ELECTRICAL ENGINEERING DEPARTMENT

M.TECH. POWER SYSTEM

Course of Study & Scheme of Examination
2016-17

Maulana Azad National Institute of Technology,
Bhopal

SCHEME

M.TECH. (POWER SYSTEM)

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
PS511	Power System Analysis	3	-	-	3
PS 512	Advanced Power System Protection	3	-	-	3
PS513	Evolutionary Techniques	3	-	-	3
PS531-543	Departmental Elective - 1	3	-	-	3
PS531-543	Departmental Elective - 2	3	-	-	3
PS551-557	Open elective-1	3	-	-	3
PS514	Power System Lab	-	-	2	2
PS515	Seminar I	-	2	-	2
				Total credit	22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
PS521	Modern Trends in Power System Operation	3	-	-	3
PS522	Advanced Control System	3	-	-	3
PS523	Power System Stability and Control	3	-	-	3
PS531-543	Departmental Elective - 3	3	-	-	3
PS531-543	Departmental Elective - 4	3	-	-	3
PS551-557	Open elective-2	3	-	-	3
PS524	Computer Applications in Power System Lab	-	-	2	2
PS525	Seminar II	-	2	-	2
				Total credit	22

Third Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
PS611	Dissertation Phase-I	-	-	16	16
				Total credit	16

Fourth Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
PS621	Dissertation Phase-II	-	-	30	30
					Total credit 30

List of Departmental Electives

PS531 EHV AC and DC Transmission

PS532 Power Controller

PS533 Computer Aided Power System Analysis

PS534 Reactive Power Control and FACTS

PS535 Power Quality

PS536 Advanced Power Electronics

PS537 Modeling and Analysis of Electrical Machines

PS538 Power System Planning & Management

PS539 Power System Transients

PS541 DSP & its Applications

PS542 Advanced Electrical Drives

PS543 Smart Grid Technologies

List of Open Electives

PS551 Finite Element Method

PS552 Microcomputer & its Application

PS553 Power System Economics

PS554 Economics of Regulation and Restructuring of Energy Industries

PS555 Instrumentation

PS556 Reliability Engineering

PS557 Principle of Data Converter

SYLLABUS

Course Number: PS-511

Title of Course: POWER SYSTEM ANALYSIS

Designation as a required or elective course: Required

Pre-requisites: Preliminary knowledge of power system

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Knowledge of power system analysis & operation

Topics:

Power System components and their representation, Transmission line parameters, Modelling and performance of short, medium and long lines, Line compensation, Load flow studies, A.C. and D.C. Load flow methods, comparison of different load flow methods, Introduction of Optimal system operation, Economic Load Dispatch, , Power system management under normal & abnormal conditions, State estimation & Contingency analysis, Load Forecasting.

Reference Books:

1. Glenn W. Stagg & Ahmed H.El-Abiad ,Computer Methods In Power System Analysis,1968
2. M.A.Pai,Computer Methods In Power Sytem Analysis
3. George L.Kusic, Computer Aidded Power Sytem Analysis
4. O.Elgerd Electrical Energy System, 2nd , Mc-Graw Hill Education, 19 February 2001
5. L.P.Singh ,Advanced Power System Analysis And Dynamics, 6th , New Age International Publishers Ltd.-New Delhi, 2012
6. J.Duncan Gluver & Mulukuata S. Sharma ,Power System Analysis And Design, 3rd, Prentice Hall Inc., 2002
7. Yong Hua Song, Modern Optimization Techniques In Power System, 1st , Kluwer Academic Publisher, (5 December 2010)

Course Number: PS-512

Title of Course: ADVANCED POWER SYSTEM PROTECTION

Designation as a required or elective course: Required

Pre-requisites: Preliminary knowledge of power system

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Knowledge of power system protection & coordination

Topics:

General Philosophy of Production, Protective Relays-, different types of electromagnetic and static relay characteristics, operating equations and their applications, phase and amplitude comparators and their analysis, differential relays, protection of generator, transformer and bus bar, protection of transmission lines using over current and distance relays, Carrier schemes for HV and EHV lines, numerical protection- fourier analysis of analog signals, digital filtering, numerical over current protection, transformer and line protection using numerical relays, testing and maintenance of relays.

