POWER CONVERSION TECHNIQUES

PEM 201

L-T-P=3-1-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Select and design dc-dc converter topologies for a broad range of power conversion applications.

CO2: Analyze various single phase and three phase power converters**.**

CO3: Develop improved power converters for any stringent application requirements.

CO4: Comprehend the concepts of AC-AC power converters and their applications

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓	✓					✓	
CO2	✓	✓	✓		✓				✓			
CO3	✓	✓						✓		✓	✓	
CO4	✓	✓				✓	✓					

Course Contents:

Unit 1

Analysis of switched circuits-thyristor controlled half wave rectifier – R, L, RL, RC load circuits, classification and analysis of commutation

Unit 2

Single-Phase and Three-Phase AC to DC converters- half controlled configurations- operating domains of three phase full converters and semi-converters – Reactive power considerations.

Unit 3

Analysis and design of DC to DC converters- Control of DC-DC converters, Buck converters, Boost converters, Buck-Boost converters, Cuk converters Single phase and Three phase inverters, Voltage source and Current source inverters, Voltage control and harmonic minimization in inverters.

Unit 4

AC to AC power conversion using voltage regulators, choppers and cyclo-converters, consideration of harmonics.

References:

1. Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and design", John Wiley and sons.Inc, Newyork, 1995.

2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, New Delhi, 1995.

3. P.C Sen., "Modern Power Electronics", Wheeler publishing Co, First Edition, New Delhi, 1998.

POWER SYSTEM INSTRUMENTATION

PEM 202

L-T-P=3-1-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: To Differentiate the various types of thermodynamic cycles, Draw block diagram and describe the operation of thermal power plant with auxiliary equipments.

CO2: Clarify the operation of hydro power plants with layout, Select and Governing the water turbines.

CO3: To understand system load variations and get an overview of power system operations.

CO4: To attain knowledge about hydrothermal scheduling.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓	✓						
CO2	✓	✓	✓		✓	✓			✓			
CO3	✓	✓	✓					✓	✓			
CO4	✓	✓	✓			✓	✓					

Course Contents:

Unit I

Introduction: Power generating Station – Thermal, Hydel, Nuclear, Wind – Their functional characteristics as processes, Components of power Grid – interdependency between different blocks, Review of Mechanical, Electrical, Electronics, Thermal, Optical, Pneumatic, fluidics

Unit II

a) Coal handling plant – coal feed rate measurement, determination of calorific value.
b) Water treatment
c) Boiler – Feed water, pressure, temperature, steam flow rate, flue gas analysis, optical pyrometer
d) Turbine – Speed, shaft eccentricity, temperature
e) Condenser – pressure, temperature
f) Generator – Speed, hydrogen leakage
g) Control and protection systems of a thermal power plant.
h) Thermal power generation from nuclear reactor.
i) Ash handling and pollution control

Unit III

Hydel Power Plant: Types - flow rate, Water pressure
Wind Power: Principles – synchronization with grids
Transformer: Transformer oil, hot spot, moisture detection,
Transmission Lines: Fiber optics meter for high voltage and high current measurement, Transmission line sag measurement using triangulation technique.

Unit IV

Tariff: Objective, Available based tariff, Digital energy meter, Remote terminal unit (RTU)
Local Dispatch Centre: Data handling – Processing, Logging, Acquisition, Accounting, Display and Storage, SCADA, Techniques of Data acquisition at Central Load Dispatch Centres for coordinated control of the grid.
Computer Control of Power Plant:
IS specification: Introduction, Application and Relevancy of IS specification in perspective of power system instrumentation

Text Book:

1. Modern Power Station Practice – Vol: C, Vol: D, Pergamon Press
2. Principles of Industrial Instrumentation - D Patranabish, TMH, New Delhi

Reference Book:

1. Industrial Instrumentation Control and Automation – S Mukhopadhyay, S.Sen, A. Deb – Jaico Publishing House, Mumbai.
2. B. G. Liptak, Instrument Engineers Handbook, Chilton Book Co. Philadelphia

INDUSTRIAL CONTROL ELECTRONICS

PEM 203

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Ability in understanding atomization in the Industrial Sector.

CO2: Know-how of control mechanism utilized in Industrial Devices.

CO3: Proficiency in signal conditioning & processing in automated systems.

CO4: Competency in Designing automated industrial control systems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓					✓	✓
CO2	✓	✓	✓	✓	✓	✓					✓	✓
CO3	✓	✓	✓	✓	✓	✓					✓	✓
CO4	✓	✓	✓	✓	✓	✓					✓	✓

Course Contents:

Unit 1

Review of switching regulators and switch mode power supplies-Uninterrupted power supplies- OFF-LINE AND ON-LINETOPOLOGIES-Analysis of UPS topologies-solid state circuit breakers-solid-state tap-changing of transformer.

Unit 2

Analog Controllers - Proportional controllers, Proportional – Integral controllers, PID controllers, derivative overrun, integral windup-cascaded control-Feed forward control-Digital control schemes- control algorithms-programmable logic controllers.

Unit 3

Signal conditioners-Instrumentation amplifiers – voltage to current, current to voltage, voltage to frequency, frequency to voltage converters; Isolation circuits – cabling; magnetic and electro static shielding and grounding.

Unit 4

Opto-Electronic devices and control , electronic circuits for photo-electric switches-output signals for photo-electric controls; Applications of opto-isolation, interrupter modules and photo sensors – Fibre optics – Bar code equipment, application of barcode in industry.

