RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

Credit Based Grading System

Electrical Engineering, VIII Semester

EE-8001 Advanced Electrical Drives

Unit-I Review of electric motors & Solid state converters: Speed control techniques of DC, Induction & synchronous motor, Converters, inverters, chopper and cyclo converter operation, Effects of power electronic equipments on load side & supply side.

Unit-II Review of closed loop controllers, sensors & transducers : PI, PID, Variable structure. AC, DC & Pulse tacho- generators.

Unit-III AC & DC Drives : Converter & chopper fed DC drive, Reversing, Starting, Regenerative breaking , Four quadrant operation, High power application. AC Drive: Inverter & cyclo converter fed drive, Vector control, Sensor less operation, Linear electrical motor concept, Synchronous motor Drive

Unit-IV Special Drives: Switched reluctance & permanent magnet brushless DC Operation, Converters, Characteristics &Control, PLC based drives. Servo drives & stepper motor- AC& DC Servomotor, Stepper motor, Control techniques, Controllers, Microstepping, Sensorless operation.

Unit-V Power Quality & energy Conservation- Line Side pollution, standards, Harmonic elimination techniques in converter, Filters, Energy efficient electric motors, Pay back periods, Energy conservation through sold state control

Reference:

- Ned Mohan, T.M. Undeland, W.P. Robbins, Power Electronics-Converters,• Applications and design", John Wiley & Sons.
- J.M.D. Murphy, F.O. Turnbull, "Power Electronic Control of AC• motors", Pergamon Press.
- P.C. Sen, D.C. drive, Pergamon Press•
- Sivanagaraju–Power Semiconductor Drives –PHI Learning•
- B.K. Bose, Power Electronics• & AC drive prentice Hall.
- Dubey G.K. "Power semi Conductor controller drives, Prentice• Hall.
- Vedam Subramanyam, "Electrical Drives".
- T.J.E. Miller, Switched Reluctance• & P.M. B.L. DC motor, Pergamon Press
- P.V. Rao, "Power semiconductor Drives", BS• Publications.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

Credit Based Grading System

Electrical Engineering, VIII Semester

EE-8002 APPLICATION OF POWER ELECTRONICS TO POWER SYSTEMS

UNIT-I Review of transmission lines; surge impedance loading; voltage profile along radial and symmetrical lines, effect of load, Ferranti effect; role of reactive power compensators; series, shunt and unified compensation; effect on power flow and voltage profile; FACTS; Requirements of distribution systems, power quality (PQ) problems and classification, numerical indices of PQ.

UNIT-II The Static Var Compensator (SVC); TCR, FC-TCR and TSC-TCR variants: circuits, characteristics; transmission line compensation capability; dynamic model.The Static Compensator (STATCOM): circuit and steady state characteristic; effect on transmission line compensation; advantages over SVC; the D-STATCOM and its use in power quality compensation; reactive power compensator; control; active filtering for harmonic compensation; hybrid active filters.

UNIT-III The Thyristor Controlled Series Compensator (TCSC); circuit and steady-state characteristic; effect on transmission line compensation; critical aspects of operation; the NGH damper.The Dynamic Voltage Restorer (DVR); circuit and steadystate characteristic; effect on transmission line compensation; advantages over TCSC; DVR for power quality compensation; modes of control.

UNIT-IV The Unified Power Flow Compensator (UPFC); circuit and steady-state characteristic; effect on transmission line compensation; advantages over all the previous compensators; usage for power quality compensation; critical aspects of control.

UNIT-V The Interline Power Flow Controller (IPFC); circuit and steady-state characteristic; effect on transmission line compensation; advantages over the UPFC.

References:

1. N. G. Hingorani & Lazslo Gyugi, “Understanding FACTS”, IEEE Press.

2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. Publishers.

3. Arindam Ghosh & Gerard Ledwich, “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

Credit Based Grading System

Electrical Engineering, VIII Semester

EE-8003 Elective – V (1) Renewable Energy Sources

Unit - I Renewable Energy Systems Energy Sources, Comparison of Conventional and non-conventional, renewable and non-renewable sources. Statistics of world resources and data on different sources globally and in Indian context. Significance of renewable sources and their exploitation. Energy planning, Energy efficiency and management.

Unit - II Wind Energy System Wind Energy, Wind Mills, Grid connected systems. System configuration, working principles, limitations. Effects of wind speed and grid conditions. Grid independent systems - wind-battery, wind- diesel, wind-hydro biomass etc. wind operated pumps, controller for energy balance. Small Hydro System Grid connected system, system configuration, working principles, limitations. Effect of hydro potential and grid condition. Synchronous versus Induction Generator for stand alone systems. Use of electronic load controllers and self excited induction generators. Wave Energy System: System configuration: grid connected and hybrid Systems.