Reference Books :

1. B.Ram, Power System Protection And Switchgear, 2nd, Tata Mc-Graw Hill Publication, 20 July 2011
2. M.V.Deshpande, Switchgear Protection, Tata Mc-Graw Hill Publication
3. R.Ravindra Nath & M.Chander, Power System Protection And Switchgear,Willey Eastern Ltd.
4. Arun G. Phadke & James S. Thorp, Computer Relaying For Power System, Johns Willey
5. M.A.Date, Power System Protection, Bharti Prakashan Vallabh Vidya Nagar,Gujrat

Course Number: PS-513

Title of Course: EVOLUTIONARY TECHNIQUES

Designation as a required or elective course: Required

Pre-requisites: Knowledge of mathematical modelling

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Student will learn to solve the non-linear optimization problem.

Topics:

Optimization: single objective, multi-objective and constraint problem, linear, non-linear and NP hard problem, combinatorial optimization, Conventional optimization method (lambda and differential). greedy optimization technique, Simple genetic algorithm, Multi-objective genetic algorithm. Artificial neural network. Fuzzy logic. Ant colony optimization. Particle swarm optimization, Basic simulated annealing, Basic tabu search method, Bacteria forging and Fish schooling optimization. Bee flying optimization. Teaching, Learning based Optimization.
AI Application in Electrical Systems.

Reference Books :

1. M.A.Date, Introduction To Artificial Neural Systems, 1st , Jaico Pub House Bombay, 5 December 2010
2. V.Rao & H.Rao, C++ Neural Networks And Fuzzy Logic, Bps Delhi
3. V.Rao & H.Rao, Ant Colony Optimization, Springer,2002 Edition, Prentice -Hall Of India, New Delhi, 12 August 2002
4. D.E. Goldberg, Genetic Algorithm In Search Optimization And Machine Learning, Addition Wesley Publication Co. Inc. New York

Course Number: PS-521

Title of Course: MODERN TRENDS IN POWER SYSTEM OPERATION

Designation as a required or elective course: Required

Pre-requisites: Knowledge of power system

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Latest trends in power system operation and control

Topics:

Distribution automation: Supervisory Control and Data Acquisition (SCADA), Consumer Information systems (CIS), Geographical Information Systems (GIS), Advances in online control of Power System – Application of Internet and GPS in power system control, Deregulation of Electric Utilities, new environment, Competitive electricity market, Introduction to Smart Grid, Application of Artificial Neural Networks, Fuzzy, Neuro-fuzzy, Genetic Algorithms and Experts systems in Power System operation and Control.

Central Control centre/ regional control centre.

Reference Books:

1. Loi Lei Lai, Power System Restructuring And Deregulation:Trading Performance And Information Technology, John Wiley, 2001
2. Proceedings Of Ieee, February 2000
3. Steve Stoft, Power System Economics, Ieee Press, 2002.

Course Number: PS 522

Title of Course: ADVANCED CONTROL SYSTEM

Designation as a required or elective course: Required

Pre-requisites: Linear control system

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Students will acquire the knowledge of Advance control system

Topics:

Controllers and compensators, state space representation, Transfer matrix, state model for linear continuous time systems, Eigen values, eigen vectors, Solution of state equation, concept of controllability and observability. Pole placement by state feedback, Discrete time control systems, time domain approach and z domain approach. Pulse transfer function, Controllability and observability of discrete time systems, stability analysis in z plane, Different types of nonlinearities, limit cycles, phase plane methods, Describing functions, popov criterion, Liapunov functions, Various techniques of system model order reduction, Introduction to adaptive control system, Principle of optimality, Linear optimal regulator problem, Hamilton Jacobi equation, Riceati equation (Algebraic & differential), steady state solutions (LQR), optimal state estimation, Kalman filter, Output feedback control (LQG).

Design and implementation of Modern controllers for digital and analogue systems.

Reference Books:

1. M. Gopal, Digital Control Engineering, 2nd , New Age International Private Limited, 2014
2. A.P.Sage & Landue, Adaptive Optimal Control
3. A.P.Sage, Optimal Control, 1971
4. Katsuniko Ogata, Discrete Time Control System, 5th , Prentice Hall India Learning Private Limited.
5. Nagrath Gopal, Modern Control Engineering

Course Number: PS-523

Title of Course: POWER SYSTEM STABILITY AND CONTROL

Designation as a required or elective course: Required

Pre-requisites: Knowledge of power system

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: knowledge of power system stability analysis and methods of control.

