	3	
		OEEE7043T	Operations Research	3			20	15	15	15	65	100	3	
		OEEE7044T	Cyber Security and Laws	3			20	15	15	15	65	100	3	
		OEEE7045T	Personal Finance Management	3			20	15	15	15	65	100	3	
		OEEE7046T	Energy Audit and Management	3			20	15	15	15	65	100	3	
		OEEE7047T	Disaster Management and Mitigation Measures	3			20	15	15	15	65	100	3	
		OEEE7048T	Science of Well-being	3			20	15	15	15	65	100	3	
		OEEE7049T	Research Methodology	3			20	15	15	15	65	100	3	
		OEEE70410T	Public Systems and Policies	3			20	15	15	15	65	100	3	
5	PC	PCEE7050L	Electrical Engineering Simulation Laboratory			4	25				25	50	2	2
6	PJ	PJEE7060L	Project Stage-II			8	25				25	50	4	4
			Total	**12**		**18**	**205**			**60**	**385**	**650**		**21**

PC : Programme Core, PE : Programme Elective, OE : Open Elective, PJ : Project, @ Any 1 Programme Elective Course, # Any 1 Open Elective

Prepared by	Checked by	BOS Chairman	Dean Academic / Dy. Director	C.O.E.	Director
Dr. Y. K. Kirange	Dr. Nadeem Akhtar	Dr. S. A. Patil	Prof. Dr. P. J. Deore	Prof. S. P. Shukla	Prof. Dr. J. B. Patil

R. C. Patel Institute of Technology

Final Year B. Tech. Electrical Engineering Semester-VIII (with effect from 2023-24)

S. N.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme						Credits	
							Continuous Assessment (CA)				ESE	Total		
				L	T	P	TA	Term Test-I (TT-I)	Term Test-II (TT-II)	Average of TT-I and TT-II				
							[A]			[B]	[C]	[A+B+C]		
1	PE@	PEEE8011T	HVDC Transmission*	3			20	15	15	15	65	100	3	3
		PEEE8012T	EHVAC Transmission*	3			20	15	15	15	65	100	3	
		PEEE8013T	Restructured Power System*	3			20	15	15	15	65	100	3	
		PEEE8014T	Optimization Techniques*	3			20	15	15	15	65	100	3	
		PEEE8015T	NPTEL / SWAYAM Course#	3			20	15	15	15	65	100	3	
2	PE@	PEEE8021T	Computer Vision and Image Processing*	3			20	15	15	15	65	100	3	3
		PEEE8022T	DC Microgrid and Control Systems*	3			20	15	15	15	65	100	3	
		PEEE8023T	Power System Dynamics*	3			20	15	15	15	65	100	3	
		PEEE8024T	Emerging Trends in Electrical Engineering*	3			20	15	15	15	65	100	3	
		PEEE8025T	NPTEL / SWAYAM Course#	3			20	15	15	15	65	100	3	
3	INT	INTEE8030L	Internship			20	150				150	300	10	10
			Total	**6**		**20**	**190**			**30**	**280**	**500**		**16**

1. @ Any 1 Elective Course.
2. * Professional Elective Courses offered for the students doing Internship at institute level.
3. # Professional Elective Courses offered for the students doing Internship at Industry.
   These courses are to be studied in self study mode using NPTEL / SWAYAM platform.
4. Students doing internship at industry shall submit certificate of NPTEL examination
   OR
   They have to appear examinations conducted by institute like TT-I, TT-II and End Semester Examination (ESE).
5. Students undergoing internship have the option to appear for both the NPTEL examination and ESE conducted by the institute for the respective course. In such cases, the best of the two scores (NPTEL or ESE) shall be considered for final grading.
6. List of NPTEL courses will be declared by concerned BoS at the beginning of the semester-VIII.

Prepared by	**Checked by**	**BOS Chairman**	**Dean Academic / Dy. Director**	**C.O.E.**	**Director**
Dr. Y. K. Kirange	Dr. Nadeem Akhtar	Dr. S. A. Patil	Prof. Dr. P. J. Deore	Prof. S. P. Shukla	Prof. Dr. J. B. Patil

R. C. Patel Institute of Technology, Shirpur
SES
Autonomous

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Switchgear and Protection (PCEE7010T)		
Switchgear and Protection Laboratory (PCEE7010L)		

Prerequisite: Generation Transmission and Distribution of Electric Power, Power System.

Course Objectives

1. To explores the knowledge of arc interruption.
2. To demonstrate different type of circuit breakers and relay.
3. To understanding the characteristic feature and proper selection of protective elements in different protective scheme.
4. To possess knowledge related to different protection for major and individual power system elements.
5. To meet desired needs the recent technology in protection.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the knowledge of science for understanding arc generation and interruption in medium and high voltage circuits.	L3	Apply
CO2	Illustrate construction, operation, and specifications of different circuit breakers used in power systems.	L3	Apply
CO3	State and apply basic relay and their role in protection systems.	L3	Apply
CO4	Apply relay based on modern techniques and their role in protection schemes.	L3	Apply
CO5	Analyze different protection schemes used in power systems.	L4	Analyze

Switchgear and Protection (PCEE7010T)
Course Contents

Unit-I 08 Hrs.

Arc Interruption Theories: Basic requirement of Switching and protection, Arc phenomenon, maintenance of arc Properties of arc, interruption theories Transient recovery Voltage, Transient analysis, RRRV. Switching Transients: Closing of a line, Reclosing of a line, Interruption of small capacitive Currents, Interruption of Inductive load currents, Current chopping

Unit-II 08 Hrs.

Circuit Breakers: Construction, Working principle, Application and comparison of different types of circuit Breakers such as Air break, Air blast, Minimum oil circuit breaker, SF6 and Vacuum Circuit breakers, H.V.D.C. Circuit breakers, Circuit breaker ratings.

Unit-III 09 Hrs.

Protective Relay-I: Protection system and its attributes, organization of protection, zones of protection and maloperation. Desirable qualities of protective relaying, Definitions of terms used in relaying, Construction, working and characteristic features of electromagnetic relay: Over current, instantaneous over-current, definite time over-current, inverse time over-current relay directional over current relay and differential relay

Unit-IV 09 Hrs.

Protective Relay-II: Principle of operation and characteristics of induction type, Impedance relay, Reactance relay, MHO relay, Buccolz, Negative Phase Sequence, Harmonic restraint relays. Static Over current relay: overview of Static relay, block diagram, operating principal,merits and demerits of static relay. Digital relay: Basic component of digital relay, Microprocessors based relay, block diagram, DMPR relays, DTPR relays, digital temperature protection relays.

Unit-V 08 Hrs.

Protection Schemes: Different type of protective scheme: Over current protection, Differential protection, earth fault protection, distance protection and carrier aided protection. Protective scheme for generator, transformer, bus bar, transmission line and motor.

Switchgear and Protection Laboratory (PCEE7010L)

List of Laboratory Experiments

Suggested Experiments: (Any 8)

1. To conduct and study of Arc extinction phenomenon,Application in air circuit breaker.
2. To conduct and plot the characteristic of rewirable fuses and MCB.
3. To conduct and plot operating characteristics of over current relay.
4. To conduct Protection of transformer using differential relay.
5. To conduct and study of Static relay.
6. To conduct and study of microprocessor base relay.
7. To Study of protection scheme for alternator.
8. Study of switchgear testing kit.
9. To Study Electromechanical Relay.
10. Simulation of protection of transmission line.
11. Simulation of differential protection of transformer.
12. Modeling and Simulation of Over Current Relay.
13. Modeling and Simulation Protection of alternator.
14. Modeling and Simulation of digital relay.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books

1. B. Ravindranath,M. Chander,"Power SystemProtection and Switchgear", New Age International, 2^{nd} Edition, 2018.
2. Sunil S. Rao, "Switchgear Protection and Power Systems", Khanna Publisher, 14^{th} Edition, 1977.
3. Y. G. Paithankar, S. R. Bhide, "Fundmentals of Power System Protection", Prentice Hall of India, 2004.

Reference Books

1. T. S. Madhavarao, "Power System Protection Static Relay", Tata MacGraw Hill, 2^{nd} Edition, 2017 .
2. R. P. Maheshwari, Nilesh G. Chothani, "Protection and Switchgear", Oxford Press, 2011.
3. Badri Ram, D. Vishvakarma, "Power System Protection and Switchgear", Tata McGraw Hill, 2^{nd} Edition, 2017.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Electrical Drives and Control (PCEE7020T)		
Electrical Drives and Control Laboratory (PCEE7020L)		

Prerequisite: Electrical Machines, Power Electronics and Control System.

Course Objectives

1. To describe the structure of Electric Drive systems and their role in various applications.
2. To understand the basic principles of control aspects in drives using controlled converters.
3. To review the basic concepts of operation and modern control aspects of dc and ac motors.
4. To select suitable electric drive for various applications in industrial field.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the basic knowledge of electrical drives.	L3	Apply
CO2	Analyze the different control techniques of electrical drives.	L4	Analyze
CO3	Analyze the various parameters of converter-fed electrical drives.	L4	Analyze
CO4	Apply the different speed control methods of AC motor drives.	L3	Apply
CO5	Analyze the various parameters of electrical drives used in various industrial applications.	L4	Analyze

Electrical Drives and Control (PCEE7020T)
Course Contents

Unit-I 08 Hrs.

Introduction to Electrical Drives: Advantages of Electrical Drives, Parts of Electrical drive, Choice of Electric drives Dynamics of Electrical drives: fundamental torque equations, multi-quadrant operation, nature and classification of load torques, steady state stability, concept of load equalization in drives.

Unit-II 08 Hrs.

Control of Electrical Drives: Modes of operation: Steady state, Acceleration, Deceleration, Drive classification Closed loop control of drives: Current limit control, torque control, speed control, position control and control of multi-motor drives, speed sensing, current sensing. Classes of motor duty, criteria for selection of motor.

Unit-III 09 Hrs.

DC Motor Drives: Single phase drives: Single phase half wave, half controlled, Full controlled and Dual converter drives. Three phase drives: Three phase half wave, half controlled, Full controlled and Dual converter drives. Chopper drives: Principle of Rheostatic and regenerative braking control, combined control, two and four quadrant DC-DC converter fed drives. Introduction to closed loop control of DC drives.

Unit-IV 09 Hrs.

AC Motor Drives: Induction motor drives: Speed control methods on stator and rotor sides of induction motor drives. Closed loop control of Induction motors. Multi-quadrant operation of induction motor drives fed from Voltage Source Inverters. static slip power recovery control.

Synchronous Motor Drives: Static variable frequency control for Synchronous motors. Load commutated inverter fed Synchronous motor drive, Introduction to closed loop control of Load commutated inverter fed Synchronous motor drive

Unit-V 08 Hrs.

Drives for Specific Applications: Construction and operation, motor torque equation converter circuits, closed loop motor operation, solar and battery power drive. Textile Mill, Steel Rolling Mill, Cement Mill, and Sugar Mill: Various stages and drive requirements control of ac motors for controlling torque. Introduction to Electric Drive Vehcile.

Electrical Drives and Control Laboratory (PCEE7020L)

List of Laboratory Experiments

Suggested Experiments: (Any 8)

1. To perform a speed control of D. C. Motor using Single phase fully and half controlled converter.
2. To study the operation of D. C. Drive in four quadrant mode.
3. To observe load voltage and load current waveform of shaded pole induction using A. C Voltage regulator.
4. To observe the speed control of three phase induction motor in vector control mode.
5. To study the working operation of dual converter with PMDC Motor.
6. To perform the MATLAB / SIMULINK model of closed loop speed control of dc motor using PID Controller.
7. To perform the MATLAB / SIMULINK model of Voltage Source Inverter fed Induction Motor Drive.
8. To perform the Step-up Chopper fed DC Drive using MATLAB / SIMULINK.
9. Design and Simulation of Three Phase Induction Motor at different load conditions
10. MATLAB / SIMULINK Model of Three Phase Permanent Magnet Synchronous Motor Drive
11. MATLAB / SIMULINK Model of Speed control of BLDC Motor using PID Controller
12. MATLAB / SIMULINK Model of Switched Reluctance Motor

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books

1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 2nd Edition, 2010.
2. B. R. Gupta, V. Singhal, "Fundamentals of Electric Drives and Control", S. K. Kataria and Sons, Reprint 2013 Edition, 2013.

