PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018

(AUTONOMOUS)

M.E. POWER SYSTEMS ENGINEERING

CHOICE BASED CREDIT SYSTEM

CURRICULUM I - II SEMESTERS

REGULATIONS 2019

SEMESTER I

S.No	Course Code	Course Title	L	T	P	C
Theory						
1	PPS19101	Advanced Power System Analysis	3	1	0	4
2	PPS19102	Power System Dynamics	3	0	0	3
3	PPS1915*	Professional Elective I	3	0	0	3
4	PPS19***	Professional Elective II	3	0	0	3
5	PEN19101	Research Methodology and IPR	2	0	0	2
6	PEN19171	English for Research Paper Writing(Audit I)	2	0	0	0
Practical						
7	PPS19103	Power System Simulation Laboratory I	0	0	4	2
		TOTAL	**16**	**1**	**4**	**17**

SEMESTER II

S.No	Course Code	Course Title	L	T	P	C
Theory						
1	PPS19201	Advanced Power System Protection	3	0	0	3
2	PPS19202	High Voltage Direct Current Transmission	3	0	0	3
3	PPS1935*	Professional Elective III	3	0	0	3
4	PPS1945*	Professional Elective IV	3	0	0	3
5	PEN19271	Pedagogy Studies (Audit II)	2	0	0	0
Practical						
7	PPS19203	Power System Simulation Laboratory II	0	0	4	2
8	PPS19204	Mini Project	0	0	4	2
		TOTAL	**14**	**0**	**8**	**16**

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LIST OF ELECTIVES

Course Code	Course Title	L	T	P	C
PROFESSIONAL ELECTIVE I (PE)					
PPS19151	Power Electronics for Renewable Energy Systems	3	0	0	3
PPS19152	Smart Grids	3	0	0	3
PPS19153	High Power Converters	3	0	0	3
PPS19154	Wind and Solar Systems	3	0	0	3
PROFESSIONAL ELECTIVE II (PE)					
PMA19152	Mathematical Methods in Power Engineering	3	0	0	3
PPS19251	Electrical Power Distribution System	3	0	0	3
PPS19252	Analysis and Design of Power Converters	3	0	0	3
PPS19253	Electric and Hybrid Vehicles	3	0	0	3
PROFESSIONAL ELECTIVE III (PE)					
PPS19351	Restructured Power Systems	3	0	0	3
PPS19352	Advanced Digital Signal Processing	3	0	0	3
PPS19353	Dynamics of Electrical Machines	3	0	0	3
PPS19354	Solar and Energy Storage Systems	3	0	0	3
PROFESSIONAL ELECTIVE IV (PE)					
PPS19451	Advanced Microcontroller Based Systems	3	0	0	3
PPS19452	SCADA System and Application	3	0	0	3
PPS19453	Power Quality	3	0	0	3
PPS19454	Artificial Intelligence and its Application	3	0	0	3

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SEMESTER I

PPS19101 **ADVANCED POWER SYSTEM ANALYSIS** **3 1 0 4**

COURSE OBJECTIVES

To enable the students to

- analyse the mathematical representation of power system components and solution techniques.
- generalise the power flow analysis using various methods.
- produce the optimal power flow solutions by using Newton's method, gradient method, LP methods.
- infer knowledge of the different types of faults and its calculation using computer method and mathematical model.
- know the concept of numerical integration methods to analyse power system transient stability.

UNIT I SOLUTION TECHNIQUES 12

Sparse matrix techniques for large scale power systems: Optimal ordering schemes for preserving sparsity - Flexible packed storage scheme for storing matrix as compact arrays - Factorization by Bifactorization and Gauss elimination methods - Repeat solution using left and right factors and L and U matrices.

UNIT II POWER FLOW ANALYSIS 12

Fast decoupled power flow method - Sensitivity factors for P-V bus adjustment - Net interchange power control in multi-area power flow analysis: ATC, assessment of available transfer capability (ATC) using repeated power flow method - Continuation power flow method - Contingency analysis.

UNIT III OPTIMAL POWER FLOW 12

Problem statement - Solution of optimal power flow (OPF) – The gradient method, Newton'smethod, linear sensitivity analysis; LP methods with real power variables only – LP method with AC power flow variables and detailed cost functions - security constrained optimal power flow - Interior point algorithm - Bus Incremental costs.

UNIT IV SHORT CIRCUIT ANALYSIS 12

Fault calculations using sequence networks for different types of faults - Bus impedance matrix (ZBUS) construction using building algorithm for lines with mutual coupling - Simple numerical problems - Computer method for fault analysis using ZBUS and sequence components - Derivation of equations for bus voltages, fault current and line currents, both in sequence and phase domain using Thevenin’s equivalent and ZBUS matrix for different faults.

UNIT V TRANSIENT STABILITY ANALYSIS 12

Introduction, numerical integration methods: Euler and fourth order Runge-Kutta methods, algorithm for simulation of SMIB and multi-machine system with classical synchronous machine model - Factors influencing transient stability, numerical stability and implicit integration methods.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end this course, students will be able to

- design proper mathematical models for analysis of power system components.
- illustrate the methodologies of power flow studies for the power system network.
- produce the optimal solutions for power flow problems.
- evaluate the short circuit problems prevailing in power systems.
- perform numerical integration to analyze power system transient stability.

REFERENCES

1. Grainger, J.D., “Power System Analysis”, Tata McGraw Hill Publishing Company, 2016.
2. Kusic, C.L.,“Computer Aided Power System Analysis” , Tata McGraw Hill Publishing Company, Reprint 2017.
3. Pai, M. A.,“Computer Techniques in Power System Analysis” , TMH Publishing Company, Reprint 2015.
4. Stagg, G. W. and Elabiad, A. H., “Computer Methods in Power System Analysis” , McGraw Hill, Reprint 2016.
5. Wood, A.J. and Wollenberg, B.F.,“Power Generation, Operation and Control” , John Wiley and Sons, 2015.
6. Singh L.P.,“Advanced power system analysis and dynamics” , 3rd Ed., Wiley eastern, New Delhi, 2015.

CO-PO MAPPING:

Mapping of Course Outcome with Programme Outcomes and Programme Specific Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO’s	Programme Outcomes PO’s												PSO’s	
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CO3	3	3	3	1	3	-	-	-	2	2	3	3	3	3
CO4	3	3	3	3	3	-	-	-	2	-	3	3	3	3
CO5	3	3	3	2	3	1	-	-	2	-	3	3	3	3

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PPS19102 POWER SYSTEM DYNAMICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the basics of mathematical description of a synchronous machine.
- acquire knowledge in speed governing systems.
- understand the concepts of system stability analysis with and without controllers.
- deduce the stability and instability analysis of various power system networks.
- analyse the digital simulation of various energy functions.

UNIT I SYNCHRONOUS MACHINE MODELING 9

Synchronous machine - Physical description - Mathematical description of a synchronous machine - Basic equations of a synchronous machine - Stator circuit equations, stator self, stator mutual and stator to rotor mutual inductances - dq0 transformation - Per unit representation - Equivalent circuits for direct and quadrature axes - Steady-state analysis - Steady-state equivalent circuit, computation of steady-state values equations of motion - Swing equation, H-constant calculation - Representation in system studies - Synchronous machine representation in stability studies - Simplified model with amortisseurs neglected - classical model with amortisseur windings neglected.

UNIT II MODELING OF EXCITATION AND SPEED GOVERNING SYSTEMS 9

Excitation system modeling - Excitation system requirements - Types of excitation system - Rotating rectifier and potential source controlled rectifier systems: hardware block diagram and IEEE(1992) type ST1A block diagram - Turbine and governing system modeling - Functional block diagram of power generation and control - Schematic of a hydroelectric plant - Classical transfer function of a hydraulic turbine (no derivation) - Special characteristic of hydraulic turbine - Electrical analogue of hydraulic turbine governor for hydraulic turbine - Requirement for a transient droop, block diagram of governor with transient droop compensation - Steam turbine modeling: Single reheat tandem compounded type only and IEEE block diagram for dynamic simulation, generic speed-governing system model for normal speed/load control function.

UNIT III SMALL-SIGNALS STABILITY ANALYSIS WITH AND WITHOUT CONTROLLERS 9

Classification of stability - Basic concepts and definitions: Rotor angle stability - Fundamental concepts of stability of dynamic systems: State-space representation - Stability of dynamic system - Linearization, Eigen properties of the state matrix – Eigenvalue and stability - Single-machine infinitiesbus (SMIB) Configuration - Classical machine model stability analysis with numerical example - Effect of field flux variation on system stability: analysis with numerical example -Effects of excitation

System - Analysis of effect of AVR on synchronizing and damping components using a numerical example - Multi-machine configuration - Equations in a common reference frame - Formation of system state matrix for a two-machine system with classical models for synchronous machines, illustration of stability analysis using a numerical example.