Topics:

Power System Structure and Operating states, Governors, Excitation system, Effect of exciter and governor, Control of Power and Frequency, Control of voltage and Reactive Power, Power system stability, Dynamic and transient stability analysis of single machine and multi-machine systems, Power system stabilizer design and analysis for stability problem, Techniques for the improvement of stability.

Reference Books:

1. Prabha Kundur, Power System Stability And Control, , 1st , Mc- Graw Hill Inc,New York, 1993
2. Taylor C.W, Power System Voltage Stability, Mc- Graw Hill Inc,New York, 1993
3. Nagrath I.J., Kothari D.P, Power System Engineering, 2nd , Tata Mc- Graw Hill,New Delhi, 1994
4. Weedy B.M, Electric Power System , 3rd , John Wiley & Sons, 1998
5. P.S.R.Murthy, Power System Operation And Control, , Tata Mc- Graw Hill,New Delhi, 1984

DEPARTMENTAL ELECTIVES

Course Number: PS-531

Title of Course: EHV AC & DC TRANSMISSION

Designation as a required or elective course: Departmental Elective

Pre-requisites: Knowledge of Power System

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Knowledge of Extra High Voltage AC & DC Transmission System

Topics:

Long line theory, corona power loss and audible noise. Series & Shunt Compensation on EHV AC lines, FACTs devices, Sequential impedances of AC systems and Modes of Propogation, Problems associated with EHVAC Transmission, Electrostatic field of EHV Lines, Effect of High Electrostatic field on Humans, Animals, Plants, Theory of travelling waves & standing waves, Design problems on EHVAC long lines, Sub-synchronous resonance problem and counter measures, High voltage testing of AC equipments, Comparison of EHV AC & DC transmission HVDC system configuration and components conversion and inversion, Analysis of three phase bridge converter and Performance equations, Control of HVDC system, Principle of DC link control, current and Extinction angle control, Transmission power control, alternative inverter control modes, Harmonics and AC/DC filters, Interaction responses to DC and AC system faults. Modelling of HVDC system.

Reference Books:

1. Begmudre R.D, Ehvac Transmission Engineering, Willy Eastern Limited
2. P.Kundur, Power System Stability And Control, 1st , Mc Graw Hill Publication, 1993
3. Arrilaga, Hvdc Transmission, Peter Peregrinus Publication
4. Rao S., Ehvac &Dc Transmission Systems, 3rd , Khanna Publication, 2008
5. Padiyar K.R. , Hvdc Power Transmission Systems, 3rd , Willy Eastern Ltd.

Course Number : PS-532

Title of Course : POWER CONTROLLER

Designation as a required or elective course : Departmental Elective

Pre-requisites : Fundamental knowledge of Basic Electrical, Electronics and Control

Contact hours : 03

Type of Course : Lecture

Course Assessment methods : Both continuous and semester-end assessment

Course Outcomes : Acquire knowledge of power converters and applications

Topics:

Review of power semiconductor devices, series-parallel operation, various firing/driving circuit, Switching loss calculations, SOA and Heat Sink design, Analysis of 1-ϕ / 3-ϕ AC/DC bridge converter with and without freewheeling diode, Effect of source impedance, Multi pulse (12,18,24) rectifier, PWM rectifier, Analysis of non-isolated Buck, Boost, Buck-boost, Sepic & Cuk Converter in CCM and DCM with ideal and non-ideal components, Analysis of Isolated flyback, forward, push-pull, full bridge, half-bridge, & current fed DC-DC converter with ideal components. Interleaved Converters, Dynamic modelling of DC/DC converter and controller design. Analysis of 1-ϕ & 3-ϕ VSI (180° mode, 150° mode & 120° mode of conduction), Amplitude & harmonic control/reduction techniques, 1-ϕ and 3-ϕ CSI Inverter. Analysis of various 1-ϕ / 3-ϕ ac-ac regulator circuit.

