BRANCH-ELECTRICAL ENGINEERING

Specialization:ELECTRICAL POWER SYSTEM
ELECTRICAL ENGINEERING.
POWER ELECTRONICS & DRIVES
POWER ELECTRONICS
POWER SYSTEM ENGINEERING
POWER SYSTEMS
ENERGY SYSTEMS ENGINEERING
POWER ELECTRONICS AND ELECTRICAL DRIVES
POWER ELECTRONICS AND POWER SYSTEMS
POWER ENGINEERING AND ENERGY SYSTEMS
POWER AND ENERGY ENGINEERING

First Semester							
Theory					Practical		
Course Name	**Hours/Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
Computational Methods and Techniques	4-0	4	100	50	-	-	-
Internet of Things	4-0	4	100	50	-	-	-
Power Conversion Devices And Drives	4-0	4	100	50	-	-	-
Advanced Power Systems	4-0	4	100	50	-	-	-
Smart Electrical Energy System	4-0	4	100	50	-	-	-
Lab-I					8	4	150
Total							
Total Marks: 900							
Total Credits: 24							

INTERNET OF THINGS (IoT)

MODULE I

Introduction to Internet of Things

Introduction-Definition & Characteristics of IoT, **Physical Design of IoT-** Things in IoT, IoT Protocols, **Logical Design of IoT-** IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, **IoT Enabling Technologies-** Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, **IoT Levels & Deployment Templates.**

MODULE II

Domain Specific IoTs

Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, **Cities-**Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response, **Environment-**Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection, **Energy-** Smart Grids, Renewable Energy Systems, Prognostics, **Retail-**Inventory Management, Smart Payments, Smart Vending Machines, **Logistics-**Route Generation & Scheduling, Fleet Tracking, Shipment Monitoring, Remote Vehicle Diagnostics, **Agriculture-**Smart Irrigation ,Green House Control ,**Industry -**Machine Diagnosis & Prognosis Indoor Air Quality Monitoring ,**Health & Lifestyle –**Health & Fitness Monitoring, Wearable Electronics

IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT-Software Defined Networking , Network Function Virtualization

MODULE III

IoT Platforms Design Methodology

IoT Design Methodology-Purpose & Requirements Specification ,Process Specification, Domain Model Specification, Information Model Specification , Service Specifications , IoT Level Specification, Functional View Specification , Operational View Specification , Device & Component Integration , Application Development, **Case Study on IoT System for Weather Monitoring, Motivation for Using Python**

IoT Physical Devices & Endpoints

What is an IoT Device-Basic building blocks of an IoT Device, **Exemplary Device: Raspberry Pi**, **About the Board, Linux on Raspberry Pi , Raspberry Pi Interfaces –** Serial, SPI , I2C , **Programming Raspberry Pi with Python-**Controlling LED with Raspberry Pi , Interfacing an LED and Switch with Raspberry Pi ,Interfacing a Light Sensor (LDR) with Raspberry Pi , **Other IoT Devices-**pcDuino, Beagle Bone Black , Cubieboard

MODULE IV

IoT&Beyond : Use of Big Data and Visualization in IoT, Industry 4.0 Concepts. Overview of RFID, Low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and data-intensive IoT for continuous recognition applications. Overview of Android / IOS App Development tools & Internet Of Everything

Text Books:

1. Internet of Things, A Hands on Approach, by Arshdeep Bahga & Vijay audisetti, University Press.

Reference Books:

1. The Internet of Things, by Michael Millen, Pearson

COMPUTATIONAL METHODS AND TECHNIQUES

MODULE-I:

Neural Networks: Artificial Neural Network and Introduction, Learning Rules, Knowledge Representation and Acquisition, Different Methods of Learning.
Algorithms of Neural Network: Feed-forward Error Back Propagation, Hopfield Model, Kohonen'sFeatrure Map, K-Means Clustering, ART Networks, RBFN, Application of Neural Network to the relevant field.

