Department of Electrical Engineering
G.B PANT INSTITUTE OF ENGINEERING & TECHNOLOGY,
PAURI GARHWAL (UTTARAKHAND)-246194

Ref. No.- /EED/2021 Date: 25/11/2021

Minutes of BOS Meeting of Electrical Engineering

A meeting of Board of Studies (BOS) of the Department of Electrical Engineering held on 25-11-2021 for the design of course structures and syllabi of M. Tech in Electrical engineering w.e.f. academic session M. Tech 1st Year 2021-22 onwards.

Prof. V M Mishra	Professor	Chairman
Prof. M. K. Panda	Professor	Member
Prof. Sanjay Gairola	Professor	Member
Dr. Y. Kumar	Associate Professor	Member
Dr. Bhola Jha	Associate Professor	Member
Mr. S. Sarkar	Assistant Professor	Member
Mr. S.S. Rawat	Assistant Professor	Member
Mrs. O.L. Devi	Assistant Professor	Member
Mr. Sachin Negi	Assistant Professor	Member
Mr. Abhilekh Bartwal	Assistant Professor	Member
Mr. Surjeet Singh Patel	Assistant Professor	Member
Prof. Anirudh Gupta	Professor, BTKIT	UTU Nominee
Prof. A. K. Gautam	Professor	Director Nominee
Prof. S.K. Goel	Professor, COT, GBPUAT	External Academic Expert
Prof. Ajay Srivastava	Professor, COT, GBPUAT	External Academic Expert
Mr. Aditya Khati	Senior Engineer, BHEL, Rudrapur	Industry expert
Ms. Nidhi	M. Tech., Power Systems	Student Member

Mr. Abhilekh Bartwal	Mr. Surjeet Singh Patel	Mr. Sachin Negi
Mr. S. Sarkar	Mrs. O.L. Devi	Mr. S.S. Rawat
Ms. Nidhi	Mr. Aditya Khati	Dr. Bhola Jha
Dr. Y. Kumar	Prof. Sanjay Gairola	Prof. M. K. Panda
Prof. A. K. Gautam	Prof. Anirudh Gupta	Prof. Ajay Srivastava
Prof. S.K. Goel		Prof. V.M. Mishra

Members reviewed the precious course structures and syllabi for M. Tech. in Electrical Engineering and finalized in accordance with the present requirement and in concurrence to the course structure and syllabi of other reputed institutions. After discussions on suggestions, the evaluation scheme is proposed and approved in the meeting which is enclosed herewith.

EVALUATION SCHEME

&
SYLLABI

FOR

M. TECH.

IN

POWER SYSTEMS
(Effective from the session: 2021-2022)

DEPARTMENT OF ELECTRICAL ENGINEERING

G B PANT INSTITUTE OF ENGINEERING & TEEHNOLOGY

PAURI GARHWAL (UTTARAKHAND) INDIA

VISION OF THE DEPARTMENT

"To produce globally competent professionals addressing the challenges in the field of Electrical Engineering for the Sustainable Socio-Economic Development."

MISSION OF THE DEPARTMENT

M 1. Build a strong research and teaching-learning environment that responds swiftly to the challenges of electrical engineering.

M 2. To provide best facilities, infrastructure and conducive environment to the students, researchers and faculty members for the high-quality education and research in the field of Electrical Engineering.

M 3. To provide quality education in the theoretical and practical domains of Electrical Engineering for solving the real-world problems and thus amplifying their potential to succeed and contribute to the society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Sl. No.	Program Educational Objectives
PEO 1	To enable the post graduate (PG) students with strong mathematical skills and in-depth knowledge of electrical power systems to analyse and solve complex problems with a focus on lateral thought, originality and creativity.
PEO 2	To instil research skills and scientific temperament to comprehend, analyse, designed and create technically viable and economically feasible solution for the society.
PEO 3	To provide an academic ambience for lifelong learning in power systems and allied applications to meet the challenges of the rapidly changing environment through use of modern tools and soft skills.
PEO 4	To inculcate professionalism, engineering ethics, communication skills, entrepreneurial thinking and ability to relate engineering solutions to broader social context.

PROGRAM OUTCOMES (POs)

At the end of the program the students will be able to:

Sl. No.	Program Outcome	Graduate Attribute
PO 1	Acquire strong skills and in-depth knowledge in power system that enables to view the power system problems in a wider and global perspective, with an ability to discriminate, evaluate, analyse and synthesize the acquired knowledge in the domain of signal processing for enhancement of knowledge.	Scholarship of Knowledge
PO 2	Analyse complex problems in the domain of signal processing critically to make intellectual and creative advances for conducting research in a wider, theoretical, and practical context.	Critical Thinking
PO 3	Solve problems in the core area of signal processing, by evaluating a wide range of solutions and arriving at the optimal one considering public health and safety, cultural, societal and environmental factors, imparting lateral thought and originality.	Problem Solving
PO 4	Develop skills to extract information on research problems through literature survey and apply appropriate research methodologies, Techniques and tools to design and conduct experiments, analyse and interpret data and demonstrate higher order skills to contribute individually or in groups to the development of scientific or technological knowledge in signal processing and allied disciplines.	Research Skill
PO 5	Model and simulate complex signal processing systems to conduct experiments and analyse the performance by using modern signal processing tools	Usage of modern tools
PO 6	Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research.	Collaborative and Multidisciplinary work
PO 7	Work as a member and leader in a team, demonstrating the knowledge and understanding of management principles and challenges in signal processing and allied application areas, after consideration of economical and financial factors.	Project Management and Finance
PO 8	Express ideas with clarity and communicate confidently and effectively through reports adhering to appropriate standards and/or oral presentations.	Communication
PO 9	Recognize the need to engage in life-long learning with a high level of enthusiasm and commitment to improve knowledge in the domain of signal processing.	Life-long Learning
PO 10	Acquire professional and intellectual integrity, professional code of conduct and ethics of research, considering the impact of research outcome on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.	Ethical practices and Social Responsibility
PO 11	Critically analyse one's own actions and make corrective measures independently.	Independent and Reflective Learning