Reference Books :

1. G.K.Dubey,Doradla,Joshi Sinha ,Thyristerised Power Controllers, 2nd , New Age International Private Limited, 2010
2. C.W.Lander, Power Electronics
3. Rashid M.H., Power Electronics, , 2nd Revised (2 November 2006), Academic Press Inc
4. B.R.Pelly, , Thyristerised Power Controlled Converters And Cycloconverter
5. N.Mohan,, Power Electronics, 3rd Revised, 8 November 2002
6. Vithiyathil J.,Power Electronics
7. Philip Kranes,Power Electronics, Oxford University Press, 2009

Course Number: PS-533

Title of Course: COMPUTER AIDED POWER SYSTEM ANALYSIS

Designation as a required or elective course: Departmental Elective

Pre-requisites: Basic knowledge of power system analysis

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Develops the skills to use computer programming in power system analysis

Topics:

Introduction to Modern Power Systems operation , control and analysis. Modeling of Power System Components, Digital computers in power system simulations, Computer aided Power Flow Solution Algorithms, Sparse Matrices, Solution Algorithms - LU Factorization. Fault Analysis of Large Power Systems, Security Analysis: Basic Concepts, Static Security Analysis at Control Centers, Contingency Analysis and Selection, state estimation and optimal power flow.

Reference Books:

1. O.I.Elgerd, Electrical Energy Systems Theory
2. A.H.El.Abiad, Computer Methods in Power system Analysis
3. O.I. Elgerd, Electric Energy Systems Theory - An Introduction, McGraw-Hill, 1988.
4. J.J. Grainger and W.D. Stevenson, Power System Analysis, Mc Graw-Hill, New York, 1994. (PG)
5. I.J. Nagrath and D.P . Kothari, Power System Engineering, Tata Mc Graw Hill Publishing Co., 1994.
6. M.A. Pai, Computer Techniques in Power Systems Analysis, Tata Mc Graw Hill. Revised with dheman chatergy update
7. S.A Soman, computational meth
8. Marisa crow
9. Vijay vital (UG also)

Course Number: PS-534

Title of Course: REACTIVE POWER CONTROL AND FACTS

Designation as a required or elective course: Departmental Elective

Pre-requisites: Fundamental knowledge of power system and power electronics

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Knowledge of Modern power controllers to enhance the stability and capability of existing network.

Topics:

Reactive Power Requirement and necessity of Compensation, Objectives in Load Compensation, Dynamic Power Compensation, Passive Compensation: SVC, TCR, Classification of FACTS devices. Shunt Compensators: STATCOM - Characteristics and Device selection (GTO/SCR/IGBTs), STATCOM Control Strategies and applications, Series Compensation: SSSC - Compensator characteristics and control Strategies, SSC applications. TCSC- Compensator characteristics and control Strategies, TCSC applications Series-shunt Compensation: UPFC - Principle of operation, configuration and control, Simulation of UPFC, Steady State Model of UPFC.

Sub synchronous resonance and its mitigation with FACTS devices, Power system Control using FACTS devices.

Reference Books :

1. T J E Miller, Reactive Power Control In Power Systems', John Wiley, 1982
2. Prabha Kundur, Power System Stability And Control
3. N G Hingorani And L Gyugyi, Understanding Facts', IEEE Press, 2000
4. Y.H. Song And A.T. Johns,, Flexible Ac Transmission Systems (Facts)', IEEE Press, 1999
5. Yong-Hua Song And Xi-Fan Wang, Operation Of Market Oriented Power Systems Springer-Verlag Londan, Springer-Verlag Londan

Course Number : PS-535

Title of Course : POWER QUALITY

Designation as a required or elective course : ELECTIVE

Pre-requisites : Fundamental knowledge of Power System and Power Electronics

Contact hours : 03

Type of Course : Lecture

Course Assessment methods : Both continuous and semester-end assessment

Course Outcomes : Monitoring and improvement of Power Quality

Topics:

Power Definition and Components with sinusoidal and non-sinusoidal voltage & current, Understanding Power quality, Causes and effects of power quality disturbances, Causes and effects of harmonics, converter configuration and their contribution to supply harmonics. Elimination/suppression of harmonics, classical solutions & their drawbacks, elimination/suppression of harmonics, passive and active solutions, topologies and their control methods, design of passive and active filters, EMI Issues, Wiring & Grounding,

PQ standards, Power quality monitoring and analysis of utilities, distribution system and industrial customers, Power quality measuring instruments.