MODULE-II:

Fuzzy Logic: Basic Concepts of Fuzzy Logic, Fuzzy vs Crisp Set, Linguistic variables,Membership Functions, Operations of Fuzzy Sets, Fuzzy If-Then Rules, Variable Inference Techniques, Defuzzification, Basic Fuzzy Inference Algorithm, Fuzzy System Design, FKBC and PID Control, Antilock Breaking System(ABS), Industrial Applications.

MODULE-III:

Optimization Fundamentals: Definition, Classification of Optimization Problems, Unconstrained and Constrained Optimization, Optimality Conditions.
LINEAR Programming: Simplex Method, Duality, Sensitivity Methods
NON-LINEAR Programming: Newton's Method, GRG Method, Penalty Function Method, Augmented Langrange Multiplier Method, Dynamic Programming and Integer Programming, Interior Point Methods, Karmakar's Algorithm, Dual Affine, Primal Affine.

MODULE-IV:

Genetic Algorithm: GA and Genetic Engineering, Finite Element based Optimization, PSO,BFO, Hybridization of Optimization Technique, Application of Optimization Technique for Solving Projects(Project solutions). Implementation of Branch Relevant Industrial Applications by Matlab Code.
Books Recommended:

1. Neural Networks- by Simon Haykin
2. Fuzzy Logic with Engineering Application- by ROSS J.T (Tata Mc)
3. Neural Networks and Fuzzy Logic – by Bart Kosko
4. An introduction Fuzzy Control – by D.Driankor, H. Hellendorn, M.Reinfrank (Narosa Pub)
5. Fuzzy Neural Control – by Junhong NIE & Derek Linkers (PHI)
6. Related IEEE/IEE Publications
7. Fuzzy System Design Principles, Building Fuzzy IF-THEN Rule Bases – by Riza C. Berikiu and Trubatch, IEEE Press
8. Ashok D. Begundu&chandrapatla T.R "Optimization concept and application in engineering",Prentice Hall,1999
9. Rao S.S "Engineering Optimization"
10. Gill,Murray and Wright ,"Practical Optimization"
11. James A.Memoh. "Electric Power System Application Of Optimization".
12. Song Y.,"Modern Optimization Techniques In Power System"
13. Optimization Research;PrabhakarPai,Oxford University Press.

POWER CONVERSION DEVICES AND DRIVES

Module-I (8Hrs)

Basic concepts of Modeling: Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine - voltage, current and Torque equations.

Dynamic Analysis of Synchronous Machine: Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics.

Module- II(12Hrs)

Modeling of Synchronous Machine: Synchronous machine inductances –voltage equations in the rotor's dq0 reference frame- electromagnetic torque-current in terms of flux linkages-simulation of three phase synchronous machine- modeling of PM Synchronous motor

Poly-phase Induction Machines: Introduction, construction and principle of operation,Induction motor equivalent circuit, steady-state performance equations of the induction motor, steady-state performance, Measurement of motor parameters, Dynamic modeling of induction machines.

Module- III(12 Hrs)

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. 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-IV(15 Hrs)

Introduction to motor drives: Components of power electronic Drives- Criteria for selection of Drive components-match between the motor and the load- Thermal consideration- match between the motor and the power electronics converter- characteristics of mechanical systems- stability criteria.

Induction motor drives: Torque speed characteristics of 3-phase induction motor drive, speed control of 3-phase induction motor by varying stator frequency and voltage – impact of non sinusoidal excitation on induction motors- variable frequency converter classifications – variable frequency PWM-VSI drives- variable frequency square wave VSI drives- variable frequency CSI drives-comparison of variable frequency drives- Line frequency variable voltage drives- soft start of induction motors – speed control by static slip power recovery, static Cramer and Scherbius drives.