EVALUATION SCHEME
M. TECH. POWER SYSTEMS
I-YEAR (I-SEMESTER)
(Effective from session: 2021-22)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEE-511	Power System Analysis	3	1	0	30	20	50	100	150	4
2.	TEE-512	Power System Dynamics-I	3	1	0	30	20	50	100	150	4
3.	EEE-51X	Elective-I	3	1	0	30	20	50	100	150	3
4.	EEE-51X	Elective-II	3	1	0	30	20	50	100	150	3
5.	TRM-511	Research Methodology and IPR	2	0	0	30	20	50	100	150	2
6.	TAS-513	English for Research Paper Writing *	2	0	0	30	20	50	50	100	0
PRACTICAL											
7.	PEE-511	Power System Steady State Analysis Lab	0	0	2	10	15	25	25	50	1
8.	PEE-512/ PEE-513	Power System Dynamics Lab/ Renewable Energy Lab	0	0	2	10	15	25	25	50	1
9.	GPP-511	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**17**	**4**	**4**	**170**	**180**	**350**	**550**	**900**	**18**

Elective – I	**Elective – II**
EEE510: Renewable Energy System **EEE511:** Smart grids **EEE512:** High Power Converters **EEE513:** Wind and Solar systems	**EEE515:** Electrical Power Distribution System **EEE516:** Mathematical Methods for Power Engineering **EEE517:** Pulse Width Modulation for PE Converters **EEE518:** Electric and Hybrid Vehicles

*Mandatory audit course for passing only and marks will not be considered.

EVALUATION SCHEME
M. TECH. POWER SYSTEMS
I-YEAR (II-SEMESTER)
(Effective from session: 2021-22)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEE-521	Digital Protection of Power System	3	1	0	30	20	50	100	150	4
2.	TEE-522	Power System Dynamics-II	3	1	0	30	20	50	100	150	4
3.	EEE-52X	Elective-III	3	1	0	30	20	50	100	150	3
4.	EEE-52X	Elective-IV	3	1	0	30	20	50	100	150	3
5.	TAS-522	Disaster Management *	2	0	0	30	20	50	50	100	0
PRACTICAL											
6.	PEE-521	Lab-3	0	0	2	10	15	25	25	50	1
7.	PEE-522	Lab-4	0	0	2	10	15	25	25	50	1
8.	PEE-523	Mini Project	0	0	4	20	30	50	100	150	3
9.	GPP-521	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**14**	**4**	**8**	**160**	**190**	**350**	**550**	**900**	**19**

List of Program Elective – III	**List of Program Elective – IV**
EEE 520: Restructured Power Systems **EEE 521:** Advanced Digital Signal Processing **EEE 522:** Dynamics of Electrical Machines **EEE 523:** Power Apparatus Design	**EEE 525:** Advanced Micro-Controller Based Systems **EEE 526:** SCADA System and Applications **EEE 527:** Power Quality **EEE 528:** AI Techniques

List of Lab-3	**List of Lab-4**
PEE 521: Power System Protection Lab **PEE 522:** Power Quality Lab	**PEE 524:** Artificial Intelligence Lab **PEE 525:** Power Electronics Applications to Power Systems Lab **PEE 526:** Smart Grids Lab

*Mandatory audit course for passing only and marks will not be considered.

EVALUATION SCHEME
M. TECH. POWER SYSTEMS
II-YEAR (III-SEMESTER)
(Effective from session: 2022-23)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEE- 631	Electrical Distribution System Analysis	3	1	0	30	20	50	100	150	3
2.	EEE-63X	Elective-V	3	1	0	30	20	50	100	150	3
PRACTICAL											
3.	PEE-631	Dissertation Phase – I	0	0	18	40	60	100	100	200	9
4.	GPP-631	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**6**	**2**	**18**	**100**	**150**	**250**	**300**	**550**	**15**

Elective-V

EEE 630. Power System Transients
EEE 631. FACTS and Custom Power Devices
EEE 632. Industrial Load Modelling and Control
EEE 633. Dynamics of Linear Systems

EVALUATION SCHEME
M. TECH. POWER SYSTEMS
II-YEAR (IV-SEMESTER)
(Effective from session: 2022-23)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
PRACTICAL											
1.	PEE-641	Dissertation Phase – II	0	0	32	80	120	200	200	400	16
2.	PEE-642	Seminar	0	0	4	60	40	100	0	100	2
3.	GPP-641	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**0**	**0**	**36**	**140**	**210**	**350**	**200**	**550**	**18**

TEE-511 POWER SYSTEM ANALYSIS

UNIT 1: Load flow: Overview of Newton-Raphson, Gauss-Siedel, fast decoupled methods, convergence properties, sparsity techniques, handling Q-max violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variable in load flow, Fault Analysis: Simultaneous faults, open conductor faults, generalized method of fault analysis.

UNIT 2: Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking.

UNIT 3: Economic operation, Unit Commitment

UNIT 4: State Estimation: Sources of errors in measurement, Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction.

UNIT 5: Voltage Stability: Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices.

BOOKS:

1. J. J. Grainger &W. D. Stevenson, "Power system analysis", McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal, "Power System Analysis", Pearson, 2000
3. L. P. Singh, "Advanced Power System Analysis and Dynamics", New Age International, 2006
4. G. L. Kusic, "Computer aided power system analysis", Prentice Hall India, 1986
5. A. J. Wood, "Power generation, operation and control", John Wiley, 1994
6. P. M. Anderson, "Faulted power system analysis", IEEE Press, 1995

COURSE OUTCOMES:

Students will be able to:

1. Calculate voltage phasors at all buses, given the data using various methods of load flow.
2. Calculate fault currents in each phase.
3. Rank various contingencies according to their severity.
4. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status etc.
5. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

TEE-512 POWER SYSTEM DYNAMICS-I

UNIT 1: Introduction to Power System Stability: Power System Operation and Control, Stability Problems faced by Power Systems, Impact on Power System Operation and Control

UNIT 2: Analysis of Dynamical Systems: Concept of Equilibria, Small and Large Disturbance Stability, Example: Single Machine Infinite Bus System, Modal Analysis of Linear Systems, Analysis using Numerical Integration Techniques, Issues in Modeling: Slow and Fast Transients, Stiff Systems.

UNIT 3: Modeling of a Synchronous Machine: Physical Characteristics, Rotor Position Dependent model. D-Q Transformation, Model with Standard Parameters, Steady State Analysis of Synchronous Machine, Short Circuit Transient Analysis of a Synchronous Machine, Synchronous Machine Connected to Infinite Bus.

UNIT 4: Modeling of Excitation and Prime Mover Systems: Physical Characteristics and Models, Control system components, Excitation System Controllers, Prime Mover Control Systems.

UNIT 5: HVDC: System configurations, converter theory and performance, abnormal operation, control of HVDC systems.