UNIT IV TRANSIENT STABILITY ANALYSIS 9

Introduction - Factors influencing transient stability – Review of numerical integration methods - Simulation of power system dynamic response: Structure of power system Model, synchronous machine representation - Thevenin's and Norton's equivalent circuits, Excitation system representation, transmission network and load representation, overall system equations and their solution - Partitioned - explicit and simultaneous-implicit approaches, treatment of discontinuities, simplified transient stability simulation using simultaneous-implicit approaches.

UNIT V INSTABILITY ANALYSIS 9

Small signal angle instability (sub-synchronous frequency oscillations): analysis and counter measures - Transient instability - Analysis using digital simulation and energy function method -Transient stability controllers - Introduction to voltage instability - Analysis of voltage instability.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the fundamental dynamic behavior of power systems.
- control the power systems to perform basic stability analysis.
- summarize the concepts in modeling and simulating the dynamic phenomena of power systems.
- interpret results of system stability studies. .
- demonstrate theory and practice of modeling main power system components, such as synchronous machines, excitation systems and governors.

REFERENCES

1. P. S. Kundur, "Power System Stability and Control", McGraw-Hill, 2014.
2. K.R.Padiyar, "Power System Dynamics Stability & Control", BS Publications, 2014.
3. P.M Anderson and A.A Fouad, "Power System Control and Stability", Iowa State University Press, 2016.
4. PeterW.Sauer&M.A.Pai, "Power System Dynamics & Stability", Pearson Education, 2015.
5. IEEE Committee Report, "Dynamic Models for Steam and Hydro Turbines in Power System Studies", IEEE Transactions, Vol.PAS-92, pp 1904-1915, November / December 1997.

CO-PO MAPPING:

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CO4	3	3	3	3	3	-	-	-	2	-	1	1	3	3
CO5	3	3	3	2	3	1	-	-	2	-	3	3	3	3

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PEN19101 RESEARCH METHODOLOGY AND IPR 2 0 0 2

COURSE OBJECTIVES

To enable the students to

- understand the formulation of research problem.
- learn about data collection and preparation process.
- learn the procedure for literature survey.
- learn the concept of research proposals and research report writing.
- understand about patent rights and its importance.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research, Objectives of Research, Types of research, Significance of Research, Research process, Selecting the problem, Necessity of defining the problem, Meaning of Research design, Need for research design, features of a good design, Different research designs.

UNIT II SCALING AND DATA COLLECTION 6

Quantitative and Qualitative data, Scaling, Scaling Techniques, Experiments and Surveys, Collection of primary and secondary data, Data preparation process.

UNIT III LITERTURE SURVEY 6

Bring clarity and focus to your research problems, Improve your methodology, Procedure for reviewing the literature, search for existing literature, Develop a theoretical and conceptual framework, Writing up the literature reviewed.

UNIT IV RESEARCH PROPOSAL AND RESEARCH REPORT 6

Contents of a research proposal, Writing a research report- Research writing in general, Referencing, Writing a bibliography, Developing an outline, Plagiarism, Research ethics.

UNIT V INTELLECTUAL PROPERTY RIGHTS 6

Intellectual Property- Definition, WTO, Fundamentals of Patent, Copyright- The rights of the owner, Term of copyright, Register of Trademark, Procedure for trade mark, Term of trademark.

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- identify research problems.
- collect and prepare suitable data for research.
- do literature survey in their area of research.

- write research proposals and reports.
- apply their research work for patent through IPR.

REFERENCES

1. C.R Kothari and Gaurav Garg, "Research Methodology Methods and Techniques", 4th Edition, New Age International Publishers.
2. Ranjit Kumar, " Research Methodology", 2nd Edition, Pearson Education, Australia
3. M.N. Borse, " Hand Book of Research Methodology, Modern, Methods and New Techniques", Shree Niwas Publications, Jaipur.
4. Neeraj Pandey and Khushdeep Dharni, " Intellectual Property rights", PHI Learning, 2014.
5. Dr.R.Radhakrishnan and Dr.S.Balasubramanian, " Intellectual Property Rights, text and cases", Excel Books, New Delhi.

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CO4	3	3	2	-	-	-	-	1	-	3	1	3	3	3
CO5	3	3	3	2	-	-	-	3	-	1	2	3	3	3

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PPS19103 POWER SYSTEM SIMULATION LABORATORY I 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- impart knowledge about load flow analysis through digital simulation.
- study the dynamic mechanisms behind angle and voltage stability problems in electric power systems, including physical phenomena and modelling issues.
- perform the estimation of different states of a power system.
- understand the performance of relay and generation dispatching scheme.

LIST OF EXPERIMENTS

1. Power flow analysis by Newton-Raphson method and Fast decoupled method.
2. Transient stability analysis of single machine-infinite bus system using classical machine model.
3. Contingency analysis: Generator shift factors and line outage distribution factors.
4. Economic dispatch using Lambda-iteration method.
5. Unit commitment: Priority-list schemes and dynamic programming.
6. Analysis of switching surge using EMTP: Energisation of a long distributed parameter line.
7. Analysis of switching surge using EMTP: Computation of transient recovery voltage.
8. Simulation and implementation of voltage source inverter.
9. Digital over current relay setting and relay coordination.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end this course, students will be able to

- investigate the power flow studies.
- reproduce the electromagnetic and electromechanical phenomena in the synchronous generator.
- enumerate the compensations schemes available in power systems.
- develop generation dispatching schemes in power systems.

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CO4	3	3	3	3	3	-	-	-	3	-	3	3	3	3

PROFESSIONAL ELECTIVE I

PPS19151 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- comprehend the electrical energy generation from various renewable and non-renewable sources of energy.
- recognize the fundamental principles of electrical machines in wind energy conversion system and its grid integration with PV systems.
- identify the power converters for wind and solar energy conversion systems Course Outcomes
- perform analysis of wind solar energy systems
- acquire knowledge on hybrid energy systems

UNIT I INTRODUCTION 9

Environmental aspects of electric energy conversion: Impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, Wind, Ocean, Biomass, Fuel cell, Hydrogen energy systems and Hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9

Review of reference theory fundamentals-Principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS 9

Solar: Block diagram of solar photo voltaic system - Principle of operation of line commutatedconverters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Wind: Three phase AC voltage controllers - AC-DC-AC converters, uncontrolled rectifiers, PWM inverters, grid interactive inverters-Matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS SOLAR 9

Stand-alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection issues -Grid integrated PMSG and SCIG based WECS-Grid integrated solar system.

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for hybrid systems- Range and type of hybrid systems- Case studies of Wind-PV-Maximum Power Point Tracking (MPPT).

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the power generation from various sources of energy.
- explain the fundamentals and principles of electrical machines in energy conversion.
- analyze the power electronic converters needed for energy conversion applications.
- elucidate the various wind energy systems and PV systems.
- describe the need to extract the maximum power using MPPT algorithm in hybrid systems.

REFERENCES

1. ShobhNath Singh, "Non-conventional Energy resources" , Pearson Education ,2015.
2. S. Sumathi, L. Ashok Kumar , P. Surekha, "Solar PV and Wind Energy Conversion Systems" (Green Energy and Technology), 2015.
3. Rai. G.D,"Solar energy utilization", Khanna publishes, 2012.
4. Philippe Coiffet, "Robot Technology" Vol. II (Modelling and Control), Prentice Hall Inc, 1983.
5. ShobhNath Singh, "Non-conventional Energy resources", Pearson Education, 2015.

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CO4	3	3	3	3	3	-	-	-	2	-	1	1	3	3
CO5	3	3	3	2	3	1	-	-	2	-	3	3	3	3

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PPS19152 SMART GRIDS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand concept of smart grid, smart meters and its advantages over conventional grid.
- Know smart metering techniques.
- learn wide area measurement techniques.
- understanding the problems associated with integration of distributed generation and its solution through smart grid.
- gain knowledge in communication technologies.

UNIT I INTRODUCTION TO SMART GRID AND SMART METERS 9

Evolution of electric grid, concept of smart grid, definitions and necessity of smart grid, concept of robust and self-healing grid, present development and international policies in smart grid - Real time pricing, smart appliances, automatic meter reading (AMR), outage management system (OMS), smart substations, substation automation, feeder automation.

UNIT II SMART GRID TECHNOLOGIES 9

Geographic information system (GIS), intelligent electronic devices (IED) and their application for monitoring and protection, smart storage like battery, superconducting magnetic energy storage (SMES), wide area measurement system (WAMS), phase measurement unit (PMU).

UNIT III MICRO-GRID 9

Concept, necessity and applications of micro-grid, formation of micro-grid, issues of interconnection, operation, control and protection of micro-grid -Plastic and organic solar cells, thin film solar cells, variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, integration of renewable energy sources.