Reference Books

1. Krishnan, "Electric Motor Drives: Modeling Analysis and Control", Pearson Education, 1st Edition, 2015.
2. Vedam Subramanyam, "Electrical Drives", McGraw Hill Education, 2nd Edition, 2017.
3. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson India Education, 1st Edition, 2022.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Power System Operation and Control (PEEE7031T)		
Power System Operation and Control (PEEE7031L)		

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

Course Objectives

1. Significance of power system operation and control.
2. Real power-frequency interaction and design of power-frequency controller.
3. Reactive power-voltage interaction and the compensators for maintaining the voltage profile.
4. Generation scheduling and economic operation of power system.
5. To understand unit commitment problem and importance of power system stability.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the day-to-day operation and performance of electric power systems under normal and abnormal conditions.	L4	Analyze
CO2	Evaluate and interpret control actions required to maintain real power balance under varying system load conditions.	L5	Evaluate
CO3	Examine and assess the role of compensators in maintaining reactive power balance and voltage stability.	L5	Evaluate
CO4	Develop day-ahead and real-time economic generation schedules using optimization techniques.	L6	Create
CO5	Explain and illustrate concepts of power system stability and methods to improve stability margins.	L3	Apply

Power System Operation and Control (PEEE7031T)
Course Contents

Unit-I 09 Hrs.

Introduction to Power System Operation: Power scenario in Indian grid – National and Regional load dispatching centers – requirements of good power system - necessity of voltage and frequency regulation - real power vs frequency and reactive power vs voltage control loops - system load variation, load curves and basic concepts of load dispatching - load forecasting -Basics of speed governing mechanisms and modeling - speed load characteristics -regulation of two generators in parallel.

Unit-II 08 Hrs.

Real Power - Frequency Control: Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases - static and dynamic analysis - LFC of two area system - tie line modeling - block diagram representation of two area system - static and dynamic analysis - tie line with frequency bias control – state variable model - integration of economic dispatch control with LFC.

Unit-III 08 Hrs.

Reactive Power – Voltage Control: Generation and absorption of reactive power - basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop -static and dynamic analysis – stability compensation – voltage drop in transmission line - methods of reactive power injection - tap changing transformer, SVC (TCR + TSC) and STATCOM for voltage control.

Unit-IV 09 Hrs.

Economic Operation of Power System: Statement of economic dispatch problem - input and output characteristics of thermal plant -incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - lambda-iteration method - base point and participation factors method. Statement of Unit Commitment (UC) problem - constraints on UC problem – solution of UC problem using priority list – special aspects of short term and long-term hydrothermal scheduling problems.

Unit-V 08 Hrs.

Power System Stability: Introduction, power angle equation, steady state stability, transient stability and swing equation. Equal area criterion of stability – applications of equal area criterion, step by step solution of swing equation – factors effecting transient stability.

Power System Operation and Control Laboratory (PEEE7031L)

List of Laboratory Experiments

Suggested Experiments: (Any 8)

1. Write a program for economic dispatch in power systems using MATLAB.
2. Simulation of Automatic voltage regulator using MATLAB.
3. Write a program for economic load dispatch using lambda-iteration method.
4. Write a program to compute the voltage and power factor for a given system using MATLAB.
5. Write a program to solve the given Equal Area Criteria problem using MATLAB.
6. Simulation of single area load frequency control using MATLAB.
7. To demonstrate the Excitation System using MATLAB.
8. Write a program to solve Swing Equation by Classical Method.
9. Write a program to plot power angle curve of synchronous machine using MATLAB.
10. To study reactive power compensation using any device.
11. To develop and execute dynamic programming method for unit commitment.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books

1. Allen J.Wood and Bruce F.Wollen Berg, "Power Generation, Operation and Control", JohnWiley and Sons, Inc., Third Edition, 2013.
2. Olle I. Elgerd, "Electric Energy Systems theory - An introduction", McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.

Reference Books

1. Kothari D. P. and Nagrath I. J., "Power System Engineering", Tata McGraw-Hill Education, Second Edition, 2008.
2. Hadi Saadat, "Power System Analysis", McGraw Hill Education Pvt. Ltd., NewDelhi, 21st reprint, 2010
3. Kundur P., "Power System Stability and Control", McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
4. B. M.Weedy, B. J. Cory et al, "Electric Power Systems",Wiley 2012

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Electrical Power System Design (PEEE7032T)		
Electrical Power System Design Laboratory (PEEE7032L)		

Prerequisite: Electrical Energy Generation System, Power System Transmission and Distribution, Power System Analysis .

Course Objectives

1. To explore the design concept of electrical power system.
2. To provide an ideas of electrical and mechanical design concept of transmission line.
3. To give an economical consideration, project execution and site selection concept.
4. To explore the knowledge of power system improvement.
5. To explore the knowledge of power system planning

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the concepts of transmission line, distribution systems, improvements in power systems, planning of power systems.	L3	Apply
CO2	Analyze the transmission line parameters.	L4	Analyze
CO3	Analyze the distribution system parameters.	L4	Analyze
CO4	Apply the power system improvement techniques and schemes.	L3	Apply
CO5	Design the transmission line design parameters.	L6	Create

Electrical Power System Design (PEEE7032T)
Course Contents

Unit-I 09 Hrs.

Design of Transmission Line: Requirement of transmission line, selection of voltage for high voltage transmission line, choice of conductor, spacing of conductor, corona, insulators, specification of transmission line, surge impedance loading of transmission line, , Electrical design of transmission line. Main consideration in the mechanical design of transmission lines, sag tension relation, stringing of transmission lines, towers, underground cables.

Unit-II 08 Hrs.

Design of EHV Transmission Line: Transmission of electric power at extra high voltage, design considerations of EHV lines, selection and spacing of conductors, corona, radio and television interference, insulation coordination, towers, underground cables.

Unit-III 09 Hrs.

Design of Distribution Systems: Development of a distribution plan, transmission and distribution systems, types of distribution system arrangements, types of cable, primary distribution design, secondary distribution design, distribution substations, calculation of distribution sizes: voltage drops, voltage regulation, lamp flicker, protection of distributions systems, design of rural distribution, planning and design of town electrification schemes, design of industrial distribution systems, underground cables.

Unit-IV 08 Hrs.

Power System Improvements: Methods of power system improvement, power system improvement schemes, determination of voltage regulation and losses in a power system, shifting of distribution transformer centre, financial aspects of the power system improvement scheme.

Unit-V 08 Hrs.

Power System Planning: Methods of power system planning, forecasting load and energy requirement, generation planning, transmission system planning, distribution system planning, reliability of electrical power systems, methods of measuring power system reliability, trends in power system planning in India.

Electrical Power System Design Laboratory (PEEE7032L)

List of Laboratory Experiments

Suggested Experiments: (Any 8)

1. Draw the substation layout for transmission line with report.
2. Draw the substation layout for extra high voltage transmission line with report .
3. Draw the sheet for distribution system with report .
4. Draw the sheet for equal and unequal sag tension calculation with report.
5. Draw the sheet for different bus bar arrangement and isolating switches used in substation with report.
6. Draw the sheet for various types of poles and towers used in transmission line and EHV transmission line.
7. Draw the sheet for various types of underground cables.
8. Drawthe sheet for tap changing transformer , auto transformer tap changing, booster transformer, induction regulators.
9. Draw the sheet for various types of switchgear and relays.
10. Draw the drawing sheet for various types of electrical earthings.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books

1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House Pvt. Ltd, 2^{nd} Edition, 2010.
2. B. R. Gupta, V. Singhal, "Fundamentals of Electric Drives and Control", S. K. Kataria and Sons, Reprint 2013 Edition, 2013.

Reference Books

1. P. S. Satnam and P. V. Gupta, "Substation Design and Equipment", Dhanpat Rai Publications, 1^{st} Edition, 2013.
2. M. V. Deshpande, "Electrical Power System Design", McGraw Hill Higher Education, 1^{st} Edition, 1985.
3. B. R. Gupta, "Power System Analysis and Design" , S. Chand and Company, 1^{st} Edition Reprint, 2007.

4. J. Duncan Glover, "Power SystemAnalysis and Design", Cengage learning, 5th Edition, 2012.

5. A. B. Chattopadhay, D. P. Kothari, "Advanced Electrical and Power System Design", New Age International, 1st Edition, 2021.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
High Voltage Engineering (PEEE7033T)		
High Voltage Engineering Labaratory (PEEE7033L)		

Prerequisite: Electrical Material, Power Systems.

Course Objectives

1. To make students to know and compare the various processes of breakdown in solid, liquid and gaseous dielectric materials.
2. To make students understand and apply various methods of generation and measurement of DC, AC, impulse voltage and current.
3. To enable students to understand the charge formation and separation phenomena in clouds, the causes of overvoltage and lightning phenomena.
4. To develop the ability among learners to execute testing on various high voltage equipment as per standards.
5. To introduce students to the design, layout, safety precautions, earthing, and shielding of High Voltage laboratory.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply basic knowledge of electrical engineering material for understanding breakdown phenomena in solid, liquid, and gases.	L3	Apply
CO2	Analyze the occurrence of overvoltage and provide remedial solutions.	L4	Analyze
CO3	Apply the use of various methods for generation of high AC, DC, and impulse voltage and current.	L3	Apply
CO4	Apply the methods of measurement of high AC, DC, impulse voltage and current, and tests on high voltage equipment and devices.	L3	Apply
CO5	Apply various testing procedures as per IS in laboratory with knowledge of earthing, safety, and shielding of HV laboratory.	L3	Apply

High Voltage Engineering (PEEE7033T)
Course Contents

Unit-I 08 Hrs.

Breakdown In Gases, Liquids and Solids: Review and classification of insulating material, Breakdown in gases, Townsend's law. Breakdown in electronegative gases, streamer mechanism of spark, Paschen's law, corona discharge, electronegative gases. Breakdown in pure and commercial liquids, solid dielectric and composite dielectric, Breakdown in vacuum.

Unit-II 09 Hrs.

Lightning and Switching Over Voltage Protection: Modes of operation: Steady state, Lightning phenomenon, Different types of lightning strokes and mechanisms of lightning strokes, Charge separation theories, Wilson theory, Simpson theory, Reynolds and Mason theory. Causes of over voltages and its effects on power systems, Over voltage due to switching surges and methods to minimize switching surges. Insulation co-ordination of HV and EHV power system.

Unit-III 08 Hrs.

Generation of High Voltage and Currents: Generation of high ac voltages Cascading of transformers, series and parallel resonance system, Tesla coil. Generation of impulse voltages and current Impulse voltage definition, wave front and wave tail time,Multi stage impulse generator,Modified Marx circuit, Tripping and control of impulse generators, Generation of high impulse current .

Unit-IV 09 Hrs.

Measurement of High Voltage And Currents: Sphere gap voltmeter, electrostatic voltmeter, generating voltmeter, peak reading voltmeter, resistive and capacitive potential divider, and capacitance voltage transformer, cathode ray oscilloscope for impulse voltage and current measurement, partial discharge measurements. Measurement of high power frequency a.c using current transformer.

Unit-V 08 Hrs.

Testing and EHV Line Insulation: Basic technology , testing of insulators bushing , cables , transformer, surge diverters and threshold current , capacitance of long objects, Electromagnetic interference, E.H.V line insulation design based upon transient over voltages

High Voltage Engineering Labaratory (PEEE7033L)

List of Laboratory Experiments

Suggested Experiments: (Any 8)

1. To perform breakdown test on transformer oil and obtain constants of breakdown voltage equation and breakdown strength.
2. To obtain breakdown strength of composite insulation system.
3. Measurement of unknown high a.c. voltage using sphere gap.
4. Measurement of insulation resistance of 11KV/110 V.P.T by Megger.
5. Analyzing the uniform and non uniform field in breakdown strength of air insulation system.
6. To understand basic principle of corona and obtain audible and visible corona inception and extinction voltage under non uniform field.
7. Dry and Wet power frequency withstand test for insulator.
8. To Analyzing the Effect of EHV field on Human, Animals and Plants.
9. Study of impulse generator.
10. Simulation of lightening and switching impulse voltage generator.
11. To Analyzing effect of barrier on breakdown voltage of air/ transformer oil.
12. Parametric analysis of Impulse current generator using virtual Laboratory

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books

1. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers Ltd. 3^{rd} Edition, 2012.
2. M. S. Naidu, V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill Publication, 6^{th} Edition, 2013.

Reference Books

1. R. S. Jha, "High Voltage Engineering", Dhanpat Rai Publication, 1977.
2. Rakash Das Begamudre, "Extra High Voltage Transmission", New Age International Publication, Revised Edition, 2011.

3. E. Kuffel and W. S. Zaenglo, “High Voltage Engineering”, Elsevier, 2nd Edition, 2008.

4. D. V. Razevig Translated from Russian by Dr. M. P. Chourasia, “High Voltage Engineering”, Khanna Publishers, New Delhi,2005.