BOOKS:

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia, New Delhi, 1981.
2. J Machowski, J Bialek & J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997.
3. P. Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
4**.** E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002.

COURSE OUTCOMES:

Students will be able to:

1. Understand the modelling of synchronous machine in details.
2. Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI POWER.
3. Carry out stability analysis with and without power system stabilizer (PSS).
4. Understand the load modelling in power system.

EEE-510 RENEWABLE ENERGY SYSTEM

UNIT 1: Introduction, Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines, Internal Combustion Engines.

UNIT 2: Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, Wave Energy, Geothermal Energy, Biomass and Fuel Cells.

UNIT 3: Power Electronic Interface with the Grid.

UNIT 4: Impact of Distributed Generation on the Power System, Power Quality Disturbances.

UNIT 5: Transmission System Operation, Protection of Distributed Generators, Economics of Distributed Generation, Case Studies

BOOKS:

1. Rakesh Ranjan, D. P. Kothari, K. C. Singal, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India , 2011.
2. Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley –IEEE Press.
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.
4. Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010.
5. James F. Manwell, Jon G. McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010.

COURSE OUTCOMES:

Students will be able to:

1. Knowledge about renewable energy.
2. Understand the working of distributed generation system in autonomous/grid connected modes.
3. Know the Impact of Distributed Generation on Power System.

EEE-511 SMART GRIDS

UNIT 1: Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust &Self-Healing Grid, Present development & International policies in Smart Grid, Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

UNIT 2: Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring &protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

UNIT 3: Concept of micro-grid, need & applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

UNIT 4: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT 5: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area, Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing &Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols.

BOOKS:

1. Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE,2011.
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press, 2009.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, “Smart Grid: Technology and Applications”, Wiley 2012.
4. Stuart Borlas’e, “Smart Grid: Infrastructure, Technology and solutions”, CRC Press.
5. G. Phadke, “Synchronized Phasor Measurement and their Applications”, Springer.

COURSE OUTCOMES:

Students will be able to:

1. Appreciate the difference between smart grid & conventional grid.
2. Apply smart metering concepts to industrial and commercial installations.
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
4. Come up with smart grid solutions using modern communication technologies.

EEE-512 HIGH POWER CONVERTERS

UNIT 1: Power electronic systems, An overview of PSDs, Multi-pulse diode rectifier, Multi-pulse SCR rectifier.

UNIT 2: Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter, cascaded H bridge multilevel inverter.

UNIT 3: Diode clamped multilevel inverters, flying capacitor multilevel inverter.

UNIT 4: PWM current source inverters, DC to DC switch mode converters

UNIT 5: AC voltage controllers: Cyclo-Converters, matrix converter, Power conditioners and UPS, Design aspects of converters, protection of devices and circuits.

BOOKS:

1. N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converter, Applications and Design", John Wiley and Sons, 1989.
2. M. H. Rashid, "Power Electronics", Prentice Hall of India, 1994.
3. B. K. Bose, "Power Electronics and A.C. Drives", Prentice Hall, 1986.
4. Bin Wu, "High power converters and drives", IEEE press, Wiley Enter science.

COURSE OUTCOMES:

Students will be able to:

1. Learn the characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practical systems.
2. Knowledge of working of multi-level VSIs, DC-DC switched mode converters, cyclo-converters and PWM techniques and the ability to use them properly.
3. Acquire knowledge of power conditioners and their applications.
4. Ability to design power circuit and protection circuit of PSDs and converters.

EEE-513 WIND AND SOLAR SYSTEMS

UNIT 1: Historical development and current status, characteristics of wind power generation network integration issues.

UNIT 2: Generators and power electronics for wind turbines, power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems.

UNIT 3: Isolated wind systems, reactive power and voltage control, economic aspects.

UNIT 4: Impacts on power system dynamics, power system interconnection.

UNIT 5: Introduction of solar systems, merits and demerits, concentrators, various applications, Solar thermal power generation, PV power generation, Energy Storage device, Designing the solar system for small installations.

BOOK:

1. Thomas Ackermann, Editor, "Wind power in Power Systems", John Willy and sons ltd. 2005.
2. Siegfried Heier, "Grid integration of wind energy conversion systems", John Willy and sons ltd., 2006.
3. K. Sukhatme and S.P. Sukhatme, "Solar Energy". Tata MacGraw Hill, Second Edition, 1996.

COURSE OUTCOMES:

Students will be able to:

1. Appreciate the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems.
2. Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems.
3. Demonstrate the knowledge of physics of solar power generation and the associated issues.
4. Identify, formulate and solve the problems of energy crises using wind and solar energy.

EEE-515 ELECTRIC POWER DISTRIBUTION SYSTEM

UNIT 1: Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting.

UNIT 2: Advantages of Distribution Management System (D.M.S.), Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints, Power Factor Correction.

UNIT 3: Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation, SCADA: Introduction, Block Diagram, SCADA Applied to Distribution Automation, Common Functions of SCADA, Advantages of Distribution Automation through SCADA.

UNIT 4: Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring.

UNIT 5: Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution, Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation.

BOOKS:

1. A. S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical Power Distribution Automation", University Science Press, New Delhi.
3. Anthony J. Panseni, "Electrical Distribution Engineering", CRC Press.
4. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press.

COURSE OUTCOMES:

Students will be able to:

1. Knowledge of power distribution system.
2. Study of Distribution automation and its application in practice.
3. To learn SCADA system

EEE-516 MATHEMATICAL METHODS FOR POWER ENGINEERING

UNIT 1: Vector spaces, Linear transformations, Matrix representation of linear transformation, Eigen values and Eigen vectors of linear operator.

UNIT 2: Linear Programming Problems, Simplex Method, Duality, Non Linear Programming problems.

UNIT 3: Unconstrained Problems, Search methods, Constrained Problems.

UNIT 4: Lagrange method, Kuhn-Tucker conditions, Random Variables, Distributions.

UNIT 5: Independent Random Variables, Marginal and Conditional distributions, Elements of stochastic processes.

BOOKS:

1. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992.
2. Erwin Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, 2004.
3. Irwin Miller and Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edn, PHI, 2002.
4. J. Medhi, "Stochastic Processes", New Age International, New Delhi., 1994.
5. A Papoulis, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill, 2002.
6. John B Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000.
7. Hillier F S and Liebermann G J, "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001.
8. Simmons D M, "Non Linear Programming for Operations Research", PHI, 1975.

