BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA ROURKELA

M.Tech. POWER ELECTRONICS & POWER SYSTEMS

SEMESTER- I

(Applicable to the students admitted from the Academic year 2013 – 2014 onwards)

Code No.	Course Title	L	T	P	C
THEORY					
	Professional Core				
PPPC101	Power System Analysis	3	1	0	4
PPPC102	Power Converter-I	3	1	0	4
PPPC103	Power Apparatus & System	3	1	0	4
	Professional Electives -I (Any one)				
PPPE101	Advance Microprocessor & Micro controller	3	1	0	3
PPPE102	Soft Computing	3	1	0	3
	Professional Electives –II (Any one)				
PPPE103	Optimization Techniques	3	1	0	3
PPPE104	Power Quality	3	1	0	3
Sessional / Practical					
PPPR101	Modeling & Simulation Laboratory	0	0	3	4
PPPT101	Pre-Thesis work and Seminar	0	0	3	2
	Total Credit -24				

PPPC101 POWER SYSTEM ANALYSIS

Module- I

Automatic Generation and Voltage Control:

Turbine & Generator- Load frequency Scheme, Steady state & dynamic analysis in frequency domain for single & two area system, Economic dispatch Control, Automatic Voltage Control. Power flow Analysis- NR and Fast Decoupled methods.

Module- II

Optimal System Operation:

Generation allocation problem formulation, Loss Coefficients, Optimal load flow solution, Hydrothermal Coordination, constraints in Unit- commitment, Unit commitment solution methods.

Module- III

Modeling of Transmission lines & transformers with off-nominal taps.

Sparse matrices technique for large- Scale system problems- Gauss elimination & bi-factorization method. Algorithm for short circuit studies, Z Bus Formulation, Unsymmetrical fault analysis using symmetrical components.

Books Recommended:

1. *Stagg G.W., Eabiad A.H. "Computer methods in Power system analysis." Mc Graw Hill, 1968.*
2. *Nagrath & Kothari, "Modern Power System Analysis"*
3. *Elgerd O.Z, "Electrical Energy System Theory- An*

PPPC102 POWER CONVERTER - I

Module-I (12 hours)

Phase controlled rectifiers– Single phase half wave controlled rectifier with R, R-L, R-L with freewheeling diodes. Full wave controlled rectifier with various kind of loads. Half controlled and full controlled bridges with passive and active loads-Input line current harmonics and power factor-Inverter mode of operation. Three phase half wave controlled rectifier with R, R-L an R-L-E loads. Three phase semi and full converters with RL and RLE loads. Input side current harmonics and power factor. Dual converters-Circulating current mode and Non circulating current mode.

Module-II (12 hours)

AC voltage regulators and DC Choppers-Types of ac voltage regulators-single phase full wave ac voltage controllers-single phase transformer tap changers-Multistep transformer tap changer. Three phase ac voltage regulators. Output performance analysis of type A chopper, four quadrant chopper operation.

Module-III (14 hours)

Switch-mode dc-ac inverters. Basic concepts, single phase inverters, push pull, half bridge and full bridge square wave inverters, Blanking time, Single pulse modulation of single phase square wave inverters,Multi pulse modulation-PWM principle, Sinusoidal PWM in single phase inverters, Choice of carrier frequency in SPWM,Spectral content in the output,Unipolar and Bipolar switching in SPWM-Maximum attainable dc voltage, Switch utilization, Reverse recovery problem and Carrier frequency selection, Output side filter requirements and filter design-Ripple in the inverter output-DC side current, Three phase inverters-Three phase square wave/stepped wave inverters. Three phase SPWM inverters, Output filters, DC side current, Effect of blanking time on inverter output voltage.

Text/References:

1. Ned Mohan et. al : Power Electronics ,John Wiley and Sons
2. P C Sen : Power Electronics , TMH
3. G K Dubey et. al : Thyristorised Power Controllers , Wiley Eastern Ltd.
4. B K Bose : Modern Power Electronics and AC Drives, Pearson Edn (Asia)

PPPC103 POWER APPARATUS AND SYSTEMS

Module-I (12 Hrs)

Synchronous Machines: The basis of General Theory and Generalized Equation of A.C machines, Equation in terms of phases variable park's transformation, Various reference frames, Derivation of two-axis equation, Torque equation, Field and damper windings, Equivalent circuits, Operational impedances and frequency response loci, Modified equation with more accurate coupling between field and damper windings.