Reference Books :

1. R.C. Duggan, Mark F Mcgranaghan, H Wayne Beaty, Electrical Power Systems Quality, Mc-Graw-Hill, 2012
2. Derek A. Paice, Power Electronic Converter Harmonics, Wiley-Blackwell, 1999
3. Math H J Bollen, Understanding Power Quality Problems, Wiley-Blackwell, 1999
4. J. Arrillga, N R Watson, Power System Harmonics,Wiley-Blackwell, 2003
5. T J E Miller, Reactive Power Control In Electric Systems, Wiley Blackwell, 1983.

Course Number : PS536

Title of Course : ADVANCED POWER ELECTRONICS

Designation as a required or elective course : Departmental Elective

Pre-requisites : Fundamental knowledge Power Electronics, Basic Electronics and Control

Contact hours : 03

Type of Course : Lecture

Course Assessment methods : Both continuous and semester-end assessment

Course Outcomes :

- To learn drawbacks of power electronic converters and their solutions
- Learn and understand applications of Power Electronic converters
- Study and understanding of new breed of power converters

Topics:

Review of 1-phase and 3-phase Controlled Converters, Harmonics and Power Factor Calculations, High Power Factor Converters, DC-DC Switch Mode converter, Power Supplies, Switching Mode Inverters, Multilevel Inverter, Resonant Converters, Design and selection of components.

Reference Books :

1. N. Mohan, Power Electronics : Converters, Applications & Design, 3rd , John Wiley & Sons, Pearson Education.
2. M. H. Rashid, Power Electronics : Circuits Devices And Application, 2nd, Academy Press Inc.
3. Joseph Vithayathil, Power Electronics: Principles And Applications, Mcgraw-Hill
4. Philip T Krein, Elements Of Power Electronics, Oup Usa, 2009
5. P S Bimbhra, Elements Of Power Electronics, Khanna Publisher.

Course Number: PS537

Title of Course: MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

Designation as a required or elective course: Departmental Elective

Pre-requisites: Knowledge of electrical machines, Steady state and transient analysis

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: To acquire knowledge of electrical machine model for performance evaluation under normal and abnormal conditions.

Topics:

Review: Primitive machine, voltage and torque equation, Concept of transformation change of variables & m/c variables and transform variables. Steady state and transient analysis, equation of cross field commutator machine, Induction Machine: Analysis of 1-ϕ & 3-ϕ Induction Motor. Synchronous Machine: Detail analysis, Operational Impedances, Reactance's and Time Constants. Unbalanced operation of 3-ϕ transformer & Vector groups, Steady state of electrical machine.

Transient analysis of electrical machine.

Reference Books:

1. P.C.Krause, Analysis Of Electric Machinery, 2nd Edition.
2. B.Adkins, The General Theory Of Electrical Machines.
3. B.Adkins & R.G.Harley, The General Theory Of Ac Machines.
4. P.S.Bhimbra, Generalised Theory Of Electrical M/C.
5. White & Woodson, Electro Mechanical Energy Conversion.

Course Number: PS-538

Title of Course: POWER SYSTEM PLANNING AND MANAGEMENT

Designation as a required or elective course: Departmental Elective

Pre-requisites: Power system analysis

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: To acquire the knowledge of power system economics and regulation

Topics:

Introduction of power planning, Electricity Regulation, Electrical Forecasting, Generation planning, Transmission and distribution planning, Power system Economics, Power supply Reliability, online power flow studies, Computer aided planning, wheeling, Environmental effects, Optimal power system expansion planning.

Reference Books :

1. X Wang, J R MCDonald, Modern Power System Planning, MCgraw hill
2. A.S.Pabla, Electrical Power System Planning, Machmillan India Ltd
3. M. Tllic, F.Faliana and L Fink, Power System Restructuring Engineering and Economics, Kulwar Academic Publisher
4. L.L. Lie, Power system Restructuring and Deregulation, John Willey & Sons UK, 2001

Course Number: PS-539

Title of Course: POWER SYSTEM TRANSIENTS

Designation as a required or elective course: Departmental Elective

Pre-requisites: Knowledge of power system

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: knowledge of power system transients and insulation coordination

Topics:

Origin and nature of transients and surges, Current chopping in circuit breakers, Control of transients, Lightning phenomena, Travelling waves in distributed parameter multi-conductor lines, Simulation of surge diverters in transient analysis, Bergeron methods of analysis and use of EMTP and EMTDC/PSCAD package, Insulation Coordination.