COURSE OUTCOMES:

Students will be able to:

1. Knowledge about vector spaces, linear transformation, eigenvalues and eigenvectors of linear operators.
2. To learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology.
3. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems.
4. Understanding the concept of random variables, functions of random variable and their probability distribution.
5. Understand stochastic processes and their classification.

EEE-517 PULSE WIDTH MODULATION FOR PE CONVERTERS

UNIT 1: Introduction to PE converters, Modulation of one inverter phase leg, Modulation of single phase, VSI and 3 phase VSI.

UNIT 2: Zero space vector placement modulation strategies, Losses-Discontinuous modulation, Modulation of CSI.

UNIT 3: Over modulation of converters, programme modulation strategies.

UNIT 4: Pulse width modulation for multilevel inverters, Implementation of modulation controller.

UNIT 5: Continuing developments in modulation as random PWM, PWM for voltage unbalance, Effect of minimum pulse width and dead time.

BOOKS:

1. D. Grahame Holmes, Thomas A. Lipo, "Pulse width modulation of Power Converter: Principles and Practice", John Wiley & Sons, 03-Oct-2003.
2. Bin Vew, "High Power Converter", Wiley Publication.
3. Marian K. Kazimicrczuk, "Pulse width modulated dc-dc power converter", Wiley Publication.

COURSE OUTCOMES:

Students will be able to:

1. Appreciate importance of PWM techniques.
2. Implement PWM using different strategies.
3. Control CSI and VSI using PWM.
4. Compare performance of converter for different PWM techniques.

EEE-518 ELECTRIC AND HYBRID VECHILES

UNIT 1: History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization Transmission characteristics, Mathematical models to describe vehicle performance.

UNIT 2: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT 3: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor-drive Configuration and control of Switch Reluctance, Motor drives, drive system efficiency.

UNIT 4: Matching the electric machine and the internal combustion engine (ICE) Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology Communications, supporting subsystems.

UNIT 5: Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies.

BOOKS:

1. Sira -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices", Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters".

COURSE OUTCOMES:

Students will be able to:

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To learn electric drive in vehicles / traction.

TRM-511 Research Methodology and IPR

UNIT 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT 2: Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT 3: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development, International Scenario: International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT.

UNIT 4: Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.

UNIT 5: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc., Traditional knowledge Case Studies, IPR and IITs.

BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners".
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

COURSE OUTCOMES:

Students will be able to:

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

TAC-511 ENGLISH FOR RESEARCH PAPER WRITING

UNIT 1: Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT 3: Review of the Literature, Methods, Results, Discussion, Conclusions, Final Check.

UNIT 4: Key skills are needed when writing a Title, key skills are needed when writing abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT 5: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions, Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

BOOKS:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

COURSE OUTCOMES:

Students will be able to:

1. Understand that how to improve your writing skills.
2. Improve the level of readability.
3. What to write, in each sections.
4. Understand the skills needed when writing a title.
5. Improve overall personality.

TAC-513 VALUE EDUCATION

UNIT 1: Values and self-development: Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements.

UNIT 2: Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline.

UNIT 3: Personality and Behaviour Development: Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger.

UNIT 4: Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, doing best for saving nature.

UNIT 5: Character and Competence: Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, mind your Mind, Self-control, Honesty, Studying effectively.

BOOKS:

1. S. K. Chakroborty, "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi.

COURSE OUTCOMES:

Students will be able to:

1. Knowledge of self-development.
2. Learn the importance of human values.
3. Develop the overall personality.
4. Develop the character and competence.
5. Develop the integrity and discipline, punctuality, love and kindness.

PEE-511 POWER SYSTEM STEADY STATE ANALYSIS LAB

List of experiments:

1. Simulation of IGBT Inverters.
2. Simulation of Thyristor Converters.
3. Transient Stability Studies.
4. Short Circuit Studies.
5. Load Flow Studies.
6. Load Forecasting and Unit Commitment.

Note: The experiments may be added or dropped depending upon availability of equipment's and recent developments.

PEE-512 POWER SYSTEM DYNAMICS LAB

Simulation Based Experiments (using MATLAB or any other software):

1. To develop a MATLAB program to study small signal stability analysis of single machine infinite bus system using classical machine model and type B1 model.
2. To develop a Simulink model of IEEE type 1(1968) excitation system using MATLAB.
3. To develop a MATLAB program to study small signal stability analysis if single machine infinite bus system using Type B1 - effect of excitation system and PSS also.
4. Simulation of Synchronous machine dynamics.
5. Simulation of Induction machine dynamics.
6. Simulation of various faults of power systems
7. Simulation of transient over voltages
8. Simulation of SSR
9. Simulation of travelling waves
10. Stability studies – Large small signal rotor angle stability and voltage instability
11. Familiarization with PSCAD, EMTDC, Mi-Power, ETAP, Lab view, Power world simulation software
12. Modeling of various FACTS Devices
13. Study of AGC of multi area systems
14. Determine the optimal power flow solutions for IEEE systems based on cost optimization, transmission loss optimization and total voltage deviation optimization using various optimization techniques such as PSO, GA.

Note: The experiments may be added or dropped depending upon availability of equipment's and recent developments.

PEE-513 RENEWABLE ENERGY LAB

List of experiments:

1. Power Curves.
2. Build a Wind Farm.
3. Test the Capabilities of the Hydrogen Fuel Cells and Capacitors.
4. Effect of Temperature on Solar Panel Output.
5. Variables Affecting Solar Panel Output.
6. Effect of Load on Solar Panel Output.
7. Wind Turbine Output: The Effect of Load.
8. Test the Capabilities of Solar Panels and Wind Turbines.

Note: The experiments may be added or dropped depending upon availability of equipment's and recent developments.

TEE-521 DIGITAL PROTECTION OF POWER SYSTEM

UNIT 1: Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection, Mathematical background to protection algorithms**,** Finite difference techniques.

UNIT 2: Interpolation formulae, Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least-squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis.

UNIT 3: Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing, Error, sample and hold circuits, multiplexers, analog to digital Conversion, Digital filtering concepts, the digital relay as a unit consisting of hardware and software.

UNIT 4: Sinusoidal wave based algorithms, Sample and first derivative (Mann and Morrison) algorithm, Fourier and Walsh based algorithms.

UNIT 5: Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm, Least Squares based algorithms, Differential equation based algorithms, Traveling Wave based Techniques, Digital Differential Protection of Transformers, Digital Line Differential Protection, Recent Advances in Digital Protection of Power Systems.