5. Subir Ray, “An Introduction to High Voltage Engineering” PHI Pvt. Ltd. New Delhi, 2nd Edition, 2013

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Computer Aided Power System Analysis (PEEE7034T)		
Computer Aided Power System Analysis Labaratory (PEEE7034L)		

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

Course Objectives

1. Explain the use of modern tool for the analysis of the complex electrical power systems with less computational time and more accuracy.
2. To model the issues and analyze methods for the power flow, short circuit, contingency and stability analysis, required to be carried out for the continuous monitoring of power systems.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the network topology used for the representation of power system components and networks.	L2	Understand
CO2	To develop bus impedance and admittance matrices using suitable algorithms.	L6	Create
CO3	Evaluate the short circuit studies for proper selection of protection scheme.	L5	Evaluate
CO4	Perform load flow studies using Newton–Raphson, Gauss–Seidel, and Fast Decoupled methods.	L3	Apply
CO5	Analyze simultaneous faults by matrix Transformations.	L4	Analyze

Computer Aided Power System Analysis (PEEE7034T) Course Contents

Unit-I 09 Hrs.

Network Topology: Modeling of Power System Components, Basic Concepts, Single Phase, Three Phase Models,Matrix, and Representation of Networks Topology of Electric power system Network Graphs, Incidence matrices, fundamental loop and cutest matrix, primitive impedance and admittance matrix, singular transformation of network matrix. in vacuum.

Unit-II 08 Hrs.

Incidence Matrix: Formation of bus impedance and admittance matrices by algorithm – Modification of bus impedance and admittance matrix to account for change in networks. Derivation of loop impedance matrix. Algorithm for formulation of 3 phase bus impedance matrix.

Unit-III 08 Hrs.

Short Circuit Studies: Three phase network, Symmetrical components. Thevenins theorem and short circuit analysis of multi mode power system using bus impedance matrix. Short circuit calculations for balanced and unbalanced short circuit bus impedance and loop impedance matrices

Unit-IV 09 Hrs.

Load Flow Studies: Slack bus, loop buses, voltage control buses, Load flow equations, power flow model using bus admittance matrix, Power flow solution through Gauss Seidal and N-R methods sensitivity analysis, Second order N-R method, fast decoupled load flow method, Sparsity of matrix.

Unit-V 08 Hrs.

Fault Analysis: Simultaneous faults, Simultaneous Faults by two port network Theory (Z, Y and H-type Faults), Simultaneous faults by matrix Transformations, Analytical simplifications of series and shunt fault.

Computer Aided Power System Analysis Laboratory (PEEE7034L)

List of Laboratory Experiments

Suggested Experiments: (Any 8)

1. Determination of equivalent parameters of transmission line.
2. Program for building of ZBus by addition of branch.
3. Program for building of ZBus by addition of link.
4. Program/Simulation for illustration of the Ferranti Effect.
5. Program for the formation of YBus by Singular Transformation.
6. Program for evaluation of load flow by Newton Raphson Method.
7. Program/Simulation for Balanced Three phase short circuit.
8. Program/Simulation for Unbalanced short circuits.
9. Program/Simulation for Fault analysis of Power System network of an Electric Utility Company.
10. Study of IEC and ANSI standards for Short circuit analysis.
11. Introduction to PSCAD.
12. Introduction to ETAP.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
2. J. J. Gringer and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, Indian Edition, 2017.

Reference Books

1. G. W. Stagg and A. H. Ei-Abiad, "Computer Methods in Power System Analysis", Medtech, International student Edition, 2019.
2. G. L. Kusic, "Computer Aided Power System Analysis", Taylor and Francis, 2^{nd} edition, 2008.
3. A. R. Bergen and Vijay Vittal, "Power Systems Analysis", Pearson Education Asia, 2^{nd} edition, 2001.
4. Hadi Sadat,"Power System Analysis", Tata McGraw Hill, 3^{rd} Edition, 2016.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Illumination Engineering (PEEE7035T)		
Illumination Engineering Laboratory (PEEE7035L)		

Prerequisite: Knowledge basic sciences, mathematics and subjects of Electrical Engineering.

Course Objectives

1. To get the detailed information about modern lamps and their accessories.
2. To get detailed insight of indoor and outdoor illumination system components, its controls and design aspects.
3. To know the requirements of energy efficient lighting.
4. To introduce the modern trends in the lighting.
5. To get the detailed information about modern lamps and their accessories

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply basic engineering to understand the concept of lighting systems and selection of lighting factors affecting the lighting scheme.	L3	Apply
CO2	Explain and apply the criteria for the selection of lamps, measurement of light, laws of illumination, and lighting systems for indoor and outdoor spaces.	L3	Apply
CO3	Design and evaluate different types of lighting scheme designs for indoor lighting and selection of luminaires to meet specified needs with appropriate consideration.	L6	Create
CO4	Evaluate calculations on photometric performance of light sources and luminaires for outdoor purposes.	L5	Evaluate
CO5	Apply the modern trends in lighting.	L3	Apply

Illumination Engineering (PEEE7035T)
Course Contents

Unit-I 08 Hrs.

Introduction of Light: Introduction of Light: Radiation, colour and eye vision. Types of illumination, Day lighting, Supplementary artificial lighting and total lighting, Quality of good lighting, Factors affecting the lighting shadow, glare, reflection, Colour rendering and stroboscopic effect,Methods of artificial lighting, Lighting systems direct, indirect, semi direct, semi indirect, Lighting scheme, General and localized.

Unit-II 09 Hrs.

Light Sources: Lamp materials: Filament, glass, ceramics, gases, phosphors and other metals and non metals. Discharge Lamps: Theory of gas Discharge phenomena, lamp design considerations, characteristics of low and high mercury and Sodium vapour lamps, Low Vapour Pressure discharge lamps Mercury Vapour lamp, Fluorescent Lamp, Compact Fluorescent Lamp (CFL) High Vapour Pressure discharge lamps Mercury Vapour lamp, Sodium Vapour lamp, Metal halide Lamps, Solid Sodium Argon Neon lamps, SOX lamps, Electro luminescent lamps, Induction lamps.

Unit-III 09 Hrs.

Design of Interior Lighting: Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilization and factors affecting it, Illumination required for various work planes, Space to mounting height ratio, Types of fixtures and relative terms used for interior illumination, Calculation of wattage of each lamp and no of lamps needed, Layout of lamp luminaries, Calculation of space to mounting height ratio, Indian standard recommendation and standard practices for illumination levels in various areas, Special feature for entrance, staircase, Corridor lighting and industrial building.

Unit-IV 08 Hrs.

Design of Outdoor Lighting: Street Lighting : Types of street and their level of illumination required, Terms related to street and street lighting, Types of fixtures used and their suitable application, Various arrangements in street lighting, Requirements of good street lighting, Selection of lamp and luminaries, Calculation of illumination level available on road .Flood Lighting Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, Calculation of space to mounting height ratio.

Unit-V 08 Hrs.

Modern trends in illumination: LED luminary designs Intelligent LED fixtures Natural light conducting Organic lighting system LASERS, characteristics, features and applications, non lighting lamps Optical fiber, its construction as a light guide, features and applications.

Illumination Engineering Laboratory (PEEE7035L)

List of Laboratory Experiments

Suggested Experiments: (Any 8)

1. To Study the status monitoring of light.
2. To study fault monitoring in Lighting Power Systems.
3. To study electrical load monitoring in Lighting Power Systems.
4. To calculate the life of Lighting Lamp.
5. To study the energy management in illumination.
6. To study the Energy efficient illuminating system components.
7. To measure Illumination by luxmeter.
8. To prepare a report of different luminaries available in the market and collect the technical data.
9. To study the different lighting accessories required for varies types of lamps.
10. Design an Illumination scheme for a garden of medium size.
11. Design an Illumination scheme for a conference room of medium size.
12. Design an Illumination scheme for a workshop for fine work of medium size.
13. Design an Illumination scheme for a medium size Hotel / Hospital /Shopping complex.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Text Books

1. Gupta J. B., "Utilization of Electric Power and Electric Traction", S. K. Kataria and Sons, 2nd Edition, 2012.
2. Uppal S. L, "Electrical Power", Khanna Book Publication, 132th Edition, 1988.
3. Partab H. P., "Art and Science of Utilization of Electrical Engineering", Dhanpat Rai Publications, Revised Edition, 2017.

Reference Books

1. Jack L. Lindsey, "Applied Illumination Engineering", Fairmont Pr, 2nd Edition, 1996.
2. JohnMatthews, "Introduction to the Design and Analysis of Building Electrical Systems", Springer, 1993.

3. M. A. Cayless, “Lamps and Lighting”, Routledge, 4^{th} Edition, 2012.

4. O. E. Taylor, “Utilization of Electrical Energy”, Longman, 1971.

5. H. S. Mamak, “Book on Lighting”, Publisher International Lighting Academy.

6. Joseph B. Murdoch, “Illumination Engineering from Edison’s Lamp to Lasers”, Visions Communications, 1994.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Product Life Cycle Management (OEEE7041T)		

Prerequisite: Knowledge of basic concepts of Management.

Course Objectives

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management and PLM strategies.
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.	L2	Understand
CO2	Illustrate various approaches and techniques for designing and developing products.	L3	Apply
CO3	Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.	L3	Apply
CO4	Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant.	L3	Apply

Product Life Cycle Management (OEEE7041T)
Course Contents

Unit-I 10 Hrs.

Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance and Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications.

PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM.

Unit-II 08 Hrs.

Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process.

Unit-III 08 Hrs.

Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation.

Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies.

Unit-IV 08 Hrs.

Integration of Environmental Aspects in Product Design: Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design.

Unit-V 08 Hrs.

Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for

Product Life Cycle Cost Analysis.

Text Books:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realization", Springer-Verlag, 2004, ISBN: 1852338105.
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor and Francis, 2006.

Reference Books:

1. Saaksvuori Antti, Immonen Anselmie,"Product Life Cycle Management", Springer, Dreamtech, 2009, ISBN: 3540257314.
2. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265.
3. François Villeneuve, Luc Mathieu, Max Giordano, "Product Life-Cycle Management: Geometric Variations", Wiley, 2010.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Management Information System (OEEE7042T)		

Prerequisite: Knowledge of basic concepts of Management

Course Objectives

1. The course is blend of Management and Technical field.
2. To discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. To define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
4. To identify the basic steps in systems development.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain how information systems Transform Business.	L2	Understand
CO2	Use information systems concepts to assess their effects on organizational operations.	L3	Apply
CO3	Describe IT infrastructure and its components and its current trends.	L2	Understand
CO4	Explain principal tools and technologies for accessing information from databases to improve business performance and decision making.	L2	Understand
CO5	Use enterprise-wide knowledge management systems to show their benefits for business operations.	L3	Apply

Management Information System (OEEE7042T)
Course Contents

Unit-I — 05 Hrs.

Foundation Concepts: Information Systems in Business, Functional Area Information System, The Components of Information Systems, Impact of IT on organizations and society, Organizational Strategy, Information systems for strategic advantage.

Unit-II — 08 Hrs.

Information Technologies: Hardware and Software

Computer Systems: End User and Enterprise Computing

Computer Peripherals: Input, Output, and Storage Technologies

Application Software: End User Applications

System Software: Computer System Management

Data Resource Management: Technical Foundations of Database Management, Managing Data Resources, Big data, Data warehouse and Data Marts, Knowledge Management.

Networks: The Networked Enterprise (Wired and wireless), Pervasive computing, Cloud Computing models.

Unit-III — 08 Hrs.

MIS Tools and applications for Decision making: ERP and ERP support of Business Process Reengineering.

Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Visualization.

Artificial Intelligence Technologies in Business

Unit-IV — 06 Hrs.

Security and Ethical Challenges: Security, Ethical, and Societal Challenges of IT Security Management of Information Technology.

Unit-V — 07 Hrs.

Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C, Mobile commerce.

Unit-VI — 08 Hrs.

Information System within Organization: Acquiring Information Systems and Applications: Various System development life cycle models.

Enterprise and Global Management of Information Technology: Managing Information Technology, Managing Global IT.

Reference Books:

1. James A O'Brien, George M., Ramesh Behl, "Management Information Systems", 11th Edition, Tata McGraw Hill, 2019.
2. Kelly Rainer, Brad Prince, "Management Information Systems", 2nd Edition, Wiley, 2013.
3. K.C. Laudon and J.P. Laudon, "Management Information Systems: Managing the Digital Firm", 10th Edition, Prentice Hall, 2007.
4. D. Boddy, A. Boonstra, "Managing Information Systems: Strategy and Organization", Prentice Hall, 2008.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Operations Research (OEEE7043T)		

Prerequisite: Basic Knowledge of Algebra, Probability and Statistics

Course Objectives

1. To formulate a real-world decision problem as a mathematical programming model.
2. To learn the mathematical tools that are employed to solve mathematical programming models.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a real-world problem by formulating it as a Linear Programming Problem and interpreting the solution obtained using the Simplex method or other algorithms.	L4	Analyze
CO2	Determine real-world problems as Transportation Problem and Assignment Problem and solve the decision problem by choosing appropriate algorithm.	L3	Apply
CO3	Determine the decision situations which vary with time and analyse them using principle of dynamic programming to real life situations.	L3	Apply
CO4	Explain reasons of formation of queues, classify various queuing systems and apply parameters defined for various queuing systems for decision making in real life situations.	L2	Understand
CO5	Explain the concept of decision making in situation of competition and recommend strategies in case of two-person zero sum games.	L2	Understand
CO6	Explain the concept of simulation and replacement policy, apply Monte Carlo Simulation technique to systems such as inventory and queuing, and determine optimal replacement age.	L2	Understand

Operations Research (OEEE7043T)
Course Contents

Unit-I 10 Hrs.