Selected topics on prime mover and energy supply systems: Governors for hydraulic and steam turbines, Transient droop, speed governing system.

Module-II (12 Hrs)

Synchronous Generator short circuit and system faults: Symmetrical short circuit of unloaded generator, Analysis of short circuit oscillograms, short circuit of loaded synchronous generator, Unsymmetrical short of synchronous generator, system fault calculation, sudden load changes, Equivalent circuit under transient condition, Constant flux linkage theorem, Simplified phasor diagram for transient changes.

Selected topics on excitation systems: Modeling of excitation system components, exciter (D.C and A.C), Amplifier, Stabilizing circuit

Module-III (12 Hrs)

Induction machines: Generator equation of the induction motor (equation), Application of equation in primary and secondary reference frames and complex form of equation, Short circuit and fault current due to the induction motor, fault calculation.

Transformers: Transient phenomena in transformer and transformer protection: General characteristics of over voltage and current inrush, Transient over voltage characteristics tics, Ferro resonant over voltage, protection against surges and insulation co-ordination.

***BOOKS RECOMMENDED**:*

1. *The Generalized theory of electrical machines (Chapters: 1,2,34,5,8 and 11 by B.Adkins and R.H. Hiiley.*
2. *Principle, Operation and Design of power Transformer By S.B Vasciitnsky.*
3. *The J & P transformer Book (Chapter: 22&23) By S. Austen Stigant and A.C Franklin.*
4. *Power System Stability & Control (Chapters: 8&9) By P.Kundur, McGraw Hill-1994.*

PPPE101 ADVANCED MICROPROCESSOR AND MICROCONTROLLER

Module I (10 Hours)

(Prerequisite: A basic course on 8 bit ups such as 8085)

16-bit microprocessor(one well known processor, say 8086 to 68000 to be taken as case study)-quick overview of the instruction set, Assembly language programming. Interrupt structure, Interfacing memory and I\O devices. Memory organizations.

Standard peripherals and their interfacing-(s\w and h\w aspects) color graphic terminals and ASCII keyboards, mouse, floppy and hard disc drive, other storage media (optical disks, Digital Audio Tapes etc.)

Module II (10 Hours)

Data transfer techniques-Asynchronous and synchronous. Serial and parallel interface standards. Communication media and adapters. Modems and their interfacing.

Bus structures and standards-basic concepts. Example of a bus standard (PC\-VME bus).

Salient features of other processors (80286\386\486 or 68020\68030\68040). Microcontrollers and digital signal processors. I\O processors and arithmetic coprocessors.

Logic design for microprocessor-based systems-design of state.

Module III (10 Hours)

Introduction to Microcontrollers - Motorola 68HC11 - Intel 8051 - Intel 8096 - Registers - Memories - I/O Ports - Serial Communications - Timers - Interrupts.

Text/References

1. John.F.Wakerly: Microcomputer Architecture and Programming, John Wiley and Sons.
2. Ramesh S.Gaonker: Microprocessor Architecture, Programming and Applications with the 8085, Penram International Publishing (India).
3. Yu-Cheng Liu and Glenn A.Gibson: Microcomputer systems: The 8086/8088 Family Architecture, Programming and Design, Prentice Hall of India.
4. Raj Kamal: The Concepts and Features of Microcontrollers, Wheeler Publishing.

PPPE102 SOFT COMPUTING

Module-I 12hrs

Basic tools of soft computing – Fuzzy logic, neural network , evolutionary computing.

Fuzzy Logic System:Basic of fuzzy logic theory , crisp and fuzzy sets, Basic set operation like union , interaction , complement , T-norm , T-conorm , composition of fuzzy relations, fuzzy if-then rules , fuzzy reasoning.

Fuzzy inference System: Zadeh's compositional rule of inference, defuzzification , Mamdani Fuzzy Model, Sugeno Fuzzy Model,

Introduction to type –II Fuzzy System.