BOOKS:

1. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009.
2. A. T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEE Press,1999.
3. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publics Corporate Publishing, 2006.
4. S. R. Bhide, "Digital Power System Protection", PHI Learning Pvt. Ltd. 2014.

COURSE OUTCOMES:
Students will be able to:

1. Learn the importance of Digital Relays.
2. Apply Mathematical approach towards protection.
3. Learn to develop various Protection algorithms.

TEE-522 POWER SYSTEM DYNAMICS-II

UNIT 1: Modeling of Transmission Lines and Loads: Transmission Line Physical Characteristics, Transmission Line Modeling, Load Models - induction machine model, Other Subsystems - HVDC, protection systems.

UNIT 2: Stability Issues in Interconnected Power Systems: Single Machine Infinite Bus System, Multi-machine Systems, Stability of Relative Motion, Frequency Stability: Centre of Inertia Motion, Concept of Load Sharing: Governors, Single Machine Load Bus System: Voltage Stability, Torsional Oscillations.

UNIT 3: Power System Stability Analysis Tools: Transient Stability Program, Small Signal Analysis Program, EMTP Programs, Real-Time Simulators.

UNIT 4: Enhancing System Stability: Planning Measures, Stabilizing Controllers (Power System Stabilizers), Operational Measures- Preventive Control, Emergency Control.

UNIT 5: FACTS devices: SVC, STATECOM, TCSC, SSSC, UPFC.

Text Book:

1. P. Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
2. J. Machowski, Bialek, Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997.
3. L. Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press, 2007.
4. V. Ajjarapu, "Computational Techniques for voltage stability assessment & control"; Springer, 2006.

COURSE OUTCOMES:

Students will be able to:

1. Gain valuable insights into the phenomena of power system including obscure ones.
2. Understand the power system stability problem.
3. Analyze the stability problems and implement modern control strategies.
4. Simulate small signal and large signal stability problems.

EEE-520 RESTRUCTURED POWER SYSTEMS

UNIT 1: Fundamentals of restructured system, Market architecture, Load elasticity, Social welfare maximization.

UNIT 2: OPF: Role in vertically integrated systems and in restructured markets, congestion management.

UNIT 3: Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power.

UNIT 4: Ancillary services, Standard market design, Distributed generation in restructured markets.

UNIT 5: Developments in India, IT applications in restructured markets, Working of restructured power systems PJM, Recent trends in Restructuring.

BOOKS:

1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub.,1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
4. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems operation, trading and volatility", Marcel Dekker.

COURSE OUTCOMES:

Students will be able to:

1. Describe various types of regulations in power systems.
2. Identify the need of regulation and deregulation.
3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4. Identify and give examples of existing electricity markets.
5. Classify different market mechanisms and summarize the role of various entities in the market.

EEE-521 ADVANCED DIGITAL SIGNAL PROCESSING

UNIT 1: Discrete time signals, Linear shift invariant systems, Stability and causality, Sampling of continuous time signals, Discrete time Fourier Transform-Discrete Fourier series- Discrete Fourier transform, Z Transform-Properties of different transforms.

UNIT 2: Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method.

UNIT 3: FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantisation effects in IIR and FIR filters.

UNIT 4: A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero-input limit cycles in IIR filters, Linear Signal Models.

UNIT 5: All pole, all zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals, Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters, Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

BOOKS:

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach", Tata McGrow-Hill Edition1998.
2. Dimitris G. Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions. -2000

COURSE OUTCOMES:

Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems.
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals.
5. Design of optimum FIR and IIR filters.

EEE-522 DYNAMICS OF ELECTRICAL MACHINES

UNIT 1: Stability, Primitive 4 Winding Commutator Machine, Commutator Primitive Machine, Complete Voltage Equation of Primitive 4 Winding Commutator Machine.

UNIT 2: Torque Equation Analysis of Simple DC Machines using the Primitive Machine Equations, The Three Phase Induction Motor, Transformed Equations, Different Reference Frames for Induction Motor Analysis, Transfer Function Formulation.

UNIT 3: Three Phase Salient Pole Synchronous Machine, Parks Transformation, Steady State Analysis.

UNIT 4 Large Signal Transient, Small Oscillation Equations in State Variable form, Dynamical Analysis of Interconnected Machines.

UNIT 5: Large Signal Transient Analysis using Transformed Equations, DC Generator /DC Motor System, Alternator /Synchronous Motor System.

BOOKS:

1. D. P. Sengupta & J.B. Lynn," Electrical Machine Dynamics", The Macmillan Press Ltd. 1980.
2. R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education, 2001.
3. P.C. Kraus, "Analysis of Electrical Machines", McGraw Hill Book Company,1987.
4. I. Boldia & S. A. Nasar, "Electrical Machine Dynamics", The Macmillan Press Ltd. 1992.
5. C.V. Jones, "The Unified Theory of Electrical Machines", Butterworth, London. 1967.

COURSE OUTCOMES:

Students will be able to:

1. Formulation of electrodynamic equations of all electric machines and analyze the performance characteristics.
2. Knowledge of transformations for the dynamic analysis of machines.
3. Knowledge of determination of stability of the machines under small signal and transient conditions.
4. Study about synchronous machine.

EEE-523 POWER APPARTUS DESIGN

UNIT 1: Principles of Design of Machines-Specific loadings, choice of magnetic, and electric loadings, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling.

UNIT 2: Specific loadings, choice of magnetic and electric loadings Real and apparent flux-densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation, continuous and intermittent rating.

UNIT 3: General considerations, output equation, emf per turn, choice of flux-density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, Calculation of losses, efficiency and regulation, Forces winding during short circuit.

UNIT 4: General considerations, output equation, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor, Elimination of harmonic torques, Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data.

UNIT 5: Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions, Introduction to Computer Aided Electrical Machine Design Energy efficient machines.

BOOKS:

1. Clayton A. E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M. G. Say, "The Performance and Design of A.C. Machines ", Pitman.
3. A. K. Sawhney, "A course in Electrical Machine Design", Dhanpat Rai & Sons, 5th Edition.

COURSE OUTCOMES:

Students will be able to:

1. To give a systematic approach for modeling and analysis of all rotating machines under both transient and steady state conditions with the dimensions and material used.
2. Ability to model and design all types of rotation machines including special machines.

EEE-525 ADVANCED MICRO-CONTROLLER BASED SYSTEMS

UNIT 1: Basic Computer Organization, Accumulator based Processes-Architecture, Memory Organization-I/O Organization.