UNIT IV POWER QUALITY 9

Electromagnetic compatibility (EMC) of smart grid, power quality issues of grid connected renewable energy sources, power quality conditioners for smart grid

UNIT V COMMUNICATIONS IN SMART GRID 9

Advanced metering infrastructure (AMI), home area network (HAN), neighborhood area network, communication through GPRS and power line carrier communication, internet of things (IoT) based protocols.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the difference between smart grid and conventional grid.
- apply smart metering concepts to industrial and commercial installations.
- formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
- analyze the issues of power quality in smart grid.
- elucidate the smart grid solutions using modern communication technologies.

REFERENCES

1. Ali Keyhani, “Design of Smart Power Grid Renewable Energy Systems”, 2nd Edn., Wiley IEEE Press.
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press, 2009.
3. JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu and Nick Jenkins, “Smart Grid: Technology and Applications”, Wiley Online Library, 2012.
4. Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions”, CRC Press.
5. AliKeyhani, “Design of Smart Power Grid Renewable Energy Systems”, 2nd Edn., Wiley IEEE Press.

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CO4	3	3	3	3	2	-	-	-	3	-	3	2	3	3
CO5	3	3	3	2	3	1	-	-	3	-	3	3	3	3

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PPS19153 HIGH POWER CONVERTERS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the electrical circuit concepts behind the different working modes of multi-pulse diode rectifier.
- know the different working modes of multilevel concept and applications.
- familiarize in the design and development of DC-DC converters.
- acquire knowledge about various operating modes of different configurations of AC voltage controllers.
- gain information from the concepts of protection of devices and circuits.

UNIT I MULTI-PULSE DIODE RECTIFIER 9

Multiphase star rectifier, three phase bridge rectifier, three phase bridge rectifier with RL load, three phase rectifier with a highly inductive load - Twelve pulse converters - Effect of load and source inductance.

UNIT II MULTILEVEL INVERTERS 9

Multilevel concept -Types of multilevel inverters such as: diode clamped multilevel inverter, flying-capacitor multilevel inverter, cascaded multilevel inverter – Applications - PWM current source inverters.

UNIT III DC-DC CONVERTER 9

Performance parameter of DC-DC converters, Switching mode regulators such as: buck, boost and buck-boost regulators

UNIT IV AC VOLTAGE CONTROLLERS 9

Performance parameters of AC voltage controllers, single phase full wave controller with resistiveloads and inductive loads, three phase full wave controllers, three phase full wave delta connected controllers, Single phase and three phase cycloconverters, matrix converter - Un-interruptible power supply (UPS)

UNIT V PROTECTION OF DEVICES AND CIRCUITS 9

Cooling and heat sinks, thermal modeling of power switching devices, snubber circuit -Reverse recovery transients, supply and load side transients - Voltage protection by selenium diodes and metal oxide varistors - Current protections, fusing, fault current with AC and DC source.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the various circuit concepts of multi-pulse diode rectifier.
- analyse the working of multilevel inverter topology.
- design and develop DC-DC converters.
- derive the design criteria and analyse the various operating modes of different configurations of AC voltage controllers.
- provide protection to devices and circuits of various power applications.

REFERENCES

1. Rashid M.H., “Power Electronics Circuits, Devices and Applications", Prentice Hall India, New Delhi, 2014.
2. BimalK.Bose., “Modern Power Electronics and AC Drives”, Pearson Education,2012.
3. Ned Mohan, Undeland and Robbin, “Power Electronics: converters, Application and design” John Wiley and sons. Inc, Newyork,2009.
4. P.C. Sen, “Modern Power Electronics” , S. Chand Limited, New Delhi, 2008.
5. P.S.Bimbra, “Power Electronics”,Khanna Publishers,2005.
6. Dubey. G.K., "Thyristorised power controllers", New age International, New Delhi, 2002.

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CO3	3	3	3	1	3	-	-	3	3	2	3	2	3	3
CO4	3	3	3	3	3	-	-	-	3	-	3	2	3	3
CO5	3	3	3	2	3	1	-	-	3	-	3	2	3	3

PPS19154 **WIND AND SOLAR SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- infer knowledge on renewable energy resources.
- get the concepts of wind energy and its application.
- study characteristics of solar and photovoltaic cell.
- know about power electronics converters.
- understand the fundamental concepts of grid connectors in wind and solar.

UNIT I INTRODUCTION 9

Environmental aspects of electric energy conversion: Renewable energy resources and their importance - qualitative study of solar PV, wind electrical systems - control strategy, operating area, operating principles and characteristics - Trends in energy consumption - World energy scenario – Energy sources and their availability - Conventional and renewable sources - Need to develop new energy technologies.

UNIT II WIND ENERGY 9

Introduction - Basic principles of wind energy conversion system - Nature of wind -Site selection consideration -Basic components of wind energy conversion system - Types of wind machines - Basic components of wind electric conversion systems - Schemes for electric generations - Generator control, load control, energy storage -Applications of wind energy - Inter connected systems- Power electronics in wind energy utilization.

UNIT III SOLAR ENERGY 9

Solar radiation, availability, measurement and estimation - Solar thermal conversion devices andstorage, solar cells, solar cell interconnection, solar cell characteristics and photovoltaic conversion -PV systems - Analysis of PV systems- MPPT - Applications of PV Systems - Solar energy collectors and storages - Power electronics in solar energy utilization - DC-DC converters for solar PV systems.

UNIT IV POWER CONVERTERS 9

Solar: Block diagram of solar photo voltaic system: line commutated converters (inversion mode) - Boost and buck-boost converters- Selection of inverter, battery sizing, array sizing - Wind: three phase AC voltage controllers - AC-DC-AC converters: uncontrolled rectifiers, PWM inverters, grid interactive inverters - Matrix converters.

UNIT V GRID CONNECTED WIND & SOLAR ENERGY CONVERSION SYSTEMS 9

Grid connectors - Connection issues - Wind farm and its accessories - Grid related problems -

Generator control - Performance improvements - Different schemes - Power converters for Grid connected wind energy conversion system and grid connected solar energy converter systems - Hybrid systems - Types of cogeneration processes.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- elucidate renewable energy resources and their importance.
- describe about the basic components in wind energy system.
- analyse the characteristics of solar cell and photovoltaic system.
- explain the modern power converters for renewable energy power harness.
- evaluate grid connection issues and provide performance improvements of wind and solar.

REFERENCES

1. Mukund R. Patel, “Wind and Solar Power Systems: Design, Analysis, and Operation” , Second Edition, CRC Taylor & Francis, 2006.
2. J.A. Duffie and W.A. Beckman, “Solar Engineering of Thermal Processes”, Second Edition, John Wiley, New York, 1991.
3. D.Y. Goswami, F. Kreith and J.F. Kreider, “Principles of Solar Engineering”, Taylor and Francis, Second Edition, 1999.
4. D. D. Hall and R.P. Grover, “Bio-Mass Regenerable Energy” , John Wiley, Newyork, 1987.
5. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, “Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications”, Wiley Publications, 2014.

CO-PO MAPPING:

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CO5	3	3	3	2	3	2	-	-	3	-	3	2	3	3

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Electrical & Electronics Engineering

PROFESSIONAL ELECTIVE II

PMA19152 MATHEMATICAL METHODS IN POWER ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- develop the ability to apply the concepts of matrix theory and linear programming in electrical engineering problems.
- achieve an understanding of the basic concepts of one dimensional random variables and apply in electrical engineering problems.
- familiarize the students in calculus of variations and solve problems using Fourier transforms associated with engineering applications.
- formulate and construct a mathematical model for a linear programming problem in real life situation.
- introduce fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.

UNIT I MATRIX THEORY 9

The Cholesky decomposition – Generalized Eigenvectors, Canonical basis – QR factorization – Least square method – Singular value decomposition.

UNIT II FOURIER SERIES 9

Fourier Trigonometric series: Periodic function as power signals – Convergence of series – Even and odd function: cosine and sine series – Non-periodic function: Extension to other intervals – Power signals: Exponential Fourier series – Parseval's theorem and power spectrum – Eigen value problems and orthogonal functions – Regular Sturm-Liouville systems – Generalized Fourier series.

UNIT III ONE DIMENSIONAL RANDOM VARIABLES 9

Random variables – Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT IV CALCULUS OF VARIATIONS 9

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional's dependant on functions of several independent variables – Variational problems with moving boundaries – problems with constraints – Direct methods: Ritz and Galerkin methods.

UNIT V LINEAR PROGRAMMING 9

Formulation – Graphical solution – Simplex method – Two phase method – Transportation and Assignment Models.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- gain a well found knowledge in matrix to calculate the electrical properties of a circuit, with voltage, amperage ,resistance, etc.
- solve a variational problem using the Euler equation.
- gain knowledge in standard distributions which can describe the real life phenomena.
- understand and apply linear, integer programming to solve operational problem with constraints.
- apply fourier series, their different possible forms and the frequently needed practical harmonic analysis.