Experience of effect of transient.

Reference Books:

1. Vanikov, Power System Transients
2. C.S. Indulkar and D.P. Kothari, Power System Transients, 2nd, PHI learning, 2010
3. Flurscheim C.H., Power Circuit breaker theory and design, Institution of Engineering and Technology; Rev Sub edition, (30 June 1982)
4. EMTP Rulebook
5. EMTDC/PSCAD Rulebook

Course Number : PS541

Title of Course : DSP & ITS APPLICATIONS

Designation as a required or elective course : Departmental Elective

Pre-requisites : Fundamental knowledge of digital electronics and microprocessor

Contact hours : 03

Type of Course : Lecture

Course Assessment methods : Both continuous and semester-end assessment

Course Outcomes : Acquire knowledge of modern digital controllers and their industrial applications

Topics:

Architectural Overview & Central Processing Unit, Memory map, CPU Architecture of TMS320F2812, Details of CPU Registers & Accumulator, Introduction to Interrupts of TMS320F2812, Emulation Logic, CPU Interrupts Overview, CPU Interrupt Vectors and Priorities, Maskable Interrupts, Nonmaskable Interrupts, Pipeline: Pipelining of Instructions, Instruction-Fetch Mechanism, Address Counters FC, IC, and PC, Pipeline Protection, Avoiding Unprotected Operations, Addressing Modes: Types of Addressing Modes, details of various Addressing Modes, Alignment of 32-Bit Operations. Assembly Language Instructions and emulation: Instruction Set Summary (Organized by Function), Register Operations, Overview of Emulation Features, Debug Interface.

Applications of DSP for Power Electronics & Drives Control.

Reference Books:

1. W.D.Stanley, Digital Signal Processing
2. Ashok Ambardar, Analog & Digital Signal Processing
3. S. Mitra, Digital Signal Processing, 3rd, McGraw hill education, 2007
4. Reference manual from Texas Instruments
5. www.ti.com

Course Number : PS542

Title of Course : ADVANCED ELECTRICAL DRIVES

Designation as a required or elective course : Departmental Elective

Pre-requisites : Fundamental knowledge of Electrical Machines and power electronics

Contact hours : 03

Type of Course : Lecture

Course Assessment methods : Both continuous and semester-end assessment

Course Outcomes : Application of Power Electronic Converters and Control System in Industrial Drives

Topics:

Introduction to Electrical Drives: Their dynamics & control, Induction Motor Drives. Starting & braking, VSI control, CSI control, Synchronous Motor and Brushless Dc Motor Drives, Brushless dc drive, Permanent Magnet SM Drive, control fundamentals, converter configuration, synchronization, trapezoidal and sinusoidal drive control structure, performance, Switched Reluctance Motors, performance characteristics, Stepper motor and switch reluctance motor drives, solar and battery powered drives.

Reference Books :

1. G.K.Dubey, Power semi conductor controlled drives, Prentice Hall, 1988
2. G.K.Dubey, Fundamentals of Electrical Drives, 2nd, AlphaScience International Ltd., 2001
3. B. K. Bose, Power electronics and variable frequency drives, Wiley-Blackwell, 1996

Course Number: PS543

Title of Course: SMART GRID TECHNOLOGIES

Designation as a required or elective course: Deptt. Elective course

Pre-requisites: Distribution systems and Measuring instruments.

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: After undergoing the course, the students would get acquainted with the smart technologies, smart meters and power quality issues in smart grids.

Topics:

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.

Smart energy resources, Smart substations, Wide area monitoring, Protection and control, Phasor Measurement Unit (PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, Phase Shifting Transformers.

Plug in Hybrid Electric Vehicles (PHEV). Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid. Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, IP based Protocols, Cyber Security for Smart Grid.

Reference Books :

1. StuartBorlase, 'SmartGrid:Infrastructure,Technologyand Solutions', CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications',Wiley, 2012.
3. Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, 'Smart Grid Technologies: Communication Technologies and Standards' IEEE Transactions On Industrial Informatics,Vol. 7, No.4, November 2011.
4. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang 'Smart Grid – The New and Improved Power Grid: A Survey', IEEE Transaction on Smart Grids, 2011.