Introduction to Operations Research: Concept of decision making. Definition of OR. Formulation of decision problem as OR model, Concept of Optimization.

Linear Programming Problem: Mathematical Formulation. Finding optimal solution - Graphical method, Simplex Method, Big M-method, Two Phase Method. Duality, Primal – Dual construction, Symmetric and Asymmetric Dual. Dual Simplex Method.

Unit-II 08 Hrs.

Assignment Problems: Mathematical Formulation, Finding optimal solution - Hungarian Method

Transportation problem: Mathematical Formulation, Finding initial basic feasible solution- Northwest corner rule, row minima, column minima, least cost method and Vogel's approximation method.

Optimality test: the stepping stone method and MODI method. Improving the solution.

Unit-III 06 Hrs.

Dynamic Programming: Bellman's Principle of optimality - Applications of dynamic programming- Employment smoothening problem, capital budgeting problem, shortest path problem, cargo loading problem.

Unit-IV 10 Hrs.

Queuing Models: Characteristics of queuing models. Single Channel – Single and multi phase servers, Poisson arrivals, exponential service time - with infinite population and finite population models – with infinite and finite capacity.

Multichannel- Single phase server - Poisson arrivals, exponential service time with infinite population.

Game Theory: Introduction, Minimax and Maximin Criterion and optimal strategy, Solution of games with saddle points, rectangular games without saddle points - 2 x 2 games, dominance principle.

Approximate methods, Iterative method, m x 2 and 2 x n games-Graphical method and method of sub-games. Expressing game as LPP.

Unit-V 08 Hrs.

Simulation: Definition. Types of simulation models. Monte Carlo simulation technique. Applications of simulation - Inventory and Queuing problems. Simulation Languages.

Replacement Models: Replacement of items that deteriorate with time - when money value is not counted and counted, Replacement of items that fail suddenly – individual and group replacement policy.

Text Books:

1. Sharma J. K., “Operations Research”, Trinity Press.
2. Gupta P. K., Hira D. S., “Operations Research”, S. Chand Limited.

Reference Books:

1. Taha, H. A., “Operations Research - An Introduction”, Pearson Education, 2022.
2. Ravindran A., Phillips D. T., and Solberg J. J., “Operations Research: Principles and Practice”, John Willey and Sons, 2009.
3. Hiller F. S., and Liebermann G. J., “Introduction to Operations Research”, Tata McGraw Hill, 2010.
4. Pradeep Prabhakar Pai, “Operations Research Principles and Practice”, Oxford University Press, 2012.
5. R. Panneerselvam, “Operations Research”, PHI Publications, 2nd Edition, 2016.
6. A. M. Natarajan, P. Balasubramani, A. Tamilarasi, “Operations Research”, Pearson Education, 2nd Edition, 2014.
7. Kanti Swarup, P. K. Gupta and Man Mohan, “Operations Research”, Sultan Chand and Sons, 2010.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Cyber Security and Laws (OEEE7044T)		

Prerequisite: Knowledge of basic concepts of security.

Course Objectives

1. To understand and identify different types cybercrime and cyber offences.
2. To recognized Indian IT Act 2008 and its latest amendments.
3. To learn various types of security standards compliances.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the different types of cybercrime and security issues E Business.	L2	Understand
CO2	Analyze different types of cyber threats and techniques for security management.	L4	Analyze
CO3	Analyze the legal requirements and standards for cyber security in various countries to regulate cyberspace.	L4	Analyze
CO4	Explain the Information Technology Act and the legal framework of right to privacy, data security, and data protection.	L2	Understand

Cyber Security and Laws (OEEE7044T)
Course Contents

Unit-I 12 Hrs.

Introduction to Cybercrime: Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus and Worm's, Email Bombing, Pornography, online gambling, Forgery, Web Defacements, Web Jacking, Illegal online Selling, Cyber Defamation, Software Piracy, Electronics/ Digital Signature, Phishing, Password Cracking, Key loggers and Spywares, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Over Flow,, Phishing Identity Theft (ID Theft) ,How criminal plan the attacks, Social Engineering, Cyber stalking.

Unit-II 08 Hrs.

Cyber Threats Analysis: Knowledge of Dynamic and Deliberate Targeting, Knowledge of Indications and Warning, Knowledge of Internal Tactics to Anticipate and/or, Emulate Threat Capabilities and Actions, Knowledge of Key Cyber Threat Actors and their EquitiesKnowledge of Specific Target Identifiers and Their Usage.

Unit-III 06 Hrs.

Electronic Business and legal issues: Evolution and development in Ecommerce, Policy Frameworks for Secure Electronic. Business, paper vs paper less contracts, E-Commerce models- B2B, B2C, E security. E- Payment Mechanism; Payment through card system, E-Cheque, E-Cash, E-Payment Threats and Protections, Security for E-Commerce.

Unit-IV 08 Hrs.

Indian IT Act : Cyber Crime and Criminal Justice, Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments

Security aspect in cyber Law: The Contract Aspects in Cyber Law , The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law ,The Evidence Aspect in Cyber Law ,The Criminal Aspect in Cyber Law.

Unit-V 08 Hrs.

Security Industries Standard Compliances: IT Security v/s IT Compliance, Cyber Security Standards, critical security controls for cyber security, GRC (Governance, Risk Management, and Compliance), SOX, GLBA, HIPAA, ISO/IEC 27001, NIST Cyber Security Framework (CSF), PCI-DSS.

OWASP Top Ten Project, GDPR (General Data Protection Regulation), NIST (National Institute of Standards and Technology), CIS Controls (Center for Internet Security Controls)

Reference Books:

1. Nina Godbole, Sunit Belapure, “Cyber Security”, Wiley India, 2011.
2. Suresh T. Vishwanathan, “The Indian Cyber Law”, 3rd Edition, Bharat Law House, 2022.
3. “The Information Technology Act, 2000”, Bare Act- Professional Book Publishers, New Delhi, 2022.
4. Anup K. Ghosh, “E-Commerce Security and Privacy”, Springer Science and Business Media, 2012.
5. Izzat Alsmadi, “The NICE Cyber Security Framework Cyber Security Intelligence and Analytics”, 1st Edition, Springer, 2019.
6. Advocate Prashant Mali, “Cyber Law and Cyber Crimes”, 2nd Edition, Snow White Publications, 2015.
7. Nina Godbole, “Information Systems Security”, 2nd Edition, Wiley India, 2017.
8. Kennetch J. Knapp, “Cyber Security and Global Information Assurance”, Information Science Publishing, 2009.
9. William Stallings, “Cryptography and Network Security”, 8th Edition, Pearson Publication, 2023.

Web Resources:

1. The Information Technology ACT, 2008- TIFR: https://www.tifrh.res.in
2. A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer- professionals-33538

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Personal Finance Management (OEEE7045T)		

Prerequisite: Basic Knowledge of Algebra, Probability and Statistics.

Course Objectives

1. To create awareness and educate consumers on access to financial services.
2. To make the students understand the basic concepts, definitions and terms related to direct taxation.
3. To help the students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
4. To familarise the students with microfinance for accelerating the expansion of local microbusinesses.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Use a framework for financial planning to understand the overall role finances play in his/her personal life.	L3	Apply
CO2	Calculate income from salaries, house property, business/profession, capital gains and income from other sources.	L3	Apply
CO3	Calculate the amount of CGST, SGST and IGST payable after considering the eligible input tax credit.	L3	Apply
CO4	Describe how Microfinance can help in financial inclusion.	L2	Understand

Personal Finance Management (OEEE7045T)
Course Contents

Unit-I 07 Hrs.

Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments and Financial Markets, Financial inclusion.

Introduction to Personal Finance: Person Financial Planning in Action, Money Management Skills, Taxes in Your Financial Plan, Savings and Payment Services. Consumer Credit: Advantages, Disadvantages, Sources and Costs.

Unit-II 07 Hrs.

Personal Financial Management : Loans: Home, Car, Education, Personal, Loan against property and Jewel loan.

Insurance: Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance.

Investment: Investing Basics and Evaluating Bonds, Investing in Stocks and Investing in Mutual Funds, Planning for the Future.

Unit-III 08 Hrs.

Income Tax Act Basics : Introduction to Income Tax Act, 1961.

Heads of Income and Computation of Total Income and Tax Liability: Income and Computation of Total Income under various heads, Clubbing Provisions, Set off and Carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons.

Tax Management, Administrative Procedures and ICDS : TDS, TCS and Advance Tax Administrative Procedures, ICDS.

Unit-IV 10 Hrs.

Goods and Services Tax : GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union and State Government); Concept of VAT: Meaning, Variants and Methods; Major Defects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST and IGST); GST Council, GST Network, State Compensation Mechanism, Registration.

Levy and Collection of GST:

Taxable event - "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import and Export; Time of supply: Valuation for GST - Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme: Classification of Goods and Services.

Unit-V 10 Hrs.

Introduction to Microfinance: Micro-Finance: Definitions, Scope and Assumptions, Types of Microfinance, Customers of Microfinance, Credit Delivery Methodologies, SHG concept, origin, Formation and Operation of Self Help Groups (SHGs).

Models in Microfinance: Joint Liability Groups (JLG), SHG Bank Linkage Model and GRAMEEN Model: Achievements and Challenges.

Institutional Mechanism: Current Challenges for Microfinance, Microfinance Institutions (MFIs), Constraints and Governance Issues, Institutional Structure of Microfinance in India: NGO-MFIs, NBFC-MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand and Supply of Microfinance Services in India, Impact assessment and social assessments of MFIs.

Reference Books:

1. Asha Singh, M.S. Gupta, "Banking and Financial Sector Reforms in India" , Serials Publication, 2010.
2. M. S. Gupta and J. B. Singh,"Indian Banking Sector: Essays and Issues", 1st Edition, Serials Publication, 2016.
3. K.M. Bhattacharya O.P. Agarwal,"Basics Of Banking and Finance", Himalaya Publishing House, 2018.
4. S. Subba Reddy , P. Raghu Ram, "Agricultural Finance and Management", Oxford and IBH Publishing, 2018.
5. Dr.Vasant Desai, "The Indian Financial System and Development", 4th Edition, Himalaya Publishing House, 2011.
6. Sanjay Kumar Satapathy, "Income Tax Management Simple Way of Tax Management, Tax Planning and Tax Saving", 2018.
7. Dr. R. K. Jain, "Direct Tax System Income Tax", SBPD Publications, 2020.
8. S K Mishra,"Simplified Approach to GST Goods and Services Tax", Educreation Publishing, 2018.
9. Todd A Watkins, "Introduction To Microfinance", World Scientific Publishing Company, 2020.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Energy Audit and Management (OEEE7046T)		

Course Objectives

1. To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To identify and describe the basic principles and methodologies adopted in energy audit of a utility.
3. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
4. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify and describe the present state of energy security and its importance.	L2	Understand
CO2	Identify and describe the basic principles and methodologies adopted in the energy audit of a utility.	L2	Understand
CO3	Describe the energy performance evaluation of some common electrical installations and identify energy-saving opportunities.	L2	Understand
CO4	Describe the energy performance evaluation of some common thermal installations and identify energy-saving opportunities.	L2	Understand
CO5	Analyze the data collected during performance evaluation and recommend energy-saving measures.	L4	Analyze

Energy Audit and Management (OEEE7046T)
Course Contents

Unit-I 05 Hrs.

Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance.

Unit-II 10 Hrs.

Energy Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring and targeting, Energy audit instruments. Technical and economic feasibility, Classification of energy conservation measures. Safety considerations during energy audit.
Financial analysis techniques: Simple payback period, NPV, Return on investment(ROI) Internal rate of return (IRR).

Unit-III 10 Hrs.

Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in water pumps, compressor, fan and blower. industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.

Unit-IV 10 Hrs.

Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Steam leakages, Steam trapping, Condensate and flash steam recovery system. Waste heat recovery, use of insulation- types and application. Energy conservation opportunities in: Boiler system. Refrigeration system and HVAC system.