REFERENCES

1. Richard Bronson, “Matrix Operation”, Schaum’s outline series, 2nd Edition, McGraw Hill,2011.
2. Gupta, A.S., “Calculus of Variations with Applications”, Prentice Hall of India Pvt. Ltd., NewDelhi, 1777.
3. Oliver C. Ibe, “Fundamentals of Applied Probability and Random Processes”, AcademicPress, (An imprint of Elsevier), 2010.
4. Taha, H.A., “Operations Research, An introduction”, 10th edition, Pearson education,New Delhi, 2010.
5. Andrews L.C. and Phillips R.L., “Mathematical Techniques for Engineers and Scientists”,Prentice Hall of India Pvt.Ltd., New Delhi, 2005.
6. Elsgolts, L., “Differential Equations and the Calculus of Variations”, MIR Publishers, Moscow,1773.
7. Johnson R. A. and Gupta C. B., “Miller & Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 7th Edition, 2007.

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PPS19251 ELECTRICAL POWER DISTRIBUTION SYSTEM 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- provide knowledge about the distribution system electrical characteristics.
- gain knowledge about planning and designing of distribution system.
- analyze power quality in distribution system.
- understand the voltage regulation in distribution system.
- get idea about the power flow in balanced and unbalanced system.

UNIT I INTRODUCTION 9

Distribution system - Distribution feeder electrical characteristics - Nature of Loads: individual customer load, distribution transformer loading and feeder load - Approximate method of analysis: voltage drop, line impedance, "K" factors, uniformly distributed loads andlumping loads in geometric configurations.

UNIT II DISTRIBUTION SYSTEM PLANNING 9

Factors effecting planning, present techniques, planning models (short term planning, long term planning and dynamic planning), planning in the future, future nature of distribution planning - Role of computer in distribution planning - Load forecast, load characteristics and load models.

UNIT III DISTRIBUTION SYSTEM LINE MODEL 9

Exact line segment model - Modified line model - Approximate line segment model - Modified "Ladder" iterative technique - General matrices for parallel lines.

UNIT IV VOLTAGE REGULATION 9

Standard voltage ratings - Two-winding transformer theory - Two-winding autotransformer - Step-voltage regulators: single-phase step-voltage regulators- Three-phase step-voltage regulators - Application of capacitors in distribution system.

UNIT V DISTRIBUTION FEEDER ANALYSIS 9

Power-flow analysis - Ladder iterative technique - Unbalanced three-phase distribution feeder- modified ladder iterative technique - Load allocation - Short-circuit studies.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- explain the various types of load and methods of analysis.
- apply the concepts of planning and design of distribution system for utility systems.

- describe about the distribution system line models.
- implement the concepts of voltage control in distribution system.
- analyze the power flow in balanced and unbalanced system.

REFERENCES

1. William H. Kersting,"Distribution System Modeling and Analysis", CRC press 3rdedition,2016.
2. TuranGonen,“Electric Power Distribution System Engineering”, McGraw HillCompany. 2015
3. Pabla H S, “Electrical Power Distribution Systems”, Tata McGraw Hill. 2012
4. James Northcote - Green, Robert Wilson, “Control and Automation of Electrical Power”.

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CO5	3	3	3	2	3	1	-	-	3	-	3	3	3	3

PPS19252 ANALYSIS AND DESIGN OF POWER CONVERTERS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the operation and characteristics of controlled rectifiers.
- know the switching techniques and basic topologies of DC-DC switching regulators.
- analyse the design of power converter components.
- get in depth knowledge about resonant converters.
- comprehend the concepts of AC-AC power converters and their applications.

UNIT I SINGLE PHASE AND THREE PHASE CONVERTERS 9

Principle of phase controlled converter operation - single-phase full converter and semiconverter (RL,RLE load)- single phase dual converter - Three phase operation full converter and semi-converter (R,RL,RLE load) - reactive power - power factor improvement techniques - PWM rectifiers.

UNIT II DC-DC CONVERTERS 9

Limitations of linear power supplies, switched mode power conversion, Non-isolated DC-DC converters: operation and analysis of buck, boost, buck-boost, cuk and SEPIC – under continuous and discontinuous operation - Isolated converters: basic operation of flyback, forward and push-pull topologies.

UNIT III DESIGN OF POWER CONVERTER COMPONENTS 9

Introduction to magnetic materials - Hard and soft magnetic materials –Types of cores , copper windings - Design of transformer - Inductor design equations - Examples of inductor design for buck/flyback converter-Selection of output filter capacitors – Selection of ratings for devices - Input filter design.

UNIT IV RESONANT DC-DC CONVERTERS 9

Switching loss, hard switching, and basic principles of soft switching- classification of resonant converters- load resonant converters – series and parallel – resonant switch converters – operation and analysis of ZVS, ZCS converters comparison of ZCS/ZVS – Introduction to ZVT/ZCT PWM converters.

UNIT V AC-AC CONVERTERS 9

Principle of on-off and phase angle control - single phase ac voltage controller - analysis with R & RL load - Three phase ac voltage controller - principle of operation of cycloconverter - single phase and three phase cycloconverters - Introduction to matrix converters.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- analyze various single phase and three phase power converters
- design dc-dc converter topologies for a broad range of power conversion applications.
- develop improved power converters for any stringent application requirements.
- design ac-ac converters for variable frequency applications.
- describe the concepts of AC-AC power converters and their applications.

REFERENCES

1. Ned Mohan,T.MUndeland and W.P Robbin, “Power Electronics: converters,Application and design” John Wiley and sons , Wiley India edition, 2006.
2. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice HallIndia, Third Edition, New Delhi, 2004.
3. P.C. Sen, “Modern Power Electronics”, Wheeler Publishing Co, First Edition, NewDelhi, 1998.
4. P.S.Bimbra, “Power Electronics”, Khanna Publishers, Eleventh Edition, 2003
5. Simon Ang, Alejandro Oliva, “Power-Switching Converters, Second Edition, CRCPress, Taylor & Francis Group, 2010
6. V.Ramanarayanan, “Course material on Switched mode power conversion”, 2007
7. Alex Van den Bossche and VencislavCekovValchev, “Inductors and Transformers for Power Electronics”, CRC Press, Taylor & Francis Group, 2005
8. W. G. Hurley and W. H.Wolfle, “Transformers and Inductors for Power Electronics Theory, Design and Applications”, 2013 John Wiley & Sons Ltd.
9. Marian.K.Kazimierczuk and Dariusz Czarkowski, “Resonant Power Converters”,John Wiley & Sons limited, 2011

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PPS19253 ELECTRIC AND HYBRID VECHILES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of conventional vehicles.
- explain and understand depth knowledge in conventional vehicles to infer knowledge in the hybrid electric drive-trains.
- describe the energy storage and energy management.
- discuss the sizing the drive system.
- understand the concepts of conventional vehicles .

UNIT I CONVENTIONAL VEHICLES 9

Basics of vehicle performance - vehicle power source characterization- transmission characteristics-Mathematical models to describe vehicle performance.

UNIT II HYBRID ELECTRIC DRIVE-TRAINS 9

Basic concept of hybrid traction - Introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis - Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT III ELECTRIC PROPULSION UNIT 9

Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC motor drives, configuration and control of induction motor drives.

UNIT IV ENERGY STORAGE AND ENERGY MANAGEMENT 9

Introduction to energy storage requirements in hybrid and electric vehicles, battery based energy storage and its analysis, Fuel cell based energy storage and its analysis, hybridization of differentenergy storage devices - Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies.

UNIT V SIZING THE DRIVE SYSTEM 9

Matching the electric machine and the internal combustion engine (ICE), sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- elucidate the various method of conventional vehicles

- apply the concepts of various topologies in hybrid electric drive-trains
- describe about the electric propulsion unit
- analyze the energy storage and energy management
- implement the concepts of sizing the drive system

REFERENCES

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”.

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CO5	3	3	3	-	3	2	-	-	3	-	3	3	3	3

ENGINEERING COLLEGE, NAMAKKAL
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BOARD OF STUDIES
Electrical & Electronics Engineering
AUTONOMOUS

AUDIT I

PEN19171 ENGLISH FOR RESEARCH PAPER WRITING 2 0 0 0

COURSE OBJECTIVES

To enable the students to

- understand how to improve the writing skills and level of readability.
- learn about what to write in each section and to understand the skills needed to write a title.
- choose and focus on a topic of interest and to learn how to paraphrase, summarize, using correct attribution and following documentation guidelines.
- craft a research paper in their discipline.
- ensure the good quality of paper at first-time submission.