Module-II 20hrs

Neural Network:

Supervised NN:Single layer network, Perception , Activation function, Adaline , Gradient descent method, least square training algorithm, Multilayer perceptron , error back propagation, generalized delta rule, Radial Basis Function Network, interpolation and approximation RBFNS, comparison between RBFN and MLP, Support Vector Machines : Optimal hypeplane for linearly separable patterns, optimal hyperplane for non-linearly separable patterns. Inverse Modeling.

Unsupervised NN and other NN:Competitive learning networks, kohonen self organizing networks, learning vector quantization, Hebbian Learning Hopfield Network: Content addressable nature, binary and continuous valued Hopfield network , simulated annealing NN. Recurrent Neural Network: NARX Model, Simple Neural Network, State – Space Model , Back Propagation Through Time (BPTT) Algorithm , Real-time Recurrent Learning (RTRL) Algorithm.

Neuro-Fuzzy Modeling: Adaptive Neuro-Fuzzy Inference System (ANFIS) , ANFIS architecture , Hybrid Learning Algorithm , modeling of a three input nonlinear function , simulation of on-line identification in control system.

Data Clustering Algorithms-k-means clustering,fuzzy c-means clustering, subtractive clustering.

Module –III 8hrs

EVOLUTIONARY AND BIO INSPIRED COMPUTING

Evolutionary computing: Genetic algorithm: Basic concept , encoding , fitness function , Reproduction , Basic genetic programming concepts , differences between GA and Traditional optimization methods , Applications, Variants of GA.

Bio Inspired optimization Techniques: Particle Swarm optimization, Ant colony optimization, Bacteria foraging method , Applications.

Text Book

1. Neuro-Fuzzy and soft computing by J S R Jang, CT Sun and E.Mizutani, PHI PVT LTD.

2. Principles of soft computing –by sivandudam and Deepa publisher –John mikey India.

Reference Book

S.haykins- Neural Networks: A comprehensive foundation.

PPPE103 OPTIMIZATION TECHNIQUES

Module-I

Optimization Fundamentals:

Definition, classification of optimization problems, Unconstrained and constrained optimization, optimality conditions.

Linear Programming:

Simplex Method, Duality, Sensitivity methods.

Module-II

Nonlinear Programming:

Powel's method, steepest descent method, conjugates gradient method, Newton's Method GRG method, Sequential quadratic programming, Penalty function method, Augmented Lagrange multiplier method.

Dynamic Programming and Integer Programming

Interior point methods

Karmakar's algorithm, Dual affine, Primal affine, Barrie algorithm.

Module-III

Simulated annealing, Evolutionary Programming, Genetic algorithm and Genetic Engineering. Finite Element Based Optimization.

Reference Books

1. Ashok D.belegundu and Chrandrapatla T. R " Optimization Concept and Application in Engineering " Prentice Hall, 1999.
2. Rao S.S " Engineering Optimization"
3. Gill , Murray and Wright ," Practical Optimization"
4. James A. Memoh." Electic Power System Application of optimization."
5. song Y. , "Modern Optimization Techniques in power System"

PPPE104 POWER QUALITY

Module-I

Introduction: power quality (PQ) problem, Voltage sag, Swell , Surges, Harmonic, over voltages, spikes, Voltage fluctuations, Transients, interruption overview of power quality phenomenon , Remedies to improve power quality, power quality monitoring.

Interruptions: Definition, Difference between failure, outage, causes and 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.

Module-II

Voltage Sag: Characterization of voltage sag, definition, causes of voltage sag , voltage sag magnitude , monitoring, theoretical calculation of voltage sag magnitude , voltage sag calculation in non-radial systems, meshed systems, voltage sag duration.

PQ considerations in Industrial Power Systems: voltage sag effects, 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 drive and its operation, mitigation methods of DC drives.

Module-III

Mitigation of Interruptions and Voltage Sags: Overview of mitigation methods- form 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.

Power Quality and EMC Standards: Introduction to standardization, IEC Electromagnetic compatibility standards, European voltage characteristics standards, PQ surveys.

Reference Book:

1. “Understanding Power Quality Problems” by Math H J Bollen, IEEE Press.

2. Electrical power quality –R C Dugan, M.F,M Granghar, H.W.Beaty-TMH.