Unit-V 07 Hrs.

Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources, Energy sources and energy management in electric vehicles.

Reference Books:

1. Geofry Stokes, "Handbook of Electrical Installation Practice", Blackwell Science, 2003.
2. Anil Valia, "Designing with light: Lighting Handbook", Lighting System.
3. W. C. Turner, "Energy Management Handbook", Fairmont Press, 5th Edition, 2004.
4. A. K. Tyagi, "Handbook on Energy Audits and Management", Tata Energy Research Institute, 2000.
5. C. B. Smith, "Energy Management Principles", Elsevier Science Publishing, 2nd Edition, 2015.
6. Dale R. Patrick, S. Fardo, Ray E. Richardson, "Energy Conservation Guidebook", Fairmont Press, 2nd Edition, 2007.
7. Albert Thumann, W. J. Younger, T. Niehus, "Handbook of Energy Audits", Fairmont Press, 6th Edition, 2010.

Web Resources:

1. www.energymanagertraining.com
2. www.bee-india.nic.in

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Disaster Management and Mitigation Measures (OEEE7047T)		

Course Objectives

1. To provide basic understanding hazards, disaster and various types and categories of disaster occurring around the world.
2. To identify extent and damaging capacity of a disaster.
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand roles and responsibilities of individual and various organization during and after disaster.
5. To appreciate the significance of GIS, GPS in the field of disaster management.
6. To understand the emergency government response structures before, during and after disaster.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe natural as well as man-made disasters, their extent, and possible effects on the economy.	L2	Understand
CO2	Describe the institutional framework and organizational structure in India for disaster management and explain government policies, acts, and various emergency laws.	L2	Understand
CO3	Describe the simple do's and don'ts during extreme events and explain the skills required to respond accordingly	L2	Understand
CO4	Explain the importance of disaster prevention and various mitigation measures with exposure to disaster hotspots across the globe.	L2	Understand

Disaster Management and Mitigation Measures (OEEE7047T) Course Contents

Unit-I 10 Hrs.

General Information about Disaster: Brief concept of Hazards, definition and types of Disasters – Natural, Man-made, and hybrid, Groups of Disasters- Natural and Technological, global Scenario, Significance of studying various aspects of disasters, effects of disasters, India's vulnerability to disasters,Impact of disaster on National development.

Study of Natural disasters: Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions,Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise,ozone depletion etc.

Study of Human/Technology Induced Disasters: Chemical, Industrial and Nuclear disasters, Internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy, Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit-II 08 Hrs.

Disaster Management: Brief Introduction, Disaster management cycle, Evolution of Disaster and Disaster management in India, Disaster management acts, policies and guidelines, laws of emergencies etc.

Prior, During and Post disaster management activities: (Preparedness, strengthening emergency centers, Logistics, optimum resource management, emergency response and relief, Training, Public awareness, Research, Reconstruction of essential services and livelihood restoration

Unit-III 08 Hrs.

Institutional framework and Mechanism for disaster management in India: Institutions in India for dealing with various disasters, Organizational structure, functionsand responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India, roles and responsibilities of central and state government during and after disaster, NGO'sinvolved in disasters and their task,Jobs carried out by armed forces. Financial Relief During disaster (State, National and International Disaster Assistance)

Unit-IV 08 Hrs.

Disaster risk reduction and Mitigation Measures: Need of disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction. Mitigation measures for flood, earthquake, cyclone monitoring, air quality, water quality, climate change, land use, winter storms and aquatic biology etc. Use of information management, GIS, GPS and remote sensing Mitigation measure. Do's and don'ts in case of disasters and effective implementation of relief aids.

Unit-V 09 Hrs.

Case studies on disaster (National /International): Case study discussion of Hiroshima – Nagasaki (Japan), India – Tsunami (2004) , Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, Cyclone Phailin (2013), Fukushima Daiichi nuclear disaster (2011), 26th July 2005 Mumbai flood, Chernobyl meltdown and so on.(Discuss case studies on disaster with respect to reason for the disaster, incidents, effects of disaster, present scenario and safety measures taken)

Reference Books and Reports:

1. H. K. Gupta, "Disaster Management", Universities Press, 2003.
2. O. S. Dagur, "Disaster Management: An Appraisal of Institutional Mechanisms in India", Centre for Land Warfare Studies, 2011.
3. D. Copolla, "Introduction to International Disaster Management", Butterworth-Heinemann, Elsevier, 2015.
4. J. Pinkowski, "Disaster Management Handbook", CRC Press, Taylor and Francis, 2008.
5. R. Dasgupta,"Disaster Management and Rehabilitation", Mittal Publications, 2007.
6. R. B. Singh, "Natural Hazards and Disaster Management, Vulnerability and Mitigation", Rawat Publications, 2006.
7. C. P. Lo and A. K. W. Yonng, "Concepts and Techniques of GIS", Prentice Hall (India), 2006.
8. C. G. F. Gonzales, "Risk Management of Natural Disasters", KIT Scientific Publishing, 2010.
9. W. N. Carter, "Disaster Management – A Disaster Manager's Handbook", Asian Development Bank, 2008.
10. R. K. Srivastava, "Disaster Management in India", Ministry of Home Affairs, Government of India, New Delhi, 2011.
11. W. Mara, "The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy", Marshall Cavendish Corporation, 2011.
12. R. Eisler, "The Fukushima 2011 Disaster", Taylor and Francis, 2013. (Learners are expected to refer reports published at national and international level and updated information available on authentic web sites)

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Science of Well-being (OEEE7048T)		

Course Objectives

1. To create consciousness about importance of holistic health and physical as well as mental well-being.
2. To make learners aware of the concepts of Happiness, Gratitude, Self-Compassion, Empathy etc.
3. To introduce the learners to the means of mental and physical well-being, ill effects of mal- practices like alcoholism, smoking etc.
4. To equip the learners to manage and cope up with stress in their daily living.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe concepts of holistic health and well-being, differentiate between its true meaning and misconceptions, and explain the benefits of well-being.	L2	Understand
CO2	Describe the meaning of happiness, practice gratitude and self-compassion, and analyze incidents from one's own life	L2	Understand
CO3	Explain the causes and effects of stress, identify reasons for stress in one's own surroundings and self.	L2	Understand
CO4	Describe the importance of physical health and fitness, assess one's lifestyle, and justify its limitations or effectiveness.	L2	Understand
CO5	Analyze one's own coping mechanisms, assess their effectiveness, develop and strategize for betterment, and execute them.	L4	Analyze

Science of Well-being (OEEE7048T)
Course Contents

Unit-I 06 Hrs.

Health and Well-being: The concept of health, dimensions of health, the notion of well- being, various facets of well-being, relation between health and well-being.

Concept of holistic health, its principles and importance, concept and benefits of holistic care, misconceptions about holistic health approach, the application of a true holistic approach to our well-being.

Unit-II 08 Hrs.

Concepts of Happiness

Happiness: what is it and how do we measure it? Philosophical perspectives on happiness,

Happiness: Nature or Nurture? Happiness in the modern world: impediments and accelerators, Narrow vs. Broad Band Approaches to Happiness, Benefits of Happiness, Self-Compassion and Gratitude. Misconceptions of happiness.

Unit-III 10 Hrs.

Stress and Mental Health / Well-being: Nature and concept of stress, meaning and definitions of stress, types of stress, meaning of stressors, types of stressors, symptoms of stress, effects of stress, different models of stress.

Sources of stress and how does stress cause illness, various sources of stress, delineate between external and internal sources of stress, differentiate between continuous and discrete stressors, the effects of these stressors on health and well-being, diversity of stressors and their health consequences, relation between stress and illness from different perspectives association between stress related physiological mechanisms and different illnesses.

Unit-IV 10 Hrs.

Physical Well-being / Health Management: Concept of health behaviours, dimensions of health behaviours. Health enhancing behaviors: Exercise and Weight control, application and importance of these health enhancing behaviours. Health protective behaviors and illness management: concept of illness management, effectiveness of illness management.

Concept of Nutrition, Role of Nutrition, Components of Nutrition, concept of Malnutrition,

Health compromising behaviours: Alcoholism, Smoking and its effects on health.

Unit-V 08 Hrs.

Dealing with Difficult Times / Coping mechanisms: The concept of chronic stress, Health and safety risks of chronic stress, Forms and Treatment of chronic stress, Coping with Acute and Chronic stress, theories of the stress-illness link, role of stress in mental disorders.

Concept of coping, Ways of coping and stress management, basic knowledge about stress manage-

ment, various techniques of stress management, stress management programs. Mental strengths and virtues, Hope, Optimism, Resilience - concept, pathways and models, Meditation and Self-introspection.

Text Books:

1. Felicia Huppert, Nick Baylis, Barry Keverne, "The Science of well-being", Oxford University Press, 2005.
2. S. Ojha, U. Rani Srivastava, Shobhna Joshi, "Health and Well-Being: Emerging Trends", Global Vision Publishing House, 2010.
3. Charles Richard Snyder, Shane, J. Lopez, Jennifer Teramoto Pedrotti, "Positive Psychology: The scientific and Practical Explorations of Human Strengths", 2nd Edition, Sage Publications, 2011.

Reference Books:

1. Kitayama S. and Markus H. R., "The Pursuit of Happiness and the Realization of Sympathy: Cultural Patterns of Self, Social Relations, and Well-being", Culture and subjective well-being, The MIT Press, 2000.
2. Dubos R., "Man Adapting New Haven", Yale University Press, 1980.
3. McMahon D. M., "Happiness a history", Atlantic Monthly Press, 2006.
4. D. Kahneman, E. Diener and N. Schwarz, "Well-being: The Foundations of Hedonic Psychology", Russell Sage Foundation, 1999.
5. Selye H., "The Stress of Life", McGraw-Hill, 1984.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Research Methodology (OEEE7049T)		

Prerequisite: Basic Knowledge of Probability and Statistics.

Course Objectives

1. To understand Research and Research Process.
2. To acquaint learners with identifying problems for research and develop research strategies.
3. To familiarize learners with the techniques of data collection, analysis of data and interpretation.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply preliminary research design concepts for projects in their subject matter areas.	L3	Apply
CO2	Analyze and report research data using appropriate statistical and analytical techniques.	L4	Analyze
CO3	Explain complex data or situations clearly.	L2	Understand
CO4	Analyze the research findings.	L4	Analyze
CO5	Summarize a structured research report based on research findings.	L2	Understand

Research Methodology (OEEE7049T)
Course Contents

Unit-I 07 Hrs.

Basic Research Concepts: Meaning of research, Objectives of research, Types of research, Significance of research Research process.

Unit-II 10 Hrs.

Research Methodology: Identification of research problem, Literature review, Formulation of hypothesis, Formulation of Research design.

Unit-III 10 Hrs.

Research and Sample Design: Meaning of research and sample design, Need of research design, Features of good research design, Important concepts, Different research designs, Types of sampling designs.

Unit-IV 10 Hrs.

Data Collection and Data Analysis: Types of data, Methods for collecting data: Experiments and surveys, Collection of primary and secondary data, Hypothesis testing and interpretation of Data.

Unit-V 05 Hrs.

Interpretation and Report Writing: Interpretation and drawing conclusions on the research, Preparation of the report, Ethical Issues.

Reference Books:

1. Dawson, Catherine, "Practical Research Methods", 1st Edition, UBS Publishers Distributors, 2002.
2. Kothari C. R., "Research Methodology- Methods and Techniques", 2nd Edition, Wiley Eastern Limited, 2004.
3. Kumar, Ranjit, "Research Methodology- A Step-by-Step Guide for Beginners", 3rd Edition, Pearson Education, 2010.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Public Systems and Policies (OEEE70410T)		

Prerequisite: Basic Knowledge of Social science and Current affairs.

Course Objectives

1. To analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
2. To understand public systems in a fast-changing environment in the global context.
3. To provide an in-depth understanding of the ills prevailing in the society and aids to identify the solutions for them.
4. To explain public policy and its operations with special focus on policy relating to Government finance.
5. To analyze and evaluate the impact of the public policy on firms and economy at large.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the importance of public systems in a fast-changing environment in the global context.	L2	Understand
CO2	Analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.	L4	Analyze
CO3	Explain public policy and its operations with special focus on policy relating to Government finance.	L2	Understand
CO4	Analyze the impact of public policy on firms and the economy at large and work under various fields as policymakers.	L4	Analyze
CO5	Apply analytical skills through Expenditure Policy in public services case studies.	L3	Apply

Public Systems and Policies (OEEE70410T)
Course Contents

Unit-I 10 Hrs.

Introduction and Overview of Public Systems: Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments, Government growth; The size of Government.

Unit-II 06 Hrs.

Public Sector in the Economics Accounts: Public Sector in the circular flow; Public Sector in the National Income Accounts.