Unit - III Solar Radiation Extraterrestrial solar radiation, terrestrial solar radiation, Solar thermal conversion, Solar Phototonic System Solar cell, Solar cell materials, efficiency, Characteristics of PV panels under varying insulation. PV operated lighting and water pumps, characteristics of motors and pumps connected to PV panels. Biomass Energy System: System configuration, Biomass engine driven generators, feeding loads in stand-alone or hybrid modes, Biomass energy and their characteristics.

Unit - IV Energy from oceans Ocean temperature difference, Principles of OTEC, plant operations, Geothermal Energy Electric Energy from gaseous cells, Magneto-hydro generated energy, Non hazardous energy from nuclear wastes, Possibilities of other modern nonconventional energy sources.

Unit - V Electric Energy Conservation Energy efficient motors and other equipment. Energy saving in Power Electronic controlled drives. Electricity saving in pumps, air-conditioning, power plants, process industries, illumination etc. Methods of Energy Audit. Measurements systems; efficiency measurements. energy regulation, typical case studies, various measuring devices analog and digital, use of thyristers.

References:

1. John Twidell & Toney Weir, Renewable Energy Resources, E & F N Spon.
2. El-Wakil, Power Plant Technology, McGraw Hill.
3. Rai G D, Non-conventional Energy Resources, Khanna.
4. F Howard E. Jordan, "Energy-Efficient Electric Motor & their Application-II", Plenum Press, New York USA
5. Anna Mani, "Wind Energy Resource Survey in India-Ill", Allied Publishers Ltd., New Delhi,
6. S.P. Sukhatme: Solar Energy, TMH- 4e,
7. Dr. A. Ramachandran, Prof B.V Sreekantan & M F.C. Kohli etc, "TERI Energy Data Directory & Year book 1994-95", Teri Tata Energy Research Institute, New Delhi,
8. Solanki –Renewable Energy Technologies – PHI Learning 9. Sawhnew –Non Conventional Energy Resources – PHI Learning

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

Credit Based Grading System

Electrical Engineering, VIII Semester

EE-8003 Elective – V (2) Electrical Hybrid Vehicles

Course Outcomes:
At the end of this course, students will demonstrate the ability to

- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.

Introduction
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Trains
Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control Of Switch Reluctance Motor drives, drive system efficiency. drive-train topologies, fuel efficiency analysis.

Energy Storage:
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, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: 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

Energy Management Strategies
Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
4. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

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Credit Based Grading System

Electrical Engineering, VIII Semester

EE-8003 Elective – V (3) Power Quality

UNIT-I

Introduction, power quality -voltage quality, power quality evaluations procedures term and definition: General classes of power quality problem, causes & effect of power quality disturbances.

UNIT-II

Voltage sags and interruption: sources of sags and interruption, estimating voltages sag performance, fundamental principles of of protection, monitoring sags.

UNIT-III

Transients over voltages: sources of transient over voltages, principles of over voltages protection, utility capacitor switching transients, fundamentals of harmonics and harmonics distortion, harmonics sources from commercial load and from industrial loads.

UNIT-IV

Applied harmonics : harmonics distortion evalutions, principles for controlling harmonics, harmonics studies devices for controlling harmonic distortion, filters, passive input filter standards of harmonics.

UNIT-V

Electro-magnetic compatibility, constant frequency control, constant tolerance band control, variable tolerance band control, discontinuous current control.

Reference Books:

1. Power Quality- by R.C. Duggan
2. Power System harmonics –by A.J. Arrillga
3. Power electronic converter harmonics –by Derek A. Paice

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Credit Based Grading System

Electrical Engineering, VIII Semester

EE -8004 Elective – VI (1) SOFT COMPUTING TECHNIQUES

UNIT-1 Review of probability theory: Random variable, distribution functions , function of random variable. generation of random digit, and random variants from various distribution function, Monte Carlo simulation, sampling distributions station evolution using MCS, confidence interval, coefficient of variation.

UNIT-2 - Rule and back propagation rule of training, RBF and FLN network.

UNIT-3 Draw back of classical optimization techniques, genetic algorithm; binary and real parameter GA, constraints handling in GA.

UNIT-4 Evolution strategies(ES), two members non-recombinative ES, multi member ES, recombinative ES. Optimization based on swarm intelligence particle, swarm optimization and its variants .

UNIT-5 Application of soft computing techniques to problem of electrical engineering e.g. economic dispatch, reliable optimization, ANN training using evolutionary algorithms.