UNIT 2: Micro-Controllers-Intel 8051 Registers, Memories, I/O Ports, Serial Communication. Timers, Interrupts, Programming.

UNIT 3: Intel 8051–Assembly language Programming, Addressing-Operations, Stack & Subroutines, Interrupts-DMA.

UNIT 4: PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication.

UNIT 5: Microcontroller development for motor control applications, Stepper motor control using micro controller, Digital Signal Processor (DSP), Architecture – Programming, Introduction to FPGA

BOOKS:

1. John. F. Wakerly, "Microcomputer Architecture and Programming", John Wiley and Sons 1981.
2. Ramesh S. Gaonker, "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing (India), 1994.
3. Raj Kamal, "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005.
4. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004.
5. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005.
6. Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F Series", Elsevier, 2008.
7. Microchip datasheets for PIC16F877.

COURSE OUTCOMES:

Students will be able to:

1. To learn how to program a processor in assembly language and develop an advanced processor based system.
2. To learn configuring and using different peripherals in a digital system.
3. To compile and debug a Program.
4. To generate an executable file and use it.

EEE-526 SCADA SYSTEM AND APPLICATIONS

UNIT 1: Introduction to SCADA, Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA.

UNIT 2: Industries SCADA System Components, Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

UNIT 3: SCADA Architecture, Various SCADA architectures, advantages and disadvantages of each system, single unified standard architecture –IEC 61850.

UNIT 4: SCADA Communication, various industrial communication technologies, wired and wireless methods and fibre optics, Open standard communication protocols.

UNIT 5: SCADA Applications, Utility applications, Transmission and Distribution sector operations, monitoring, analysis and improvement, Industries - oil, gas. and water, Case studies, Implementation, Simulation Exercises

BOOKS:

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA,2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cybersecurity for SCADA systems", Penn Well Books, 2006.
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
5. Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", Penn Well 1999.

COURSE OUTCOMES:

Students will be able to:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications**.**
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
3. Knowledge about single unified standard architecture IEC 61850.
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

EEE-527 POWER QUALITY

UNIT 1: Introduction-power quality-voltage quality-overview of power, Quality phenomena classification of power quality issues, Power quality measures and standards-THD-TIF-DIN-C-message weights, Flicker factor transient phenomena-occurrence of power quality problems, Power acceptability curves-IEEE guides, Standards and recommended practices.

UNIT 2: Harmonics-individual and total harmonic distortion, RMS value of a harmonic waveform, Triplex harmonics. Important harmonic introducing devices SMPS, Three phase power converters-arcing devices saturable devices, Harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

UNIT 3: Modelling of networks and components under non-sinusoidal conditions, Transmission and distribution systems, Shunt capacitors-transformers, Electric machines, ground systems loads that cause power quality problems, Power quality problems created by drives and its impact on drive.

.

UNIT 4: Power factor improvement- Passive Compensation, Passive Filtering, Harmonic Resonance, Impedance Scan Analysis, Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC based on Bilateral Single Phase and Three Phase Converter.

UNIT 5: Hamilton-Jacobi-Bellman equation - model reference adaptive systems (MRAS) - Design hypothesis, Introduction to design method based on the use of Liapunov function, Design and simulation of variable structure adaptive model following control.

BOOKS:

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007.
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000.
3. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000.
4. J. Arrillaga, B. C. Smith, N. R. Watson & A. R.Wood, “Power system Harmonic Analysis”, Wiley,1997.

COURSE OUTCOMES:

Students will be able to:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of Harmonics on system equipment and loads.
2. Develop analytical modelling skills needed for modelling and analysis of harmonics in networks and components.
3. To introduce the student to active power factor correction based on static VAR compensators and its control techniques.
4. To introduce the student to series and shunt active power filtering techniques for harmonics.

EEE-528 ARTIFICIAL INTELLIGENCE TECHNIQUES

UNIT 1: Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward, NN LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks.

UNIT 2: Fuzzy Logic Knowledge Representation and Inference Mechanism, De-fuzzification Methods.

UNIT 3: Fuzzy Neural Networks some algorithms to learn the parameters of the network like GA, System Identification using Fuzzy and Neural Network.

UNIT 4: Genetic algorithm Reproduction cross over, mutation, Introduction to evolutionary program.

UNIT 5 System Identification using Fuzzy and Neural Network.**:** Applications of above mentioned techniques to practical problems.

BOOKS:

1. J. M. Zurada, "An Introduction to ANN", Jaico **Publishing** House
2. Simon Haykins, "Neural Networks", Prentice Hall
3. Timothy Ross, "Fuzzy Logic with Engg.Applications", McGraw. Hill
4. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication
5. Golding, "Genetic Algorithms", Addison-Wesley **Publishing** Com

COURSE OUTCOMES:

Students will be able to:

1. Learn the concepts of biological foundations of artificial neural networks.
2. Learn Feedback networks and radial basis function networks and fuzzy logics.
3. Identifications of fuzzy and neural network.
4. Acquire the knowledge of GA.

TAC-521 DISASTER MANAGEMENT

UNIT 1: Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude, Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT 2: Disaster Prone Areas in India: Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

UNIT 3: Disaster Preparedness and Management: Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT 4: Risk Assessment: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.

UNIT 5: Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation, Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

BOOKS:

1. R. Nishith, A. K Singh, "Disaster Management in India: Perspectives, issues and strategies", New Royal Book Company.
2. Sahni, Pardeep et. al. (Eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. S. L. Goel., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

COURSE OUTCOMES:

Students will be able to:

1. Demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Understand the strengths and weaknesses of disaster management approaches.
5. Understand the planning and programming in different countries, particularly their home country or the countries they work in.

TAC-524 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT

UNIT 1: Neetisatakam-Holistic development of personality: Verses 19,20,21,22 (wisdom), Verses 29, 31, 32 (pride & heroism), Verses 26,28,63,65 (virtue), Verses 52, 53, 59 (dont's), Verses 71,73,75,78 (do's)

UNIT 2: Approach to day to day work and duties: Shrimad Bhagwad Geeta: Chapter 2 Verses 41, 47,48, Chapter 3 Verses 13, 21, 27, 35,

UNIT 3: Approach to day to day work and duties: Shrimad Bhagwad Geeta: Chapter 6 Verses 5,13,17, 23, 35, Chapter 18 Verses 45, 46, 48.