OPEN ELECTIVES

Course Number: PS551

Title of Course: FINITE ELEMENT METHODS

Designation as a required or elective course: Open Elective

Pre-requisites: Fundamental Knowledge of mathematics and system theory

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Analysis and Simulation of electrical system using FEM approach

Topics:

Various approaches in FEM, direct stiffness method, energy approach and galerkin's approach, detailed method for stress and vibration analysis problems, various elements, development of element stiffness matrices. Applications to bar, beam, truss, spring, shafts, plates and shells. Isoparmetric elements, plate bending and shell elements, Axi-symmetric problem, vibration problem, software such as IDEAS, ANSYS, Norton, used in FEM, Nonlinear FEA.

Reference Books :

1. O.C. Zienciwicz, Finite element method, 7th, Butterworth-Heinemann, 2013
2. C.S. Krishnamurthy, Finite element method, 2nd, McGraw Hill, 2001
3. Logon, Finite element method, 5th, Cengage Learning, 2010
4. Heubner, Finite element method, 4th, John Wiley & Sons, 2001

Course Number: PS-552

Title of Course: MICROCOMPUTER AND ITS APPLICATIONS

Designation as a required or elective course: Open Elective

Pre-requisites: Fundamental Knowledge of digital electronics and microprocessor

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Application of digital controllers in electrical systems

Topics:

Programmable Peripheral Devices: PPI 8255, various operating modes, fixing diagram, PIT 8253, programming and modes of operation, PIC 8259, operating modes. Interfacing: Interfacing of peripherals, A/D & D/A converters, 8255, 8253, 8259 with 8/16 bit microprocessor/Data Acquisition system, Microcontroller - 8051 Architecture, Counter/Timers, Instructions, Programming, Interfacing, Applications, Comparison of 8085, 8086, 8057, Programmable logic controller: PLC Architecture, programming, Counter/Timers and its applications. Applications of Microcontroller and PLC for Drives Control.

Reference Books:

1. Gaonkar, Microprocessor Architecture programming & applications, 6th, Penram International, 2013
2. D.V.Hall, Microprocessors & interfacing, McGraw Hill, 2006
3. K.J.Ayala, The 8051 Microcontroller,3rd, Cengage Learning, 2004
4. Gary Dunning, Introduction to programmable logic controller, 3rd, Thomson/Delmar Learning, 2005.

Course Number: PS-553

Title of Course: POWER SYSTEM ECONOMICS

Designation as a required or elective course: Open Elective

Pre-requisites: Power system deregulation

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Restructuring and economic evaluation of power system

Topics:

Fundamental of Economics, Power market fundamentals, Competition & Deregulation in Electricity market, Market Architecture, Market Power, Transmission Pricing and Open Access, Transmission Pricing methods, Transmission issues and Effect in the New market environment, Economics and reliability, Regulation approaches, Distribution pricing, AT & C losses, Demand Side Management, Competitive Bidding Strategies in Power Markets.

Reference Books:

1. Steven Stoft, Power System Economics Designing Markets for Electricity, IEEE Press, 2002
2. Fundamentals of Power System Economics
3. Daniel S. Kirschen and Goran Strbac, Power System Economics, Willey-Blackwell, 2004

Course Number: PS-554

Title of Course: ECONOMICS OF REGULATION AND RESTRUCTURING OF ENERGY INDUSTRIES

Designation as a required or elective course: Open Elective

Pre-requisites: Power system deregulation

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: To acquire the knowledge of power system restructuring and economics of regulation

Topics:

Introduction to economic regulation, principles of regulation, Monopoly, competition and its Regulation, Traditional regulation, rate of return regulation, problems with rate of return regulation, restructuring options and understanding restructuring issues, Transmission Network and Wholesale Market Institutions, Retail Competition and Customer Choice, The Economics and Politics of Government Ownership, Concept of economic regulation of energy industries.

Reference Books:

1. S. Hunt, Making competition work in electricity, John Wiley & Sons, 2002
2. S. Hunt, and G.Shuttleworth, Competition and Choice in electricity, Wiley, 1996
3. Privatisation, restructuring and regulation of network Utilities, Newbery, DMG, MIT Press, 2000
4. Viscusi, WK, JM, Vernon and JE Harrington, Economics of Regulation and Anti-trust, 3rd, MIT Press, 2000

Course Number: PS-555

Title of Course: INSTRUMENTATION

Designation as a required or elective course: Open Elective

Pre-requisites: Basic knowledge of measurement and instrumentation

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Knowledge of different advanced techniques for electrical measurement.