Unit-III 08 Hrs.

Public Choice and Fiscal Politics: Direct Democracy; Representative Democracy; The Allocation Function; The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.

Unit-IV 12 Hrs.

Introduction and Overview of Public Policy: Markets and Government; Social goods and Market failure, Public expenditure and its evaluation; Cost Benefit Analysis, Public policy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal and Budgetary Policy, Fiscal Federalism in India.

Unit-V 06 Hrs.

Case Studies in Expenditure Policy: Public Services: A) National Defense B) Highways C) Outdoor Recreation D) Education.

Reference Books:

1. Charles Wheelan, "Introduction to Public Policy", W. W. Norton and Company, 2011.
2. Thomas R. Dye, "Understanding Public Policy", Prentice Hall, 2008.
3. Anderson J.E.,"Public Policy-Making: An Introduction", Boston, 2011.
4. Avasthi and Maheshwari, "Public Administration", Lakshmi Narain Agarwal, 2008.
5. Mohit Bhattacharya, "New Horizons of Public Administration", Jawahar Publishers, New Delhi, 2011.
6. Nicholas Henry,"Public Administration and Public Affairs", Prentice Hall of India, 2017.
7. Harvey S Rosen and Ted Gayer, "Public Finance", 10th Edition, McGraw-Hill Education, 2013.
8. Richard A. Musgrave and Peggy B. Musgrave, "Public Finance in Theory and Practice", 5th Edition, McGraw Hill, 2017.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Electrical Engineering Simulation Laboratory (PCEE7050L)		

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

Course Objectives

1. The objective of this lab is to appreciate and use various software tools like MATLAB/ PSCAD/ETAP/ POWER WORLD in electrical engineering formodeling and simulation of different courses like power systems, electrical machines, solar systems, electric vehicles, and power electronic circuits in lesser time.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Recognize the importance of various modern tools for simulating electrical systems.	L2	Understand
CO2	Analyze the various electrical parameters of static and rotating machineries.	L4	Analyze
CO3	Analyze the design parameters of insulators, voltage sag, voltage swell, solar photovoltaic systems, and inverter system.	L4	Analyze
CO4	Analyze the power system stability, load flow analysis, and relay coordination in power systems.	L4	Analyze
CO5	Design and implement models of cell balancing in battery management systems, battery controller, and state of charge for battery in electric vehicle systems.	L6	Create

Electrical Engineering Simulation Laboratory (PCEE7050L) Course Contents

List of Laboratory Experiments

Suggested Experiments: (Any 10)

1. Introduction to PSCAD.
2. Introduction to ETAP.
3. Introduction to Power world.
4. Speed control of induction motor using SVPWM. (Scalar Control)
5. Modeling and simulation of single phase (two winding) transformers.
6. Measurement of efficiency of 3 phase transformer.
7. Simulation of Transformer core saturation and inrush current.
8. Design and simulation of string efficiency model of suspension insulator.
9. Simulation of solar PV MPPT System.
10. Analysis of total harmonic distortion (THD) and FFT for an inverter.
11. Design and simulation of voltage sag and voltage swell model.
12. Simulation of power system stability using Power world/MATLAB.
13. Load flow analysis using ETAP/MATLAB/Power world.
14. Simulation study of relay coordination.
15. Simulation of battery management system using passive cell balancing for electric vehicle.
16. Design and simulation of battery controller for electric vehicle.
17. Estimation of state of charge of EV.
18. Development of GUI for electrical system.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

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

Lab Tools

1. MATLAB/Simulink
2. PSCAD
3. ECAD
4. Power World Software

Program: Electrical Engineering	Final Year B. Tech.	Semester: VII
Project Stage-II (PJEE7060L)		

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.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the problem statement and produce solution of the problem considering cultural, social, environmental and economic factors using appropriate tool and method.	L4	Analyze
CO2	Interpret project based learning that allows students to transfer existing ideas into new applications.	L2	Understand
CO3	Apply the ability to work in teams and manage to conduct the project development activity.	L3	Apply
CO4	Use different perspectives from relevant disciplines which help them to get internships, jobs, and admission for higher studies.	L3	Apply
CO5	Explain the project development in the form of technical writing, and interpret what constitutes plagiarism and the use of proper referencing styles.	L2	Understand

Project Stage-II (PJEE7060L)
Course Contents

Syllabus:

1. Project-I work decided in VI semester shall be continued as Project-II in semester VII.
2. Students should complete implementation of ideas given in synopsis/Abstract.
3. Students / group must plan their execution of project, so that project work should be completed before end of semester.
4. Project-II involves fabrication, design, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. The stage also includes testing, possible results and report writing.
5. Each project group is required to maintain log book for documenting various activities of Project-II and submit group project report at the end of Semester-VII in the form of Hard bound.
6. Domain knowledge (any beyond) needed from the following areas for the effective implementation of the project: Electrical Machines, Power System Analysis, Electromagnetic Engineering,Utilization of Electrical Energy, Industrial Automation Control and Digital Signal Processing, Internet of Things, Machine Learning, Python Programming.
   The above areas can be updated based on the technological innovations and development needed for specific project.

Guidelines:

The main purpose of this activity is to improve the students' technical skills, communication skills by integrating writing, presentation and teamwork opportunities.

- Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.
- In the first review of this semester, each group is expected to complete 70 percent of project. (may consist theoretical design of project, block diagram and circuits / components required for realization of block, algorithm and its implementation details, simulation of circuits etc).
- In the second review of this semester, each group is expected to complete 100 percent of project. (may consist practical hardware fabrication, interconnection of all PCBs/ boards, final testing of project, implementation of algorithm, testing, debugging, programming).
- The students may use this opportunity to learn different computational techniques towards development of a product.
- Interaction with alumni mentor will also be appreciated for the improvement of project.

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).
- The candidate must bring the project part- 1 report and the final report completed in all respect while appearing for End Semester Examination.
- Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration based on their project.

Prescribed Project Report Guidelines:

Every group should prepare hard bound report (preferrable LaTeX) of about minimum 40 pages on the work carried out by a batch of students in respect of the project work done during semester-VII. Project Report should include appropriate content for:

- Title
- Abstract
- Introduction
- Problem identification and project objectives
- Literature Survey
- Related Theory
- Project design and Implementation details
- Case study/Analysis/Design Methodology
- Project Outcomes
- Result and Conclusion
- Future Scope
- 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 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

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 above aspects.

Table 1: Log Book Format

S. N.	Week (Start Date : End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				

Table 2: Continuous Assessment Sheet

S. N.	Exam Seat No	Name of Student	Student Attendance (5)	Log Book Maintain (5)	Literature Review (5)	Depth of Understanding (5)	Report (5)	Total (25)

Table 3: Evaluation Sheet

S. N.	Exam Seat No	Name of Student	Project Selection (5)	Design / Simulation / Logic (5)	PCB / Hardware / Programming (5)	Result Verification (5)	Presentation (5)	Total (25)

Program: Electrical Engineering	Final Year B. Tech.	Semester: VIII
HVDC Transmission (PEEE8011T)		

Prerequisite: Power System, Power Electronics.

Course Objectives

1. Impart knowledge related to the concept, planning of DC power transmission and comparison with AC Power transmission.
2. To analyze High Voltage Direct Current (HVDC) converters.
3. To study about the HVDC system control.
4. To possess knowledge related voltage stability in DC system.
5. To meet desired needs the recent technology in in DC system.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply basic transmission concepts to compare the advantages of DC transmission over AC transmission.	L3	Apply
CO2	Analyze the operation of Line Commutated Converters and Voltage Source Converters.	L4	Analyze
CO3	Analyze different the control strategies used in HVDC transmission system.	L4	Analyze
CO4	Analyze power system stability using an HVDC system	L4	Analyze
CO5	Evaluate the multi terminal HVDC transmission system	L5	Evaluate

HVDC Transmission (PEEE8011T)
Course Contents

Unit-I 09 Hrs.

DC Transmission Technology: Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of HVDC system. Line Commutated Converter and Voltage Source Converter based systems.

Unit-II 08 Hrs.

HVDC Converter: Choice of converter configuration, analysis of Gratz circuit with and without overlap, working of converter as rectifier and inverter, equivalent circuit for HVDC link.

Unit-III 08 Hrs.

HVDC System Control: HVDC System Control: Principles of DC link control, converter control characteristics, firing angle control, current and extinction angle control, Starting and stopping of HVDC link.

Unit-IV 09 Hrs.

Converter Faults and Protection: short circuit in bridge, Over current and over voltage protection, Detection of line faults, Principle of DC circuit interruption, DC breakers, Types and characteristics of DC breakers, effects of proximity of AC and DC transmission lines.

Unit-V 08 Hrs.

MTDC Links: Multi Terminal and Multi In feed Systems. Series and Parallel MTDC systems using LCCs. MTDC systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi level Converters.

Text Books

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 33rd Edition, 2017.
2. S. Rao,, "EHVAC and HVDC Transmission Engineering and Practice", Khanna Publications, 33rd Edition, 1993

Reference Books

1. T J. Arrillaga, "High Voltage Direct Current Transmission", Institution of Electrical Engineers, 23nd Edition, 2008.
2. E. W. Kimbark, "Direct Current Transmission", Wiley Interscience, 1971.
3. Kimbark, "HVDC Transmission", John Willey and Sons.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VIII
EHVAC Transmission Systems (PEEE8012T)		

Prerequisite: Electrical Machine, Power System, High voltage Engineering

Course Objectives

1. To Understand the Urgency of Energy Needs in Developing Countries: Explore the critical nature of energy requirements in developing countries and the impact of these needs on national policies.
2. Analyze Geographical Disparities in Power Generation: Examine the factors contributing to the placement of power stations far from load centers.
3. Examine the Requirement for High Voltage Transmission: Investigate the necessity for very high voltages in the transmission of electric power over extended distances.
4. Evaluate the Evolution of DC Transmission Technology: Explore the historical development of DC transmission since 1950. Assess the rapid strides made in this technology and its role in facilitating extra long distance power transmission. Understand how DC transmission complements or supplements existing Extra High Voltage Alternating Current (EHVAC) transmission systems.
5. Appraise the Role of Transmission Technologies in Global Energy Relations: Analyze how national policies related to energy, particularly in developing countries, influence relationships with other nations

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the significance and requirements of EHVAC transmission systems.	L2	Understand
CO2	Analyze line and ground parameters in transmission systems.	L4	Analyze
CO3	Analyze the environmental effects of high-voltage levels.	L4	Analyze
CO4	Apply various techniques in electrical engineering applications.	L3	Apply
CO5	Explain the corona phenomenon and its effects on EHV transmission systems.	L2	Understand

EHVAC Transmission Systems (PEEE8012T)
Course Contents

Unit-I 08 Hrs.

Introduction to Transmission Line Trends: Basic aspects of AC Power Transmission, Need for EHV transmission lines, Role of EHV AC Transmission, Power handling capacity and line loss, Examples on giant power pools and number of lines, Cost of Transmission Lines and equipment, Mechanical considerations in line performance types of vibrations and oscillations.

Unit-II 08 Hrs.

Calculation of Line and Ground Parameters: Resistance of conductors, Temperature rise of conductors and current carrying capacity, Properties of bundled conductors, Inductance of EHV line configurations, line capacitance calculations, sequence inductance and capacitances.

Unit-III 09 Hrs.

Voltage Gradient of Conductors: Electrostatic, Field of a point charge and its properties, Field of sphere gap, Field of line charges and their properties, charge potential relations for multi conductor lines, Maximum charge condition on a three phase line. Surface voltage gradient on conductors single conductor, two conductors bundle, Maximum surface voltage gradient, Mangled formula, design of cylindrical cages for corona gradients.

Unit-IV 09 Hrs.

Electrostatic and Magnetic Fields of EHV Lines: Electric shock and threshold currents, Effects of high electrostatic fields on humans, animals and plants, Calculation of electrostatic field of single circuit of three phase line, Profile of electrostatic field of line at ground level. Electrostatic field of a double circuit 3 phase AC line, Insulated ground wire and induced voltage in insulated groundwires. Magnetic field calculation of horizontal configuration of single circuit of three phase lines, Effects of power frequency magnetic fields on human health.

Unit-V 08 Hrs.

Corona and its Effects: Corona formation, visual critical voltage, corona power loss, corona loss formulae, charge voltage diagram, increase in effective radius of conductor and coupling factors, attenuation of travellingwaves due to corona loss. Audible noise – generation and characteristics, limits for audible noise, ANmeasurement and meters microphones, weighting networks.

Text Books

1. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New Age International Publishers, 33rd Edition, 2007.

Reference Books

1. A. Chakrabarti, D. P. Kothari, A. K. Mukhopadhyay, “Performance Operation and Control of EHV Power Transmission Systems”, Wheeler Publishing, 1999.