References:

1. R.Y. Rubinstein Simulation and the Monte Carlo method, John Wiley & sons 1st Edition.
2. Paul. L. Mayer-Introducing probability and statical application, Addition Weslay.
3. Rajasekaran and pai- Neural Network, Fuzzy logic & Genetic Algorithms. PHI Learing
4. LiMin. Fu, Neural Networks in Computer Intelligence, 9th Reprint TMH
5. Multi objective optimization using evolutionary algorithm- Kalyanmoy Deb John Wiley & Sons Ltd.
6. Probability and Random processes for Electrical Engineering , Alberto Leon Garcia IInd Pearson .
7. Principles of soft computing- S N Shivanandan, S N Deepa Wiley India (P) Ltd, I edition 2007.
8. Hand book of genetic algorithm- Rajaserkharans, vijaya laxmi pai.
9. PSO Tutorial- Kennedy Ebuehart.
10. Sivanandam & Deepa- An Introduction to Neural Networks using Matlab 6.0 1st ed., TMH

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Credit Based Grading System

Electrical Engineering, VIII Semester

EE-8004 Elective – VI (2) Power System Planning & Reliability

UNIT-I Review of Probability Theory Element of probability theory Probability Distribution, Random variable, Density and distribution functions. Mathematical expectation. Binominal distribution, Poisson distributions, Normal distribution, Exponential distribution, Weibull distribution.

UNIT-II Reliability of Engineering Systems Component reliability, Hazard models, Reliability of systems with non-repairable components, series, Parallel, Series-Parallel, Parallel-series configurations. Non-series-parallel configurations, minimal tie-set, minimal cut-set and decomposition methods. Repairable systems, MARKOV process, Long term reliability, Power System reliability.

UNIT-III Reliability of Engineering Systems Reliability model of a generating unit, State space methods, Combing states, sequential addition method, Load modeling, Cumulative load model, merging of generation and load models, Loss of load probability, Percentage energy loss, Probability and frequency of failure, Operating reserve calculations.

UNIT-IV Power Network Reliability Weather effect on transmission lines, Common mode failures, Switching after fauls, three, state components, Normally open paths, Distribution system reliability.

UNIT-V Composite System Reliability Bulk Power supply systems, Effect of varying load, Inter connected systems, correlated and uncorrelated load models, Cost and worth of reliability.

References:

J. Endreny, Reliability Modeling in Electric Power Systems, John Wiley & Sons.

Roy Billinton & Ronald, N allan, Reliability Evaluation of Power Systems, Plenum Press, New York.

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Credit Based Grading System

Electrical Engineering, VIII Semester

EE-8004 Elective – VI (3) GENERALIZED THEORY OF ELECTRICAL MACHINE

Unit-I Review : Primitive machine, voltage and torque equation. Concept of transformation change of variables & m/c variables and transform variables. Application to D.C. machine for steady state and transient analysis, and equation of cross field commutator machine.

Unit-II Induction Machine : Voltage, torque equation for steady state operation, Equivalent circuit, Dynamic performance during sudden changes in load torque and three phase fault at the machine terminals. Voltage & torque equation for steady state operation of 1- ö induction motor & scharge motor.

Unit-III Synchronous Machine : Transformation equations for rotating three phase windings, Voltage and power equation for salient and non salient alternator, their phasor diagrams, Simplified equations of a synchronous machine with two damper coils.

Unit-IV Operational Impedances and Time Constants of Synchronous Machines: Park's equations in operational form, operational impedances and G(P) for a synchronous machine with four Rotor Windings, Standard synchronous machine Reactances, time constants, Derived synchronous machine time constants, parameters from short circuit characteristics.

Unit-V Approximate Methods for Generator & System Analysis: The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis of line to line short circuit, Application of approximate method to power system analysis.

References:

- P.C.Krause, Analysis of Electric Machinery.
- B.Adkins, The General theory of Electrical Machines.
- B.Adkins & R.G.Harley, The General theory of AC Machines.
- P.S.Bhimbra, Generalised theory of Electrical m/c White & Woodson, Electro Mechanical Energy Conversion.

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Credit Based Grading System

Electrical Engineering, VIII Semester

EE-8005 Project-II

The objectives of the course 'Major Project' are To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses. To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems. To give students an opportunity to do something creative and to assimilate real life work situation in institution. To adapt students for latest developments and to handle independently new situations. To develop good expressions power and presentation abilities in students. The focus of the Major Project is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write-up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis, market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any).

The faculty and student should work according to following schedule:

i) Each student undertakes substantial and individual project in an approved area of the subject and supervised by a member of staff.

ii) The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty.

iii) At all the steps of the project, students must submit a written report of the same.