UNIT 4: Statements of basic knowledge: Shrimad Bhagwad Geeta: Chapter 2 Verses 56, 62, 68, Chapter 12 Verses 13, 14, 15, 16, 17, 18.

UNIT 5: Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2 Verses 17, Chapter 3 Verses 36, 37, 42, Chapter 4 Verses 18, 38, 39, Chapter18 Verses 37, 38, 63

BOOKS:

1. "Srimad Bhagavad Gita", by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

COURSE OUTCOMES:

Students will be able to:

1. Develop their overall personality.
2. Achieve the highest goal in life.
3. Get the peace and prosperity.
4. Knowledge of self-development.
5. Develop the integrity and discipline, punctuality, love and kindness.

PEE-521 POWER SYSTEM PROTECTION LAB

List of experiments:

1. Introduction to Power System Protection
2. Impact of Induction Motor Starting on Power System
3. Modelling of Differential Relay using MATLAB
4. Radial Feeder Protection
5. Parallel Feeder Protection
6. Principle of Reverse Power Protection
7. Differential Protection of Transformer
8. To the study time vs. voltage characteristics of over voltage induction relay

Note: The experiments may be added or dropped depending upon availability of equipment's and recent developments.

PEE-522 POWER QUALITY LAB

List of experiments:

1. Simulation of even and odd harmonic.
2. RMS value of harmonic waveform.
3. SMPS design.
4. Flicker Control.
5. Passive filter design.
6. Active filter design.
7. Calculation of harmonic distortion of fluorescent lamp.
8. Grounding techniques for power quality improvement.
9. Series active filter simulation.
10. Shunt active filter simulation.
11. Simulation of variable structure adoptive model.

Note: The experiments may be added or dropped depending upon availability of equipment's and recent developments.

PEE-524 ARTIFICIAL INTELLIGENCE

List of experiments:

1. Write A Program for Best First Search
2. Write A Program to Generate the output for A* Algorithm
3. Write a Program to Show the Tic Tac Toe Game for 0 and X
4. Write A Program for Expert System by Using Forward Chaining
5. Comparing the Search Methods
6. Implement the Greedy Search Algorithm
7. Implement the min-max Algorithm
8. Adding a Heuristic

Note: The experiments may be added or dropped depending upon availability of equipment's and recent developments.

PEE-525 POWER ELECTRONICS/APPLICATIONTO POWER SYSTEM LAB

List of experiments:

1. **Measurements in Power Electronics:** Measurement techniques of power electronics to be studied in the context of half-wave and full-wave rectifier circuits.
2. **AC-DC Conversion (Single-Phase Conversion):** Examine the properties of controlled rectifiers, or ac-dc converters. Converter concepts such as source conversion and switch types to be studied. Popular applications such as battery chargers and dc motor drives to be introduced.
3. **AC-DC Conversion (Poly-Phase Conversion):** Examine the properties of ac-dc converters with poly-phase input sources. Concentrate on input voltage sources, as these are the mainstay of modern electric power system supplies. The midpoint converter to be the focus of this experiment, and to be tested with inductive loads including a dc motor.
4. **DC-DC Conversion (One-Quadrant Converters):** Examine dc-dc conversion circuits with Pulse width control. The basic technique for operating such converters of the simple one-quadrant converters (buck, boost, buck-boost, boost-buck) to be analysed.
5. **DC-AC Conversion (Voltage-Sourced Inverters):** Square-wave (voltage-sourced) inverters will be studied in this first experiment of the series. Emphasis will be placed on phase control techniques and resonant filtering.
6. **DC-AC Conversion (Converters for Motor Drives):** Examine the pulse-width modulation inverter circuits, to gain familiarity with the waveforms and concepts of pulse-width modulation as it applies to power electronics, in the context of an ac motor drive.
7. **Models for Real Capacitors and Inductors:** study the behaviour of real passive components; the basic operation of realistic capacitors and inductors will be examined, with emphasis on impedance effects.
8. **Magnetics:** Experiment to provides an overview of concepts of magnetic component design, based on inductor and transformer design for high-speed converters.
9. **Converter design**: Design, build, and test a different dc-dc or dc-ac converter. Effects of capacitor ESR and switch forward voltage drop to be a special focal point.
10. **Implement converters with discrete devices**: Implement converter circuit with gate drive considerations for semiconductor switches.

***NOTE: The experiments may be performed on simulation tools. However, one of the last two experiments must be in hardware.**

Note: The experiments may be added or dropped depending upon availability of equipment's and recent developments.

PEE-526 SMART GRID LAB

List of experiments:

1. Design of solar cell using MATLAB. Plot the V-I, P-V characteristic at different irradiation and temperature.
2. Implementing the MPPT technique for a solar array in MATLAB Simulink
3. Draw the characteristics of the wind turbine
4. Design the buck, boost and buck-boost converters continuous and discontinuous conduction mode
5. Implementing the phasor estimation technique using MATLAB
6. Implementing the Overcurrent and directional relay operation using MATLAB
7. Implementing the Distance relay using the MATLAB.

Note: The experiments may be added or dropped depending upon availability of equipment's and recent developments.

TEE-631 Electrical Distribution System Analysis

UNIT 1: Structure of a distribution system, Distribution feeder configurations and substation layouts, Nature of loads.

UNIT 2: Approximate methods of analysis, Computation of transformer and feeder Loading, "K" Factors, voltage drop and power loss calculations, Distribution of loads and various geometric configurations.

UNIT 3: Modelling of distribution system components, Overhead lines, feeders and Cables, Single and three phase distribution transformers, Voltage regulators, Load Models, Capacitor banks, Distributed generation.

UNIT 4: Distribution system analysis, Load flow analysis: Backward/forward sweep, Load flow analysis: Direct approach, Load flow analysis: Direct approach for weakly meshed systems, Load flow analysis: Gauss Implicit Z-matrix Method

UNIT 5: Short-circuit analysis: Sequence-components vs. phase-variable, Short-circuit analysis: LG, LLG, LLLG and LL Faults, Short-circuit analysis: Weakly meshed system, Applications of distribution system analysis.

BOOKS:

1. W. H. Kresting, Distribution System Modelling and Analysis, CRC Press, New York, 2002.
2. A. A. Sallam and O.P. Malik, Electric Distribution System, IEEE Press, Piscataway, NJ,2011.
3. Edited by B. Das, Power Distribution Automation, IET Power and Energy Series, 75, London, 2016.
4. J.M. Gers, Distribution System Analysis and Automation, IET Power and Energy Series, 68, London, 2013

COURSE OUTCOMES:

Students will be able to:

1. Knowledge of Electric distribution system.
2. Ability to design load flow algorithm for distribution system.
3. Synthesize all kind of faults in Electric distribution system.
4. Able to model Electric distribution system.