2. S. Rao, “EHV-AC, HVDC Transmission and Distribution Engineering”, Khanna Publishers, 33rd Edition, 2017.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VIII
Restructured Power System (PEEE8013T)		

Prerequisite: Electrical Energy generation System, Transmission and Distribution of Electrical Power and Power system Analysis.

Course Objectives

1. To familiarize the students with concepts and need for deregulated power systems.
2. To impart the knowledge of power market development in India and across the world.
3. To understand the key factors in equipment specification and system design.
4. To Explain Transmission Congestion Management, Financial Transmission Rights, Pricing of transmission network usage.
5. To Understand different Ancillary Services and reforms in Indian power sector.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the fundamental reasons and motivations for worldwide restructuring in the power sector.	L2	Understand
CO2	Explain the roles and responsibilities of various entities in the electricity market.	L2	Understand
CO3	Analyze issues related to congestion management, transmission pricing, and ancillary services.	L4	Analyze
CO4	Explain the power market scenarios in India.	L2	Understand
CO5	Analyze locational marginal pricing and financial transmission rights in electricity markets.	L4	Analyze

Restructured Power System (PEEE8013T)
Course Contents

Unit-I 09 Hrs.

Introduction to Restructuring of Power Industry: Mesh and Supermesh analysis, Node and Supernode analysis, Deregulation of power industry, unbundling of electric utilities, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models,Market Mechanism.

Unit-II 08 Hrs.

Power System Operation in Competitive Environment: Role of the independent system operator, Operational planning activities of ISO: ISO in Pool markets, ISO in Bilateral markets, Operational planning activities of a GENCO: GENCOs in Pool and Bilateral markets, market participation issues, competitive bidding.

Unit-III 08 Hrs.

Transmission Congestion Management: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods, Calculation of ATC,Non market methods Market methods Nodal pricing Inter zonal and Intra zonal congestion management Price area congestion management Capacity alleviation method.

Unit-IV 09 Hrs.

Ancillary Service Management and Pricing of Transmission Network: Introduction of ancillary services, Types of Ancillary services classification of Ancillary services, Load generation balancing related services, Voltage control and reactive power support devices,Black start capability service, ancillary service, Co-optimization of energy and reserve services,International comparison, Transmission pricing, Principles, Classification, Role in transmission pricing methods, Marginal transmission pricing paradigm, Composite pricing paradigm, Merits and demerits of different paradigm.

Unit-V 08 Hrs.

Power Market Development in India: Institutional structure in Indian Power sector, generation, transmission and distribution utilities.SO and LDCs. PFC, REC, ERCs, traders, Power Exchanges and their roles. Availability based tariff, Open access, Industry structure and regulatory framework, market development, RE Policies, RPO, Tariff policies. Policy changes, regulatory changes, Critical issues / challenges before the Indian power sector and Power Trading.

Reference Books

1. Kirschen and Goran Strbac,"Fundamentals of Power System Economics Daniel", John Wiley and Sons Ltd, 2004.
2. Loi Lei Lai, "Power System Restructuring and Deregulation", Wiley India, 2018.
3. Kankar Bhattacharya, Jaap E. Daalder ,Math Bollen, "Operation of Restructured Power Systems", Springer Publication, 2001.
4. Mohammad Shahidehpour and Muwaffaq Alomoush, "Restructured Electrical Power Systems: Operation, Trading and Volatility" , CRC Press; 1st Edition, 2017

Program: Electrical Engineering	Final Year B. Tech.	Semester: VIII
Optimization Techniques (PEEE8014T)		

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

Course Objectives

1. To give students the basic knowledge and tools to recognize, classify and solve different questions related to optimization problems as they appear in engineering.
2. Topics to be covered include basics of convex analysis, least squares, linear and quadratic programs, semi definite programming, optimality conditions, duality theory, and interior point methods.
3. Applications to a variety of electrical engineering problems will be presented.
4. The emphasis will be on training students to translate question in optimization to the correct mathematical formalization and to apply the correct techniques to solve such questions.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify and formulate engineering problems as optimization problems.	L4	Analyze
CO2	Explain the basic theory of optimization problems related to power systems.	L2	Understand
CO3	Analyze the tools and solution approaches used for solving optimization problems in power systems.	L4	Analyze
CO4	Implement different technique to electrical engineering field.	L3	Apply
CO5	Formulate engineering problems as optimization models and apply appropriate techniques for their solution.	L4	Analyze

Optimization Techniques (PEEE8014T)
Course Contents

Unit-I 08 Hrs.

Introduction to Optimization: Introduction, Historical Development, Engineering Applications of Optimization, Statement of Optimization Problem.

Unit-II 08 Hrs.

Linear Programming: Simplex Method, Revised Simplex Method, Duality, Sensitivity Analysis.

Unit-III 09 Hrs.

Non Linear Programming: One Dimensional Minimization, Elimination Methods. Fibonacci Method, Golden Section Method, Interpolation Methods, Quadratic and Cubic Interpolation Methods

Unit-IV 09 Hrs.

Unconstrained Optimization Methods: Univariate and Pattern Search Methods, Rosen brocks Method of Rotating Coordinates, Simplex Method. Descent Methods, Steepest Descent Method, Conjugate Gradient Method (Fletcher Reeves Method), Davidon Fletcher Powell Method.

Unit-V 08 Hrs.

Constrained Optimization: Complex Method, Cutting Plane Method, Method of Feasible Directions, Integer Programming, Quadratic Programming, Introduction to Genetic Algorithm.

Text Books

1. S. S.Rao "Engineering Optimization: Theory and Applications", New Age International Publishers, Revised 3^{rd} Edition, 2005.
2. Chander Mohan, Kusum Deep, "Optimization Techniques", New Age International Publishers, 2^{nd} Edition, 2023.

Reference Books

1. H. A. Taha, "Operation Research", Pearson Education, 9^{th} Edition, 2014.
2. R. L. Fox, "Optimization Methods for Engineering Design", Addison Wesley, 1971.
3. D. E. Goldberg, "Genetic Algorithms in Search, Optimisation, and Machine Learning", Addison Wesley, 1989.
4. Himmelblau, D.M. "Applied Nonlinear Programming", McGraw Hill, 1972.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VIII
Computer Vision and Image Processing(PEEE8021T)		

Prerequisite: Fundamentals of image processing.

Course Objectives

1. To understand fundamental concepts/issues of Computer Vision and Image Processing.
2. To understand the concepts of image enhancement, segmentation, spatial and frequency domain in image processing.
3. To understand the concept of feature extraction and selection of pattern classification and recognition.
4. To understand motion estimation and tracking, image classification, scene understanding, object classification and tracking.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the fundamental concepts of computer vision and image processing.	L2	Understand
CO2	Describe image enhancement and segmentation processes in image processing.	L2	Understand
CO3	Analyze the feature extraction methods in image processing.	L4	Analyze
CO4	Describe image analysis and machine learning techniques used in image processing.	L2	Understand
CO5	Apply machine learning algorithms in the field of computer vision.	L3	Apply

Computer Vision and Image Processing (PEEE8021T)
Course Contents

Unit-I 08 Hrs.

Introduction to Computer Vision and Basic Concepts of Image Formation: Introduction and Goals of Computer Vision and Image Processing. Image Processing Concepts: Image Transforms.

Unit-II 08 Hrs.

Image Enhancement techniques in spatial and frequency domain. Image Filtering, Color Image Processing.

Unit-III 08 Hrs.

Image Segmentation, Image Descriptors and Features: Texture Descriptors, Color Features, Edges/Boundaries.

Unit-IV 09 Hrs.

Image Descriptors and Features: Object Boundary and Shape Representations. Image Descriptors and Features: Histogram of Oriented Gradients, Scale Invariant Feature Transform, Speeded up Robust Features, Saliency.

Unit-V 09 Hrs.

Fundamentals of Machine Learning: Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory. Applications of Computer Vision: Artificial Neural Network for Pattern Classification, Convolutional Neural Networks

Reference Books

1. Forsyth and Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2nd Edition, 2015.
2. M. K. Bhuyan, "Computer Vision and Image Processing: Fundamentals and Applications", CRC Press, 2019.
3. M.E. Valkenburg, "Network Analysis", Pearson Education, 3rd Edition, 2019.
4. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010.
5. NPTEL video lecture series on Computer Vision and Image Processing - Fundamentals and Applications

Program: Electrical Engineering	Final Year B. Tech.	Semester: VIII
DC Microgrid and Control System (PEEE8022T)		

Prerequisite: Fundamental of Power electronics, Power system and Control system

Course Objectives

1. To understand the fundamental concepts of microgrid and its components, types of microgrids, advantages of microgrid compared to the central conventional grid.
2. To understand general concepts and application, control strategies and principle of operation of DC microgrid.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the concepts of microgrids.	L2	Understand
CO2	Develop PV model for power systems and standard grid tied inverter.	L6	Create
CO3	Analyze the significance of energy management in micro grid system.	L4	Analyze
CO4	Analyze control strategies for DC microgrids.	L4	Analyze
CO5	Analyze stability issues in microgrid.	L4	Analyze

DC Microgrid and Control System (PEEE8022T)
Course Contents

Unit-I 08 Hrs.

Introduction to Microgrid: Overview of microgrids, concept of microgrid, Microgrid and distributed generation, Microgrid vs Conventional Power System, AC and DC Microgrid with Distributed Energy Resources.

Unit-II 09 Hrs.

Power Electronics for Micro grid: Power Electronics for Micro grid, Power Electronic Converters in Micro grid Applications, Power Electronic Converters in Micro grid Applications (Power Electronic for Interfacing), Converter Modulation Techniques, Modeling of converters in micro grid power system (AC /DC and DC/AC Converters Modeling), DC/DC Converter Modeling and Control, Modeling of Renewable Energy Resources (Modeling of Wind Energy System, Photovoltaic System), Modeling of Energy Storage System.

Unit-III 08 Hrs.

Microgrid Dynamics: Microgrid Dynamics and Modeling, Operation Modes and Standards, Microgrid Control Architectures, Intelligent Microgrid Operation and Control, Energy Management in Microgrid System.

Unit-IV 08 Hrs.

DC Microgrid Control System: DC Microgrid System Architecture and AC Interface, DC Microgrid Dynamics and Modelling, Control of DC Microgrid System, Applications of DC Microgrids.

Unit-V 09 Hrs.

Stability in Microgrid: Stability in Microgrid, Stability Analysis of DC Microgrid, DC Microgrid stabilization strategies (passive damping method, Impedance/Admittance stability criteria), DC microgrid stabilization using nonlinear Techniques.

Text Books

1. Fusheng Li, Ruisheng Li, Fengquan Zhou, Microgrid Technology and Engineering Application, Elsevier, 1st Edition, 2015.

2. Hassan Bevrani, BrunoFrançois, Toshifumi Ise,Microgrid Dynamics and Control JohnWiley Sons, 1st Edition, 2017.

Reference Books

1. S. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks", Institution of Engineering and Technology, 2^{nd} Edition, 2009.

2. Nikos Hatziargyriou, “Microgrids Architectures and Control”, John Wiley Sons, 2nd Edition, 2014.

3. Manuela Sechilariu, Fabrice Locment, “Urban DC Microgrid: Intelligent Control and Power Flow Optimization”, Butterworth Heinemann, 1st Edition, 2016.

4. Gevork B. Gharehpetian, S.Mohammad Mousavi Agah, Distributed Generation Systems: Design, Operation and Grid Integration, Butterworth Heinemann, 1st Edition , 2017.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VIII
Power System Dynamics (PEEE8023T)		

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

Course Objectives

1. To Understand the fundamental dynamic behavior of power systems to perform basic stability issues.
2. To acquire fundamental knowledge about modelling of synchronous machines.
3. To recognize the dynamic performance of power systems.
4. To familiarize with the power system stability and controls.
5. To realize about the impact of dynamics in power system.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Select fundamental dynamic behavior and control mechanisms of power systems for performing basic stability analysis.	L5	Evaluate
CO2	Explain the concepts of modeling and simulation of dynamic phenomena in power systems and interpret results of system stability studies.	L2	Explain
CO3	Analyze the modeling theory and practical representation of major power system components such as synchronous machines, excitation systems, and governors.	L4	Analyze
CO4	Analyze the control strategies used for maintaining power system stability.	L4	Analyze
CO5	Recognize the impact of dynamic behavior on power systems.	L2	Understand

Power System Dynamics (PEEE8023T)
Course Contents

Unit-I 08 Hrs.

Basic Concepts: Power system stability states of operation and system security, system dynamics, problems system model analysis of steady State stability and transient stability, simplified representation of Excitation control.

Unit-II 09 Hrs.