UNIT I PLANNING AND PREPARATION 6

Precision of Words, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. Expressing independent thought with grace, clarity and force.

UNIT II STRUCTURE OF A PAPER 6

Details of all the parts - Clarifying Who Did What, Highlighting the Findings, Hedging and Criticizing, Skills to identify something we really need to know -some ways to find a topic - to venture out across the swamp of research without losing our bearings - Paraphrasing - Sections of a Paper, Abstract, Introduction. Introduction to Free writing.

UNIT III LITERATURE REVIEWS AND CITATIONS 6

Key skills required to - write a title, an abstract, write an introduction, write the review of the literature, conduct a literature review of all current research in their field. Review of the Literature, Methods, Results, Discussion and Conclusions - citing references correctly and avoiding plagiarism.

UNIT IV EDITING AND ORGANISING SKILLS 6

Skills required to - write the Methods, write the Discussion, write the Results, write Conclusions. - write about what we've learned truthfully so the reader really gets it in thought and expression, demonstrating a clear understanding and execution of the research.

UNIT V WRITING STANDARDS 6

Useful phrases, to ensure paper is as good as it could possibly be the first – time submission -first draft, second draft, final draft of research report, journal article, literature review, dissertation chapter, grant proposal, or other relevant document. Avoid -inadequate support of generalizations, slipshod or hurried style, poor attention to detail, straying from directions, mechanical errors, underwritten and/or marredby confused purpose, lack of organization, repetition of ideas, improper use of words, and frequent grammatical, spelling and punctuation errors.

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- prepare and write a research paper in their discipline
- be initially organized and well-versed as a researcher, reviewing in detail general versus specific and problem-solution structures.
- understand the basics of citations, avoiding plagiarism and literature reviews.
- culminate the actual crafting and revising of a research paper.
- use suitable vocabulary, grammar and punctuation to write flawless piece of writing.

REFERENCES

1. Goldbort R (2006) Writing for Science, Yale University Press.
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.

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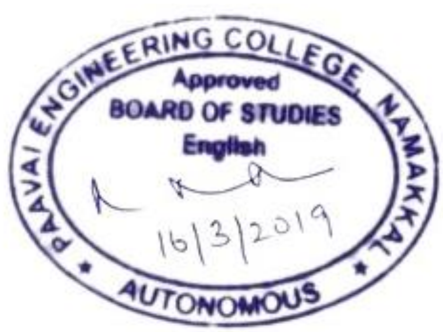

SEMESTER II

PPS19201 ADVANCED POWER SYSTEM PROTECTION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the characteristics and functions of relays and protection schemes.
- know the concepts of transformer protection and generator protection in faulty conditions.
- acquire knowledge about the usage of relays in distance and carrier protection for single and double end fed lines.
- identify the concepts of bus bar protection under various fault conditions using current transformer.
- be familiar with various schemes of static comparators and analysis of numerical protection.

UNIT I INTRODUCTION 9

Zones of protection – Primary and backup protection – operating principles and relay construction - time – current characteristics - Current setting – Time setting - Over current protective schemes - Reverse power or directional relay - Protection of parallel feeders - Protection of ring feeders - Earth fault and phase fault protection - Combined Earth fault and phase fault protection scheme - Phase fault protective scheme directional earth fault relay - Static over current relays.

UNIT II EQUIPMENT PROTECTION 9

Types of transformers – Phasor diagram for a three phase transformer - Equivalent circuit of transformer – Types of faults in transformers - Over current protection - Percentage differential protection of transformers - Inrush phenomenon - High resistance ground faults in transformers – Interturn faults in transformers – Incipient faults in transformers - Phenomenon of over fluxing in transformers – Transformer protection application chart - Generator protection: Electrical circuit of the generator – Various faults and abnormal operating conditions - Stator faults - Rotor faults – Abnormal operating conditions - Induction motor protection: Electrical Faults - Abnormal operating conditions from supply side.

UNIT III DISTANCE AND CARRIER PROTECTION OF TRANSMISSION LINES 9

Introduction to distance relay – Simple impedance relay – Reactance relay – mho relays - Distance protection of a three Phase line - Three stepped distance protection - Trip contact configuration for the three - Stepped distance protection - Three-stepped protection of three-phase line against allten shunt faults - Three-stepped protection of double end fed lines - Various options for a carrier – Coupling and trapping the carrier into the desired line section - Unit type carrier aided directional comparison relaying – Carrier aided distance schemes for acceleration of zone II - Phase comparison relaying.

UNIT IV BUSBAR PROTECTION 9

Introduction - Differential protection of bus bars - external and internal fault - Actual behaviors of a protective CT - Circuit model of a saturated CT - External fault with one CT saturation need for high impedance - Minimum internal fault that can be detected by the high impedance Bus bar differential scheme – Stability ratio of high impedance bus bar differential scheme - Supervisory relay - Protection of three Phase bus bars.

UNIT V STATIC COMPARATOR AS A RELAY AND NUMERICAL PROTECTION 9

Amplitude comparator- Phase comparator- Duality between amplitude and Phase comparator Introduction - Synthesis of various distance relay using static comparator - Numerical protection: Block diagram of numerical relay - Sampling theorem - Correlation with a reference wave - Least error squared (LES) technique - Numerical over current protection – Numerical transformer differential protection - Numerical distance protection of transmission line.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the construction and operation of electromagnetic relays.
- choose the protective circuit based on the knowledge of faults in equipment.
- analyse the usage of relays in distance and carrier protection for single and double end fed lines.
- explain the effective usage of CT in protection circuits.
- perform analysis based on synthesis of numerical protection of transmission line using static comparator.

REFERENCES

1. Ravindar P. Singh, “Digital Power System Protection”, PHI, New Delhi, 2007.
2. T.S.M.Rao, “Digital / Numerical Relays”, Tata Mc Graw Hill, 2005.
3. Y.G.Paithankar, S.R.Bhide, “Fundamentals of Power System Protection”, Prentice Hall India, 2004.
4. L.P.Singh,“Digital protection – Protective Relaying from Electromechanical to Microprocessor”, John Wiley & Sons, 1995.

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PPS19202 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic concepts of HVDC with existing HVDC projects.
- analyze the HVDC Converters and HVDC system control and harmonics and filtering.
- gain knowledge about the types of multi terminal DC systems.
- understand the concepts of power flow analysis in AC/DC systems.
- acquire knowledge on the basic concepts of simulation of HVDC systems.

UNIT I DC POWER TRANSMISSION TECHNOLOGY 9

Introduction - Comparison of AC and DC transmission - Application of DC transmission - Description of DC transmission system - Planning for HVDC transmission - Modern trends in DC transmission - DC breakers - Cables, VSC based HVDC.

UNIT II ANALYSIS OF HVDC CONVERTERS AND HVDC SYSTEM CONTROL 9

Pulse number, choice of converter configuration - Simplified analysis of Graetz circuit - Converter bridge characteristics - characteristics of a twelve pulse converter - detailed analysis of converters. General principles of DC link control - Converter control characteristics - System Control hierarchy - Firing angle control - Current and extinction angle control - Generation of harmonics and filtering - power control - Higher level controllers.

UNIT III MULTITERMINAL DC SYSTEMS 9

Introduction - Potential applications of MTDC systems - Types of MTDC systems - Control and protection of MTDC systems - Study of MTDC systems

UNIT IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC Quantities - Modeling of DC links - Solution of DC load flow - Solution of AC-DC power flow - Case studies.

UNIT V SIMULATION OF HVDC SYSTEMS 9

Introduction - System simulation: Philosophy and tools - HVDC system simulation - Modeling of HVDC systems for digital dynamic simulation - Dynamic in traction between DC and AC systems.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the basic concept of DC power transmission technology.
- enumerate about HVDC converters and HVDC system control with converter.
- specify the concepts of multi terminal DC systems with control and protection of MTDC

system.

- provide the solution of AC/DC power flow analysis.
- design the simulation of HVDC systems with philosophy and tools.

REFERENCES

1. K.R.Padiyar, “HVDC Power Transmission Systems”, New Age International (P) Ltd., New Delhi, 2010.
2. J.Arrillaga, “High Voltage Direct Current Transmission”, Peter Pregrinus, London,1983.
3. P. Kundur, “Power System Stability and Control”, McGraw-Hill, 2000.
4. ErichUhlmann, “Power Transmission by Direct Current”, BS Publications, 2004.
5. V.K.Sood, “HVDC and FACTS controllers - Applications of Static Converters in Power System”, April 2004 , Kluwer Academic Publishers.
6. S.Kakshaish, V.Kamaraju, “HVDC Transmission”, TMH Publishers, 2012.