Stepper motors – types, operation, control and applications; servo motors- types, operation, control and applications – servo motor controllers – servo amplifiers – linear motor applications-selection of servo motor.

References:

1. Michael Jacob, "Industrial Control Electronics – Applications and Design", Prentice Hall, 1988.
2. Thomas, E. Kissel, "Industrial Electronics" PHI, 2003.
3. James Maas, "Industrial Electronics", Prentice Hall, 1995.

INTELLIGENT CONTROL TECHNIQUES

PEM 204

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Will be knowledgeable to use Fuzzy logic for modeling and control of non-linear systems.

CO2: Will be capable of developing ANN based models and control schemes for non-linear system.

CO3: Stability analysis of Neural-Network interconnection systems; Implementation of fuzzy logic controller**.**

CO4: Handle, Solve and analyze problems using linear programming and other mathematical programming algorithms.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓		✓	✓					✓	
CO2	✓		✓		✓	✓			✓			
CO3	✓		✓						✓	✓	✓	
CO4	✓		✓			✓	✓					

Course Contents:

Introduction: Approaches to intelligent control; Architecture for intelligent control; Symbolic reasoning system; rule-based systems; AI approach; Knowledge representation; Expert systems.

Fuzzy Logic Control System: Motivation and basic definitions; Fuzzy arithmetic and Fuzzy relations; Fuzzy logic modeling and control; Fuzzy knowledge and rule bases; Fuzzy modeling and control schemes for nonlinear systems; Self-organizing fuzzy logic control; Fuzzy logic control for nonlinear time-delay system; Stabilization using fuzzy models; Fuzzy estimators; Adaptive fuzzy control.

ANN based Controllers and Estimators: Concept of Artificial Neural Networks and its basic mathematical model; McCulloch-Pitts neuron model; simple perceptron; Adaline and Madaline; Feed-forward Multilayer Perceptron; Learning and Training the neural

network; Data Processing: Scaling; Fourier transformation; principal-component analysis and wavelet transformations; Hopfield network; Self-organizing network and Recurrent network; Neural Network based controllers and estimators.

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps; Adjustment of free parameters; Solution of typical control problems using genetic algorithm; Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems; Evolutionary Fuzzy logic controllers.

Case Studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural network toolbox; Stability analysis of Neural-Network interconnection systems; Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox; Stability analysis of fuzzy control systems.

References:

1. Padhy.N.P.; “Artificial Intelligence and Intelligent System”; Oxford UniversityPress.
2. KOSKO;B. "Neural Networks and Fuzzy Systems"; Prentice-Hall of India Pvt. Ltd.
3. Jacek.M.Zurada; "Introduction to Artificial Neural Systems";Jaico PublishingHouse.
4. KLIR G.J. & FOLGER T.A. "Fuzzy sets; uncertainty and Information"; Prentice-Hall of India Pvt. Ltd.

POWER QUALITY

PEM 205

L-T-P=4-0-0

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Discuss the various types of power quality problem.

CO2: Analyze the sources, types and mitigation of over voltage issues and model of over voltage problem with computer software tools.

CO3: Evaluate the effects of harmonics on power system equipments and analyze the methods of controlling of harmonics.

CO4: Explain the principle of operation of various types of power quality monitoring devices.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓	✓					✓	
CO2	✓	✓				✓						
CO3	✓	✓						✓		✓	✓	
CO4	✓	✓				✓						✓

Course Contents:

Unit I

Electric power quality phenomena: Impacts of power quality problems on end users, Power quality standards, power quality monitoring.

Unit II

Power quality disturbances:- transients, short duration voltage variations ,long duration voltage variations, voltage imbalance, wave-form distortions, voltage fluctuations, power frequency variations, power acceptability curves.

Unit III

Power quality problems: poor load power factor, loads containing harmonics, notching in load voltage, dc offset in loads, unbalanced loads, disturbances in supply voltage.

Unit IV

Transients: Origin and classification- capacitor switching transient-lighting-load switching-impact on users-protection- mitigation

Unit V

Harmonics: harmonic distortion standards, power system quantities under non sinusoidal conditions-harmonic indices-source of harmonics-system response characteristics-effects of harmonic distortion on power system apparatus –principles for controlling harmonics, reducing harmonic currents in loads, filtering, modifying the system frequency response-Devices for controlling harmonic distortion, inline reactors or chokes, zigzag transformers, passive filters, active filters.

Unit VI

Power quality conditioners: Shunt and series compensators, Dstatcom-dynamic voltage restorer, unified power quality conditioners

Text Book:

1. Arindam and Ledwich Gerard, 'Power quality enhancement using custom power devices' Springer
2. Arrillaga J., Watson N. R. and Chen S., 'Power System Quality Assessment' Wiley.

Reference Book:

1. Angelo Baggini 'Handbook of Power Quality' – Wiley

POWER ELECTRONICS & DRIVES LAB

PEM 291

L-T-P=0-0-3

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Estimate & solve harmonic and power factor related problems in controlling AC and DC drives.

CO2: To impart in-depth knowledge on computer simulation of different Drives.

CO3: Analyze simulation results and effective documentation.

CO4: Acquire expertise in usage of modern tools.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓		✓	✓						
CO2	✓		✓		✓	✓			✓			
CO3	✓		✓					✓	✓			
CO4												

Course Contents:

1. Experiments and computer simulations on:
2. Single phase, three phase Semi converters and Full converters,
3. DC-DC Choppers using SCRs and Self communicating Devices.
4. Single phase and three phase inverters using IGBTs,
5. AC-AC voltage regulators.
6. DC and AC drives