Modeling of Synchronous Machine: Synchronous machine, park's Transformation analysis of steady state performance, per unit quantities, Equivalent circuits of synchronous machine, determination of parameters of equivalent circuits.

Unit-III 09 Hrs.

Excitation and Prime Mover Controllers: Excitation system, Excitation system modeling, excitation systems Standard block Diagram, system representation by state equations, Prime Mover Control System.

Unit-IV 08 Hrs.

Transmission Lines, SVC and Loads: Introduction to Transmission Lines, D-Q Transformation using Variables, Transmission Line Equations in Variables, Loads on Transmission Lines.

Unit-V 08 Hrs.

Dynamics of a Synchronous Generator: System Model, Synchronous Machine Model, Application of Model, Calculation of Initial Conditions, System Simulation, Consideration of other Machine Models.

Reference Books

1. K. R. Padiyar,"Power System Dynamics, Stability and Control", BS Publications, 2nd Edition, 2008.
2. P. Kundur, "Power System Stability and Control", McGraw Hill 1995.
3. P. M. Anderson and A. A. Fouad, "Power System Control and Stability", Wiley India, 2nd Edition, 2008.
4. I.J. Nagrath, D.P. Kothari, "Modern Power System Analysis", Tata McGraw Hill, 1994.
5. A. Chakrabarti, M. L. Soni , P.V.Gupta, U. S. Bhatnagar, "Power System Engineering", Dhanpat Rai and Co., 2009.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VIII
Emerging Trends in Electrical Engineering (PEEE8024T)		

Prerequisite: Knowledge of Basic Electrical Energy, knowledge of Electrical Energy Generation System, present scenario of power system.

Course Objectives

1. To introduce students to the basic structure and requirements of any electric power supply system.
2. To develop knowledge about nature of Electrical engineering and its profession
3. To develop an understanding of components of smart grid and to understand the basic principles involved in these components.
4. To know Role of Electric Vehicles in energy transition and challenges of smart cities in India.
5. To Know the roles and functions of the devices /components in Intelligent MCC and net metering system and Billing calculation.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the principles of IoT and its application in the given context.	L2	Understand
CO2	Apply the functions of smart grid components in relevant applications.	L3	Apply
CO3	Analyze the components required to achieve specified features in a smart home system.	L4	Analyze
CO4	Design an outline of IMCC with suitable components for a given application.	L6	Create
CO5	Analyze the application of net metering principles for integrating micro-generators with the grid system using schematic diagrams.	L4	Analyze

Emerging Trends in Electrical Engineering (PEEE8024T) Course Contents

Unit-I 08 Hrs.

Digitization beyond automation: Industrial Revolutions: Versions 1.0, 2.0, 3.0 and 4.0; the driving energies/powers for these revolutions. Components of Industrial Revolution 4.0: CPS (Cyber Physical Systems), IoT (Internet of Things), Cloud Computing and Cloud Manufacturing. IoT principle and features. IoT application areas in electrical systems: building automation SCADA, Smart metering, Illumination systems (public lighting). IoT initiatives in power distribution systems.

Unit-II 08 Hrs.

Smart Grid: Need and evolution, layout and its components, Advantages and barriers, Smart Grid Projects in India. Micro Grid and Distributed Energy Resources: Need and formation of micro grid, Distributed Generation. Systems and Distributed Generation Technologies. Smart Substation: Need, Layout and Components, Typical Specifications of existing substations.

Unit-III 08 Hrs.

Smart City (Electrical Features): Features, components, Objectives and challenges of smart Cities in India. E car, Role of Electric Vehicles in energy transition, basics of electric car, types of electric cars, working principle, charging stations. Fuel cell for e cars, types, features, limitations. Smart Home: Features and Components. Illumination and smart appliance control principles (block diagram/s).

Unit-IV 09 Hrs.

Intelligent Motor Control Centers: General/traditional (conventional) Motor control center, Role in Motor protection and motor management. Typical block diagram and general architecture or arrangement. Components: symbols and functions. Traditional MCCs, advantages and disadvantages. Intelligent or Smart MCCs: Need and the requirements that lead to have IMCCs. Role as compared to traditional MCCs. Functional Block diagram/s with general arrangements. Devices and Components typical to IMCCs: Intelligent relays, fuses, control devices, effective security and dedicated software. Basic components of intelligent systems: Control by microprocessor / microcontroller based systems; networking / technology replaces hard wiring and enhanced diagnostic/protective functionality. eSelection of MCC: intelligent and conventional types for typical applications.

Unit-V 09 Hrs.

Tariff Metering and Billing: Tariff, Power Purchase, Power Purchase Agreements (PPA), Power purchase cost. Tariff Design: Key factors for Tariff Design, Major Components of an Electricity Bill, various slabs in billing, electricity duty, tax on electricity and Cross subsidy. Special tariffs: Average Billing Rate (ABR), Aggregate Revenue Requirement (ARR), Availability based Tariff (ABT), Time of Day Tariff

(ToD), Recent ToD structure. kVAh tariff: kVAh billing method for HT and LT Consumers, kVAh Metering methodology, kVAh based Billing calculation, Metering and Bill Management, Working of Net metering and Gross metering, MERC rules for Net metering bill(Regulations 2015), Application of Net Metering for integration of micro generators with grid system. Recent Meter Reading techniques MRI / AMR reading.

Text Books

1. Bharat Modi,Anu Prakash, Yogesh Kumar, "Fundamentals of SmartGrid Technology", S. K. Kataria and Sons, 2015.
2. Janaka Ekanayake, Kithsiri Liyanage et. al., "Smart Grid: Technology and Applications", Wiley, 2015.
3. Sharma, Poonam, Rajput, Swati, "Sustainable Smart Cities in India: Challenges and Future Perspectives", Springer, 2017.

Reference Books

1. S. K. Bhattacharya, "Control of Electrical Machines", New Age International, 2006.
2. U. S. Eshwar, "Handbook of Electrical Motor Control Systems", Tata McGraw-Hill Education, 1989.
3. Keli Shi and Tze Fun Chan, "Applied Intelligent Control of Induction Motor Drives", Wiley-IEEE Press, 1st Edition, 2011.
4. Yogendra Talware, "Art of Reading Electricity Bill", Strom Energie Pvt. Ltd. Pune.

Program: Electrical Engineering	Final Year B. Tech.	Semester: VIII
Internship (INTEE8030L)		

Course Objectives

1. To expose technical students for the industrial environment, allowing them to gain real-world experience and develop into competent professionals.
2. To provide opportunities to learn and enhance the practical technical skills required for professional roles.
3. To familiarize students with current technological developments relevant to their field of study.
4. To develop technical writing skills for reports and projects.
5. To introduce students to the responsibilities and ethics of the engineering profession.
6. To develop an understanding of employee psychology, habits, attitudes, and problem-solving approaches.

Course Outcomes

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply theoretical knowledge to real-world engineering problems through hands-on experience in industry or field settings.	L3	Apply
CO2	Apply technical knowledge and problem-solving approaches to address complex engineering problems in an industrial environment.	L3	Apply
CO3	Analyze organizational structures, workflows, and technologies to understand industry practices and operational challenges.	L4	Analyze
CO4	Develop technical documentation, reports, and presentations reflecting experiential learning and problem-solving approaches.	L6	Create
CO5	Discuss career goals and identify areas for personal and professional development based on internship exposure.	L2	Understand

Internships offer valuable educational and career development opportunities by providing students with practical experience in their field of study. In Semester–VIII, students have two options for their internship: Industry Internship and In-house Internship.

A Industry Internship

(a) Industry Internship Guidelines:

i. The Training and Placement (T&P) cell of the institute will arrange internships for students in industries/organizations after the seventh semester.

ii. Students are expected to accept internship offers regardless of the company, job profile, location, or stipend offered.

iii. Alternatively, students can individually apply by submitting "Student Internship Program Application" (available on Institute Website) for industry internships, adhering to the prescribed guidelines as follows:

A. Only T&P department granted internship will be considered.

B. The internship duration should be of minimum 12 Weeks.

C. Each student needs to take prior permission from T&P department before proceeding for any internship opportunity on his/her own.

D. Each student will be monitored twice (virtually/through online meetings) during the internship period in the presence of an industry mentor and the departmental faculty mentor and the concerned TPC.

E. If any student wants to withdraw from the Internship, he/she can only be allowed within two weeks of joining the same. Such students will have to continue the semester VIII academic activities regularly along with In-house internship.

(b) Expected Activity in Industry Internship:

i. Students may choose to work on innovation or entrepreneurial activities resulting in start-ups or undergo internships with Industry/NGO/ Government organizations/Micro/ Small/ Medium enterprises to prepare for the industry.

ii. Every student is required to prepare a file containing documentary proofs of the activities done by him/her. The evaluation of these activities will be done twice (virtually/through online meetings) during the internship period by the committee constituted by the Head of the Department which shall include Industry mentor, faculty mentor and Department T&P Co-ordinator (TPC). The assessment criteria for continuous assessment is as per Table 1.

Table 1: Continuous Assessment for Industry Internship

Internship Objectives and Goals (30 Marks)	Internship Experience Skills Gained / Enhanced (30 Marks)	Professional Development and Growth (30 Marks)	Internship Report (30 Marks)	Presentation (30 Marks)

iii. The ESE will be jointly evaluated by an industry mentor, faculty member and department T&P coordinator (TPC). The evaluation criteria is as per Table 2.

Table 2: Evaluation Criteria of Industry Internship

Internship Objectives and Goals (30 Marks)	Internship Experience Skills Gained / Enhanced (30 Marks)	Professional Development and Growth (30 Marks)	Internship Report (30 Marks)	Presentation (30 Marks)

(c) **Industry Internship Report:**

i. Upon completion of the internship, students should prepare a comprehensive report that reflects their observations and learnings during the internship period. Students can consult their Industrial Supervisor, Faculty Mentor, or T&P Co-ordinator/Officer for guidance on selecting special topics and problems for the report.

ii. The internship report will be evaluated based on the following criteria:

A. Adequacy and purposeful write-up.

B. Variety and relevance of learning experience.

C. Practical applications and connections with the fundamental theories and concepts covered in the course (Semester I to VII).

B **In-house Internship** The in-house internship provides students with research-oriented opportunities to cultivate a research mindset. It serves as an extension of the project completed in VI and VII semesters (Project Stage-I & II) or offers new objectives provided by the department or research guide.

(a) The in-house internship can be pursued individually or as a group activity.

(b) If extending a project from Stage II, at least one student in the group must have participated in Stage I & II.

(c) If working on the topic offered by the department or in-house mentor, a group of fresh students can form a team.

(d) The maximum group size is limited to four students.

(e) In case of extension of project stage II, the outcomes should be in the form of product development/technology transfer along with patent and copyright / one research publication (UGC care listed journal/conference). Students can work jointly with any government funding agency or industry. In such cases, a detailed project report shall be submitted after verification by the in-house mentor and industry/funding agency mentor/authority. In case of standalone/non-sponsored activity, i.e. without any funding agency/industry collaboration, the detailed project report shall be submitted after verification by the in-house mentor.

(f) If pursuing a Topic offered by the department or in-house mentor, the outcome of the in-house internship should include the publication of a research paper, preferably in an

SCI/Scopus/UGC care listed/indexed Journal/Conference. The detailed project report must be submitted and verified by the in-house mentor.

(g) All the designated work shall be submitted to the department in the form of a report in hardbound as well as soft copy.

C **Evaluation Scheme:**

(a) **Continuous Assessment:**

i. A logbook (as per Table 3) of the work done must be maintained by each group.

ii. Each in-house internship activity will be reviewed twice in the semester. In the first review (as per Table 4), at least 40% work shall be completed including the topic identification / introduction/ scope of the work, literature survey, problem definition and objectives. The remaining 60% of work shall be completed in the second review (as per Table 5) including implementations, key findings, publications and / patenting and / copyright and / product development etc.

(b) **End Semester Examination:** End semester examination (as per Table 6) will be jointly evaluated by the faculty mentor and an external examiner appointed by the HOD in consultation with the COE.

Assessment Formats:

Table 3: Log Book Format

S. N.	Week (Start Date: End Date)	Work Done	Sign of In-house mentor	Sign of Coordinator
1				

Table 4: First Review

Topic Identification and Validation (20 Marks)	Literature Survey (20 Marks)	Problem Definition (20 Marks)	Objectives (15 Marks)

Table 5: Second Review

Implementation (20 Marks)	Publications (20 Marks)	Report (20 Marks)	Presentation (15 Marks)

Table 6: End Semester Examination

Topic Identification and Validation (30 Marks)	Literature Survey and Problem Definition (30 Marks)	Objectives and Implementation or Product Development (30 Marks)	Presentation (30 Marks)	Report, Publications / Patent / IPR Documents (30 Marks)