CO-PO MAPPING:

Mapping of Course Outcome with Programme Outcomes and Programme Specific Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO's	Programme Outcomes PO's												PSO's	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	2	-	3	3	3	3	3
CO2	3	3	3	-	3	2	-	-	3	-	3	3	3	3
CO3	3	3	3	-	3	-	-	-	3	2	3	2	3	3
CO4	3	3	3	3	3	-	-	-	3	-	2	2	3	3
CO5	3	3	3	-	3	2	-	-	3	-	3	3	3	3

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Electrical & Electronics Engineering

PPS19203 POWER SYSTEM SIMULATION LABORATORY II 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- understand the concept of SMIB using classical machine model.
- get idea to analyze two-bus system with STATCOM
- know the details of relay protection.
- study about DFIG, PMSG in wind energy conversion system.

LIST OF EXPERIMENTS

1. Small-signal stability analysis of single machine-infinite bus system using classical machine model.
2. Small-signal stability analysis of multi-machine configuration with classical machine model
3. Induction motor starting analysis
4. Load flow analysis of two-bus system with STATCOM
5. Transient analysis of two-bus system with STATCOM
6. Available Transfer Capability calculation using an existing load flow program
7. Study of variable speed wind energy conversion system- DFIG
8. Study of variable speed wind energy conversion system- PMSG
9. Computation of harmonic indices generated by a rectifier feeding a R-L load
10. Co-ordination of over-current and distance relays for radial line protection.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end this course, students will be able to

- implement the concept SMIB using classical machine model through simulation.
- analyze two-bus system with STATCOM.
- execute the relay protection circuit in simulation
- describe the concept of DFIG, PMSG in wind energy conversion system.

CO-PO MAPPING:

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CO2	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO3	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	-	3	-	3	3	3	3

PPS19204 **MINI PROJECT** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- develop the ability to implement their engineering knowledge to build products.
- train the students in preparing project reports and to face reviews and viva voce examination.

The student in a group of3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- apply the basic fundamentals and concepts of engineering in developing hardware modules.

CO-PO MAPPING:

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CO2	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO3	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	-	3	-	3	3	3	3

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PROFESSIONAL ELECTIVE III

PPS19351 RESTRUCTURED POWER SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- introduce the restructuring of power industry and market models.
- impart knowledge on fundamental concepts of congestion management.
- understand the concepts of locational marginal pricing and financial transmission rights.
- acquire knowledge about various power sectors in India.
- know the reforms in power sector.

UNIT I INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9

Introduction: Deregulation of power industry, Restructuring process, 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, electricity vis-a- vis other commodities, market architecture, case study.

UNIT II TRANSMISSION CONGESTION MANAGEMENT 9

Introduction: 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 III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS 9

Mathematical preliminaries: Locational marginal pricing - Lossless DCOPF model for LMP calculation - Loss compensated DCOPF model for LMP calculation - ACOPF model for LMP calculation - Financial transmission rights - Risk hedging functionality - Simultaneous feasibility test and revenue adequency - FTR issuance process: FTR auction, FTR allocation - Treatment of revenue shortfall – Secondary trading of FTRs - Flow gate rights - FTR and market power - FTR and merchant transmission investment.

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK 9

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 - How to obtain ancillary service - Optimization of energy and reserve services - Transmission pricing - Principles - Classification - Rolled in transmission pricing methods - Marginal transmission pricing paradigm - Composite pricing paradigm - Merits and demerits of different paradigm.

UNIT V REFORMS IN INDIAN POWER SECTOR 9

Introduction - Framework of Indian power sector - Reform initiatives - Availability based tariff - Electricity act 2003 - Open access issues - Power exchange - Reforms in the near future.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- explain about restructuring of power industry.
- describe the basics of congestion management.
- analyse the locational margin prices and financial transmission rights.
- interpret the ancillary services and pricing of transmission network.
- review the various power sectors in India.

REFERENCES

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, “Restructured electrical power systems: operation, trading and volatility” Pub., 2001.
2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, “Operation of restructured power systems”, Kluwer Academic Pub., 2001.
3. Paranjothi, S.R, “Modern Power Systems”, New Age International, 2017.
4. Sally Hunt,” Making competition work in electricity”, John Willey and Sons Inc. 2002.
5. Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley & Sons, 2002.

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CO3	3	3	3	-	3	-	-	-	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO5	3	3	3	-	3	2	-	-	3	-	3	3	3	3

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Electrical & Electronics Engineering
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PPS19352 ADVANCED DIGITAL SIGNAL PROCESSING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- provide in-depth treatment on methods and techniques of digital signal processing
- know the spectrum estimation using non-parametric and parametric methods
- understand power spectrum estimation, multi-rate digital signal processing.
- have an insight on DSP architectures which are of importance in the areas of signal processing, control and communications.
- impart knowledge on multi-rate signal processing

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Weiner Khitchine relation – Power spectral density – Filtering random process, spectral factorization theorem, special types of random process - Signal modeling - Least Squares method, Pade approximation, Prony's method, iterative pre-filtering, finite data records, stochastic models.

UNIT II SPECTRUM ESTIMATION 9

Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators - Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation - Model based approach - AR, MA, ARMA signal modeling - Parameter estimation using Yule-Walker method.

UNIT III LINEAR ESTIMATION AND PREDICTION 9

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion - Wiener filter - Discrete Wiener Hoff equations - Recursive estimators - Kalman filter - Linear prediction, prediction error - Whitening filter, inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT IV ADAPTIVE FILTERS 9

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS adaptive filters - Exponentially weighted RLS - Sliding window RLS - Simplified IIR LMS Adaptive filter.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9

Mathematical description of change of sampling rate - Interpolation and decimation - Continuous time model - Direct digital domain approach - Decimation by integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization - Applications to sub band coding -

Wavelet transform and filter bank implementation of wavelet expansion of signals.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- review the basis of discrete signal processing
- perform spectrum estimation using non-parametric and parametric methods
- carry out power spectrum estimation, multi-rate digital signal processing.
- identify DSP architectures for various applications
- design multi-rate DSP systems

REFERENCES

1. Monson H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley and Sons Inc., New York, 2016.
2. Sophoncles J. Orfanidis, “Optimum Signal Processing” , McGraw-Hill, 2014.
3. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing”, Prentice Hall of India, New Delhi, 2015.
4. Simon Haykin, “Adaptive Filter Theory”, Prentice Hall, Englehood Cliffs, NJ Reprint 2014.
5. S. Kay, “Modern Spectrum Estimation Theory And Application”, Prentice Hall, Englehood Cliffs, NJ reprint 2015.
6. P. P. Vaidyanathan, “Multi-rate Systems And Filter Banks”, Prentice Hall, Reprint 2016.

CO-PO MAPPING:

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CO4	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO5	3	3	3	-	3	2	-	-	3	-	3	3	3	3

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PPS19353 DYNAMICS OF ELECTRICAL MACHINES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the principle of co-energy.
- know the working of basic two pole machine.
- transform a machine between reference frames.
- analyze induction and asynchronous machine
- analyze induction and synchronous machine.

UNIT I BASIC PRINCIPLES OF ELECTRICAL MACHINE ANALYSIS 9

Operation and steady state behavior of electrical machines: Magnetically coupled circuits - Electromechanical conversion - Principles of energy flow - Steady state equations of dc machines - rotating field theory - Operation of induction motor – Operation of synchronous motor – Power angle characteristics.

UNIT II THEORY OF TWO POLE MACHINE 9

Elements of generalized theory basic two pole machine - Transformer and speed voltages in the armature - Kron's primitive machine - Analysis of electric machines.

UNIT III REFERENCE FRAME THEORY 9

Linear transformation in machines - Invariance of power, transformation from a displayed brush axis - Reference theory transformation from three phases to two phases, (α-β and d-q transformation) - Physical concept of Park's transformation - Transformation between reference frames.

UNIT IV MODELING AND ANALYSIS OF ASYNCHRONOUS MACHINES 9

Poly phase induction machines - Mathematical modeling of induction machines - Voltage and torque equations in machine variables, induction machine dynamics during starting and braking - Induction machine dynamics during normal operation.

UNIT V MODELING AND ANALYSIS OF SYNCHRONOUS MACHINES 9

Synchronous motor - Circuit model of a three phase synchronous motor, flux linkages voltage equations – Parks transformation to dq0 variables - Electromechanical equation - Motor operation - generator operation - Small oscillations - General equations for small oscillations.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- explain the basis of electrical machines and steady state analysis.

- analyze different control theories.
- model and simulate AC machines for further studies.
- utilize BLDC and SRM motors.
- design induction machine for starting, accelerating and braking with respect to rotor resistance.

REFERENCES

1. Werner Leonhard, “Control of Electrical Drives", Springer; 3rd edition, 2001.
2. D. P. Sen Gupta and J. W. Lynn, “Electrical Machine Dynamics”, The Macmillan Press, 1980.
3. T.J.E Miller, “Brushless permanent Magnet & Reluctance Motor Drives” Clarendom press, Oxford 1989.
4. Kenjo T and Nagamoris “Permant Magnet & brushless Dc motor” , Clarendon press, Oxford, 1989.