EEE-630 Power System Transients

UNIT 1: Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits -Abnormal switching transients, Three-phase, circuits and transients, Computation of power system transients.

UNIT 2: Principle of digital computation – Matrix method of solution, Modal analysis- Z transform-Computation using EMTP, Lightning, switching and temporary over voltages, Lightning, Physical phenomena of lightning.

UNIT 3: Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance, Switching Short line or kilometric fault, energizing transients - closing and re-closing of lines, line dropping, load rejection – over voltages induced by faults.

UNIT 4: Switching HVDC line Travelling waves on transmission line, Circuits with distributed Parameters Wave Equation, Reflection, Refraction, Behaviour of Travelling waves at the line terminations, Lattice Diagrams – Attenuation and Distortion, Multi-conductor system and Velocity wave.

UNIT 5: Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Co-ordination between insulation and protection level, Statistical approach, Protective devices, Protection of system against over voltages, lightning arresters, substation earthling.

BOOKS:

5. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991.

COURSE OUTCOMES:

Students will be able to:

5. Knowledge of various transients that could occur in power system and their mathematical formulation.
6. Ability to design various protective devices in power system for protecting equipment and personnel.
7. Coordinating the insulation of various equipment in power system.
8. Modelling the power system for transient analysis.

EEE-631 FACTS AND CUSTOM POWER DEVICES

UNIT 1: Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System, Power flow control -Constraints of maximum transmission line loading –Benefits of FACTS Transmission line compensation, Uncompensated line -Shunt compensation - Series compensation –Phase angle control. Reactive power compensation, Shunt and Series compensation principles – Reactive compensation at transmission and distribution level.

UNIT 2: Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM -Compensator control, Comparison between SVC and STATCOM.

UNIT 3: Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications, Static series compensation –GCSC, TSSC, TCSC and Static synchronous, series compensators and their Control.

UNIT 4: SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF, Basic Principle of P and Q control- Independent real and reactive power flow control- Applications.

UNIT 5: Introduction to interline power flow controller. Modelling and analysis of FACTS Controllers –Simulation of FACTS controllers Power quality problems in distribution systems harmonics, Loads that create harmonics, modelling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering shunt, series and hybrid and their control, Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality.

BOOKS:

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007**.**
2. X. P. Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer Verlag, Berlin, 2006.
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K. S. Suresh kumar, S. Ashok, "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
5. G. T. Heydt, "Power Quality", McGraw-Hill Professional, 2007.
6. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

COURSE OUTCOMES:

Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power.
2. Compensation Schemes at Transmission and Distribution level in Power Systems.
3. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled.
4. Reactive Power Systems, PWM Inverter based Reactive Power Systems and their controls.
5. To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

EEE-632 INDUSTRIAL LOAD MODELING AND CONTROL

UNIT 1: Electric Energy Scenario-Demand Side Management-Industrial Load Management, Load Curves-Load Shaping Objectives, Methodologies-Barriers, Classification of Industrial Loads, Continuous and Batch processes -Load Modelling.

UNIT 2: Electricity pricing – Dynamic and spot pricing –Models, Direct load Control-Interruptible load control, Bottom-up approach- scheduling- Formulation of load Models, Optimization and control algorithms - Case studies.

UNIT 3: Reactive power management in industries, controls-power quality impacts, application of filters Energy saving in industries, Captive power units, Operating and control strategies, Power Pooling- Operation models, Energy banking, Industrial Cogeneration.

UNIT 4: Cooling and heating loads, load profiling, Modelling- Cool storage, Types-Control strategies, Optimal operation, Problem formulation- Case studies.

UNIT 5: Selection of Schemes Optimal Operating Strategies, Peak load saving, Constraints Problem formulation- Case study, Integrated Load management for Industries.

BOOKS:

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989.
2. C.W. Gellings and S.N. Talukdar, Load management concepts. IEEE Press, New York, 1986, pp. 3-28.
3. Y. Manichaikul and F.C. Schweppe, " Physically based Industrial load", IEEE Trans. on PAS, April 1981.
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
5. I. J. Nagarath and D. P. Kothari, Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi, 1995.
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc., USA.

COURSE OUTCOMES:

Students will be able to:

1. Knowledge about load control techniques in industries and its application.
2. Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO.
3. Apply load management to reduce demand of electricity during peak time.
4. Apply different energy saving opportunities in industries.

EEE-633 DYNAMICS OF LINEAR SYSTEMS

UNIT 1: State variable representations of systems**,** transfer function and transfer function matrix**,** solutions of state equations.

UNIT 2: Observability and controllability, minimal realization of MIMO systems, analysis of linear time varying systems, concepts of stability.

UNIT 3: Lyapunov stability analysis, Lyapunov function and its properties, controllability by state variable feedback.

UNIT 4: Ackerman's Formula - stabilisation by output feedback, asymptotic observers for state measurement, observer design.

UNIT 5: State space representation of discrete systems, solution of state equations, controllability and observability stability analysis using Lyapunov method, State feedback of linear discrete time systems, design of observers - MATLAB Exercises.

BOOKS:

1. Thomas Kailath, "Linear Systems", Prentice Hall Inc., Englewood Cliffs, N.J. 1980.
2. K. Ogata, "State Space Analysis of Control Systems", Prentice Hall Inc., Englewood Cliffs, N.J., 1965.
3. K. Ogata, "Modern Control Engineering, (second edition)", Prentice Hall Inc., Englewood Cliffs, N.J., 1990.
4. M. Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
5. C. T. Chen, "Linear System Theory and Design", New York: Holt Rinehart and Winston ,1984.
6. R. C. Dorf, and R. T. "Bishop, Modern Control Systems", Addison Wesley Longman Inc., 1999.

COURSE OUTCOMES:

Students will be able to:

1. To learn linear system modelling, analysis and design so as to obtain the ability to apply the same to engineering problems in a global perspective.
2. Knowledge on carrying out detailed stability analysis of both linear and nonlinear systems.
3. Design observers and controllers for linear systems.
4. Acquire knowledge of discrete time linear systems modeling, analysis and design.
5. Develop and utilize modern software tools for analysis and design of linear continuous and discrete time systems.