Topics:

Transducers - Measurement of Displacement. Resistive potentiometers, strain gauges, differential transformer, synchros, induction potentiometers, piezoelectric, optical, Digital displacement transducers, Magnetic, speed, torque, voltage, current, power, frequency, power factor and phase angle measurement. Signal Conditioning - Necessity, Instrumentation amplifiers, chopper stabilized amplifiers, Impedance converters, Noise problems, shielding and grounding, Active & Passive filters, Dynamic compensation, Linearization, Concept of A/D and D/A Converters, Sample/hold amplifiers, Microprocessor applications in signal conditioning, Data Transmission & Recording, Microprocessor Based Measurement of Electrical Quantities, Computerized Data Acquisition System.

Reference Books:

1. Ernest O.Docben, Measurement systems, Application and Design, 4th, McGraw Hill, 1990
2. A.K. Shawney, Electrical and electronic measurement, Dhanpat Rai, 2014
3. B.Ram., Fundamental of microprocessor and microcomputers, Dhanpat Rai, 2012

Course Number: PS556

Title of Course: RELIABILITY ENGINEERING

Designation as a required or elective course: Open Elective

Pre-requisites: Basic concepts of Probability theory

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Knowledge of reliability theory will enable students in understanding system planning with greater efficacy.

Topics:

Basic Concepts of Reliability-indices and criteria, use of probability theory for reliability evaluation, System Reliability Evaluation using Probability Distributions- series, parallel and series-parallel, MTTF, MTBF, concept of redundancy, Markov Modeling, Frequency and Duration techniques, Generating System Reliability Analysis-recursive model building, Distribution System Reliability analysis-application to radial networks, Effect of protection system and their failures.

Case studies concerning reliability analysis of power and distribution system.

Reference Books:

1. R. Billinton, R.N.Allan, Reliability Evaluation of Engg. System, 2nd, Springer, 1992
2. R. Billinton, R.N.Allan, Reliability Evaluation of Power systems,2nd, Springer, 1996
3. G.H.Sandler, System Reliability Engg.
4. Endreynil, Probabilistic Reliability Evaluation

Course Number: PS-557

Title of Course: PRINCIPLE OF DATA CONVERTERS

Designation as a required or elective course: Open Elective

Pre-requisites: Knowledge of Discrete system and Electronics devices.

Contact hours: 03

Type of Course: Lecture

Course Assessment methods: Both continuous and semester-end assessment

Course Outcomes: Knowledge of data converters employed in Processors and embedded systems. .

Topics:

Review of Discrete Time Signals**,** Fourier Series and Transforms, Z-transform. Nyquist Sampling Theorem, Different types of Sample and Hold circuits, Voltage References. Design Fundamentals for Analog ICs**:** MOSFETs and MOS devices, Op-Amp circuits design. Advanced Filters: Gm-C Filters, MOSFET-C Filters. Switched Capacitor Circuits: Switched Capacitor Amplifiers, Integrators and Switched Capacitor Filters. Nyquist Rate ADC: Flash, Interpolating, Folding Flash, SAR and Pipelined architectures.

Nyquist Rate DAC: Voltage, Current and Charge mode converters, Hybrid and Segmented Converters. Oversampled A/D and D/A converters, Delta-Sigma data converters, Data Converters in μC, DSP and Embedded systems.

Reference Books:

1. R. Jacob Baker: CMOS Mixed Signal Circuits Design, Willey-IEEE 2nd edition 2008
2. *R. Gregorian and Ternes: Analog MOS integrated circuits for signal processing, JosseyBass, 1986.*
3. R.Gregorian: Introduction to CMOS OP-AMPs and comparators, John-Wiley, 1999.
4. D.Johns and K.Martin: Analog integrated circuit design, John-Wiley, 1997.
5. B.Razavi: Monolithic Phase-locked loops and clock recovery circuits: Theory and design, Wiley-IEEE Press, 2008.
6. R. J. Baker: CMOS: Mixed-Signal Circuit Design, (2nd edition) 2008