CO-PO MAPPING:

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CO3	3	3	3	2	3	-	-	-	3	2	3	1	3	3
CO4	3	3	3	3	3	-	-	-	3	2	3	2	3	3
CO5	3	3	3	2	3	2	-	-	3	-	3	3	3	3

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PPS19354 SOLAR AND ENERGY STORAGE SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know about solar energy storage systems
- understand the basic knowledge on standalone PV system
- recognize the issues in grid connected PV systems
- identify different energy storage systems and analyze their performances
- get knowledge on different applications using solar energy

UNIT I INTRODUCTION 9

Characteristics of sunlight - Semiconductors and PN junctions - Behavior of solar cells - Cell properties - PV cell interconnection

UNIT II STAND ALONE PV SYSTEM 9

Solar modules - Storage systems - Power conditioning and regulation - MPPT- Protection - Standalone PV systems design - Sizing

UNIT III GRID CONNECTED PV SYSTEMS 9

PV systems in buildings - Design issues for central power stations - Safety - Economic aspect efficiency and performance - International PV programs

UNIT IV ENERGY STORAGE SYSTEMS 9

Impact of intermittent generation - Battery energy storage - Solar thermal energy storage - Pumped hydroelectric energy storage

UNIT V APPLICATIONS 9

Water pumping - Battery chargers - Solar car - Direct-drive applications - Space - Telecommunications.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe about solar energy storage systems
- illustrate the basic knowledge on standalone PV system
- analyze the issues in grid connected PV systems
- model different energy storage systems and analyze their performances
- implement different applications using solar energy

REFERENCES

1. Solanki C.S., “Solar Photovoltaics: Fundamentals, Technologies And Applications”, PHI Learning Pvt. Ltd.,2015.
2. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, “AppliedPhotovoltaics”, 2007,Earthscan, UK.
3. Eduardo Lorenzo G. Araujo, “Solar electricity engineering of photovoltaic systems”, Progensa,1994.
4. Frank S. Barnes & Jonah G. Levine, “Large Energy storage Systems Handbook”, CRC Press, 2011.
5. McNeils, Frenkel, Desai, “Solar & Wind Energy Technologies”, Wiley Eastern, 1990
6. S.P. Sukhatme , “Solar Energy”, Tata McGraw Hill,1987.

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CO3	3	3	3	-	3	-	-	-	3	1	3	3	3	3
CO4	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO5	3	3	3	-	3	2	-	-	3	-	3	3	3	3

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PROFESSIONAL ELECTIVE IV

PPS19451 ADVANCED MICROCONTROLLER BASED SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concept of microcontroller and its peripherals function.
- infer the architecture and processor of CORTEX M
- recognise the advanced concept of embedded C
- know the features of STM32F4xx.
- acquire knowledge on STM32F4 peripherals and programming

UNIT I ADVANCED CONCEPTS IN 8051 ARCHITECTURE 9

Review of 8051 architecture, concept of synchronous serial communication, SPI and I2C communication protocols, study of SPI port on 89LP 51RD2, study of SAR ADC/DAC MCP3304 / MCP 33, interfacing concepts for SPI based ADC/DAC, study of watchdog timer, study of PCA timer in different modes like capture mode, PWM generation mode, High speed output toggle mode Embedded 'C' programming for the above peripherals atrices.

UNIT II INTRODUCTION TO ARM CORTEX M PROFILE 9

CORTEX M0 and M4 cores, Harvard and Von Neumann architectures, CPU Registers, CPU Operating Modes, Thumb-2 Instruction Set, Memory Map, Bus Interface, bit bending , interrupt handling ,NVIC(Nested Vectored Interrupt Controller), system tick timer, Debug system

UNIT III ADVANCED CONCEPTS IN EMBEDDED 'C' PROGRAMMING 9

Pointers, structures, unions, pointers to structures, pointers to functions, addressing mechanism for memory mapped registers, enumerators, Interrupt Handlers, Embedded software architecture: Round robin architecture, Round robin with interrupt architecture

UNIT IV INTRODUCTION TO STM32F4XX ARCHITECTURE 9

Features of STM32F4XXDSC, Memory and bus architecture, Multilevel AHB bus matrix, Memory organization, Memory map, NVIC Operation Exception Entry And Exit , Reset and Clock Circuit

UNIT V STM32F4 PERIPHERALS AND PROGRAMING 9

GPIO, General Purpose Timers, GPIO :Introduction, Main Features , Function Description, Registers, Basic timers (TIM6&TIM7): introduction, main features, functional description, registers Embedded C Programming for GPIO and Timers

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the working of microcontroller and its peripherals functions.
- enumerate the architecture and processor of CORTEX M
- program an embedded system in assembly and C
- design to implement and test a single-processor embedded systems for real-time applications
- optimizing embedded software for speed and size for industrial applications.

REFERENCES

1. Datasheet of 89V51RD2 (www.nxp.com, www.atmel.com)
2. Datasheet MCP3304/MCP4822 (www.microchip.com)
3. The 8051 Microcontroller and Embedded Systems Using Assembly and C, By Muhammad Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay
4. David E. Simon. “An Embedded Software Primer” Addision Wesley Pearson Education, 1999.
5. “The Definitive Guide to ARM® CORTEX®-M3 and CORTEX®-M4 Processors (Third Edition)”, By Joseph Yiu, Newnes, Elsevier
6. “The insider’s guide to the STM32 ARM based Microcontroller”, (www.hitex.com)
7. Datasheet, programming and user reference manual of STM32F4xx (www.st.com)
8. “The Designer's Guide to the Cortex-M Processor Family: A Tutorial Approach”, By Trevor Martin, Newnes, Elsevier

CO-PO MAPPING

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CO4	3	3	3	3	3	-	-	-	3	2	3	2	3	3
CO5	3	3	3	3	3	-	-	-	3	-	3	3	3	3

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PPS19452 **SCADA SYSTEM AND APPLICATION** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- gain knowledge of basics and configurations of SCADA System.
- understand the architecture and types of SCADA system
- evaluate the vulnerability and security methods of SCADA system.
- infer knowledge on the communication protocols for SCADA interface.
- acquire knowledge of various skills necessary for Industrial applications of SCADA.

UNIT I SCADA IN POWER SYSTEMS 9

Introduction to supervisory control and data acquisition, SCADA functional requirements and components, general features, functions and applications, benefits - Configurations of SCADA, RTU (Remote Terminal Units) connections, SCADA communication requirements

UNIT II ARCHITECTURE AND TYPES 9

SCADA system architecture, interfacing SCADA with PLC; Types: First Generation: Monolithic or Early SCADA systems - Second Generation: Distributed SCADA systems - Third Generation: Networked SCADA systems - Fourth Generation: Internet of things technology, SCADA systems.

UNIT III EVOLUTION OF SCADA PROTOCOLS 9

Background technologies of the SCADA protocols, Structure of a SCADA Communications Protocol, SCADA protocols: IEC 60870-5, the MODBUS model, the DNP3 protocols, RP 750, profibus, conitel and the security implications of the SCADA protocols.

UNIT IV SCADA VULNERABILITIES AND ATTACKS AND SECURITY METHODS AND TECHNIQUES 9

The myth of SCADA invulnerability, SCADA risk management components, assessing the risk, mitigating the risk, SCADA threats and attack routes. SCADA security methods and techniques: SCADA security mechanisms, SCADA intrusion detection systems and SCADA security standards.

UNIT V APPLICATIONS 9

SCADA for power generating stations, SCADA for power distribution systems, manufacturing industries, waste water treatment and distribution plants, SCADA in power system, power system automation and wireless SCADA.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- explain the basics and configurations of SCADA systems applied to power systems.
- describe the architecture and types of SCADA system components.
- describe and access the risk of vulnerability and security methods.
- demonstrate the knowledge of communication protocols for data transmission.
- design and analyze the general structure of an automated process for real time industrial applications using SCADA.

REFERENCES

1. Ronald L Krutz, "Securing SCADA System", Wiley Publication, 2015.
2. Stuart A Boyer, "SCADA Supervisory Control and Data Acquisition", ISA, 4th Revised Edition, 2009.
3. A.S. Pabla, 'Electric Power Distribution', Tata McGraw Hill Publishing Co. Ltd., Fourth Edition, 2004.
4. Green, J. N, Wilson, R, "Control & Automation of Electric Power Distribution Systems", Taylor & Francis, 2007.
5. Tanuj Kumar Bisht, "SCADA and Energy Management System", 2014.

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CO4	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO5	3	3	3	2	2	2	-	-	3	-	3	3	3	3

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PPS19453 **POWER QUALITY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the concepts of the power quality issues.
- know the concept of long and short interruptions.
- infer knowledge in the single phase voltage sag.
- specify the power quality considerations in industries.
- recognize the mitigation of interruptions and voltage sags.

UNIT I INTRODUCTION 9

Introduction of the power quality (PQ) problem, terms used in PQ: Voltage, sag, swell, surges,harmonics, over voltages, spikes, voltage fluctuations, transients, interruption, overview of power quality phenomenon - Remedies to improve power quality - Power quality monitoring.

UNIT II LONG AND SHORT INTERRUPTIONS 9

Interruptions – Definition – Difference between failures, outage, interruptions – Causes of long interruptions – Origin of interruptions – Limits for the interruption frequency – Limits for the interruption duration – Costs of interruption – Overview of reliability evaluation to power quality, comparison of observations and reliability evaluation.

Short interruptions: definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems - Multiple events, single phase tripping – Voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

UNIT III SINGLE AND THREE PHASE VOLTAGE SAG CHARACTERIZATION 9

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

UNIT IV POWER QUALITY CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS 9

Voltage sag – Equipment behavior of power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation - Mitigation of AC drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

UNIT V MITIGATION OF INTERRUPTIONS AND VOLTAGE SAGS 9

Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface - Voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- elucidate the various power quality issues.
- explain the concept of long and short interruptions.
- explain the concept of single and three phase voltage sag.
- implement the power quality considerations in industrial power.
- describe the concept of mitigation of interruptions and voltage sags.

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1. Math H J Bollen , "Understanding Power Quality Problems" , IEEE Press, 2016.
2. R. Sastry Vedam Mulukutla S. Sarma , - "Power Quality VAR Compensation in Power Systems", CRC Press, 2016.
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4. Roger C. Dugan , Mark F.McGranaghan, H. Wayne Beaty, - "Electrical Power Systems Quality" , Tata McGraw Hill , 2012

CO-PO MAPPING

Mapping of Course Outcome with Programme Outcomes and Programme Specific Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO's	**Programme Outcomes PO's**												**PSO's**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	2	2	-	-	-	-	-	-	3	3	3	3
CO2	3	3	3	3	3	-	-	2	3	-	-	3	3	3
CO3	3	3	3	-	3	-	-	3	3	2	3	3	3	3
CO4	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO5	3	3	3	-	-	2	-	-	3	-	3	3	3	3

Approved BOARD OF STUDIES Electrical & Electronics Engineering 23/3/17

PPS19454 ARTIFICIAL INTELLIGENCE AND ITS APPLICATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basics of design aspects of neural networks.
- know the fundamentals of fuzzy logic.
- use the fundamentals of genetic algorithm and application
- get idea about the fuzzy logic, genetic algorithm and neural networks in power systems.
- understand the basics of PSO and DE.

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Basics of ANN – Perceptron - Delta learning rule – Back propagation algorithm - Multilayer Feed forward network - Memory models - Bi-directional associative memory - Hopfield network - Application of neural networks to load forecasting - Contingency analysis - VAR control, economic load dispatch.

UNIT II INTRODUCTION TO FUZZY LOGIC 9

Crispness – Vagueness - Fuzziness – Uncertainty - Fuzzy set theory Fuzzy sets - Fuzzy set operations - Fuzzy measures – Fuzzy relations – Fuzzy function - Structure of fuzzy logic controller - Fuzzification models - Data base, rule base - inference engine - Defuzzification module - Control Schemes.

UNIT III APPLICATIONS TO AI TECHNIQUES 9

Decision making control through fuzzy set theory - Use of fuzzy set models of LP and its scheduling problems - Fuzzy logic based power stabilizer.

UNIT IV GENETIC ALGORITHM AND ITS APPLICATIONS 9

Introduction – Simple genetic algorithm – Reproduction, crossover, mutation - Advanced Operators in genetic search – Applications to voltage control and stability Studies.

UNIT V PSO AND DE TECHNIQUES 9

Introduction – Review on PSO and DE – Restoration using particle swarm optimization and differential evolution techniques - Formulation, applications.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course students will be able to

- describe the artificial intelligence networks.
- elucidate the fuzzy logic operations.
- analyze the application of genetic algorithm.
- knowledge on neural networks and its real-time performance.
- implement the PSO and DE techniques

REFERENCES

1. James.A.Freeman and B.M.Skapura – "Neural Networks, Algorithms Applications and Programming techniques"- Addison Wesley, 2000.
2. GeorgeKlir and Tina Folger,.A., - "Fuzzy sets, Uncertainty and Information", Prentice Hall of India Pvt.Ltd., 2002 .
3. Zimmerman,H.J. – "Fuzzy Set Theory and its Applications", Kluwer Academic Publishers,2004.
4. IEEE tutorial on – "Application of Neural Network to Power Systems", 2010
5. Loi Lei Lai, - "Intelligent System Applications in Power Engineering", John Wiley and Sons Ltd., 1998.

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CO1	3	3	-	-	-	-	-	-	-	-	3	3	3	3
CO2	3	3	3	3	3	-	-	2	3	-	3	3	3	3
CO3	3	3	3	-	3	-	-	-	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO5	3	3	3	-	-	2	-	-	3	-	3	3	3	3

ENGINEERING COLLEGE, NAMAKKAL
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Electrical & Electronics Engineering
AUTONOMOUS

AUDIT II

PEN19271 **PEDAGOGY STUDIES** **2 0 0 0**

COURSE OBJECTIVES

To enable the students to

- understand the aims, objectives and educational philosophies of education .
- acquire the knowledge of Instructional objectives of teaching and teaching skills .
- apply the knowledge of methods and strategies of teaching in real classroom situation.
- utilize the instructional aids and tools for effective classroom teaching.
- acquaint with the knowledge of professional development of teachers .

UNIT I EDUCATION AND ITS PHILOSOPHY 6

Education- Definition, Aims, Objectives, Scope, Educational philosophy of Swami Vivekananda, Mahatma Gandhi, Rabindranath Tagore, Sri Aurobindo and J.Krishnamoorthy, Montessori,Jean- Jacques Rousseau, Friedrich Froebel and John Dewey.Current trends and issues in Education-

Educational reforms and National policy on Education-1968 and 1986-its objectives and features

UNIT II INSTRUCTIONAL OBJECTIVES AND DESIGN 8

Instructional Objectives: Taxonomy of Educational objectives- Writing of general and specific objectives. Instructional design: Planning and designing the lesson, Writing of lesson plan : meaning, its need and importance, format of lesson plan. Types of lesson plan Skills of teaching : various ways of introducing lessons, explaining skills, problem solving skills, illustrative skills, scaffolding skills, integrating ICT skills, questioning skills, Reinforcement skills, skill of probing questions, skill of stimulus variation and computation skills.

UNIT III INSTRUCTIONAL METHODS AND STRATEGIES 6

Instructional strategies – Lecture, demonstration, laboratory, Inductive method, Deductive method, Inquiry method, seminar, panel discussion, symposium, problem solving, project based learning (PBL), Learning by doing, workshop, role- play(socio-drama), Recent trends: Constructivist learning - Problem-based learning - Brain-based learning – Collaborative learning - Flipped learning - Blended

learning - e-Learning trends - Video conferencing

UNIT IV INSTRUCTIONAL MEDIA 6

Key concepts in the selection and use of media in education, Developing learning resource material using different media, Instructional aids – types, uses, selection, preparation, utilization. Dale cone of Experience, Teacher's role in procuring and managing instructional Aids – Projected and non-projected aids, multimedia, video-teleconferencing etc.

UNIT V TEACHER PREPARATION 4

Teacher – roles and responsibilities, functions, characteristics, competencies, qualities, Preparation of professional teacher, Organizing professional aspects of teacher preparation programs, Professional development of teachers-In-service training, Refresher programmes, workshop and higher studies.

TOTAL PERIODS 30

PRACTICUM

- Writing of three lesson plans
- Practice teaching for 15 days
- Preparation of one teaching aid
- A seminar on one educational philosophy
- Assignment on any of these five units

COURSE OUTCOMES

At the end this course, students will be able to

- explain the educational philosophies of education
- write instructional and specific objectives in lesson plan
- utilize the teaching skills and methods effectively
- use instructional media efficiently
- update themselves in the area of professional development

REFERENCES

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6. Karthikeyan, C. (2004). A Text book on instructional technology, RBSA
7. Siddiqui, MujibulHasan (2005). Techniques of classroom teaching A.P.H
8. Dhamija, N. (1993). Multimedia approaches in teaching social studies. New Delhi: Harman Publishing House
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CO3	-	-	-	-	-	-	-	3	2	3	-	3	-	-
CO4	-	-	-	-	1	-	-	-	3	3	-	3	-	-
CO5	-	-	-	-	-	-	-	3	3	3	-	3	-	-