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.*
5. *Ned Mohan etial : Power Electronics , John wiley and sous*
6. *R.Krishnan :Electric Motor Drives – PHI publication*
7. *B K Bose :Modern Power Electronics and AC drives, Pearson Education (Asia)*
8. *P C Sen : Power Electronics TMH Publication*
9. *Dubey : Power Electronics Drives- Wiley Eastern*
10. *P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drivesystems", IEEE Press, Second Edition.*

ADVANCED POWER SYSTEMS

Module- I (7 Hrs)

Modeling of Transmission lines & transformers with off-nominal taps. Power flow Analysis- NR and Fast Decoupled methods

Algorithm for short circuit studies, Z Bus Formulation, Unsymmetrical fault analysis using symmetrical components

Module- II(10 Hrs)

Optimal System Operation:

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

Turbine & Generator- Load frequency Scheme, Steady state & dynamic analysis in frequency domain for single & two area system

Module-III(16 Hrs)

Power Quality Problems

Voltage Sag and over view of reliability: 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. Reliability of power systems

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.

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.

Module- IV(12 Hrs)

Power Pools & Electricity Markets: Inter-area transactions, multi-area power interchanges, Energy brokerage systems, Market design and auction mechanism, Pool versus bilateral markets and price formation, Role of independent generators and system operator

*L*oad characteristics and load forecast: Basic definitions- load definitions, load factor definitions, diversity principle in distribution systems, Load Forecast- factors affecting load forecasting methods, small areas load forecasting, spatial load forecasting methods, simulation, trending and mixed load forecasting methods

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. *Elaerd O.Z, " Electrical Energy System Theory- An Introduction"*
4. " Understanding Power Quality Problems" by Math H J Bollen, IEEE Press.
5. Electrical power quality –R C Dugan, M.F,MGranghar, H.W.Beaty-TMH.
6. A. J. Wood and B. F. Wollenberg, *Power generation, operation and control,* Wiley-Interscience, 2nd Edition, 1996.
7. K. Bhattacharya, M. H. J. Bollen and J. E. Daalder, *Operation of restructured power systems,* Kluwer Academic Publishers, USA, 2001.

SMART ELECTRICAL ENERGY SYSTEM

Module- I (7 Hrs)

Non-renewable reserves and resources; renewable resources, Transformation of Energy. Solar Power: Solar processes and spectral composition of solar radiation; Radiation flux at the Earth's surface. Solar collectors. Types and performance characteristics. Applications.

*SOLAR THERMAL SYSTEM:*Solar Collection Devices; their analysis; Solar Collector Characteristics; Solar Pond; application of solar energy to space heating etc.

Module- II (8 Hrs)

Wind Energy: Wind energy conversion; efficiency limit for wind energy conversion, types of converters, aerodynamics of wind rotors, power - speed and torque - speed characteristics of wind turbines, wind turbine control systems; conversion to electrical power: induction and synchronous generators, grid connected and self excited induction generator operation, constant voltage and constant frequency generation with power electronic control, single and double output systems, reactive power compensation

Module- III (15 Hrs)

Distributed Generation

Standards, DG potential, Definitions and terminologies; current status and future trends, Technical and economical impacts, Definitions and terminologies; current status and future trends, Technical and economical impacts

DG Technologies, DG from renewable energy sources, DG from non-renewable energy sources, Distributed generation applications, Operating Modes, Base load; peaking; peak shaving and emergency power, Isolated, momentary parallel and grid connection

Distribution system performance and operation

Distribution automation and control, Voltage drop calculation for distribution networks, Power loss Calculation, Application of capacitors to distribution systems, Application of voltage regulators to distribution systems

Module- IV (15 Hrs)

Introduction to smart grid:

Introduction to the smart grid, including objectives and functions, views of the smart grid with in the industry, and design criteria.

BOOKS RECOMMENDED :

1. S. N. Bhadra, D. Kastha, S. Banerjee, *Wind Electrical Systems*: Oxford Univ. Press, 2005.
2. S.A. Abbasi, N. Abbasi, *Renewable Energy Sources and Their Environmental Impact:* Prentice Hall of India, 2004.
3. S.P. Sukhatme - Solar Energy: Principles of thermal Collection and Storage,TMH,New Delhi
4. H.P. Garg and Jai Prakash - Solar Energy: Fundamentals and Applications,TMH
5. 5.Ned Mohan et. al : Power Electronics ,John Wiley and Sons
6. *6.P C Sen : Power Electronics , TMH*
7. *G K Dubey et. al :Thyristorised Power Controllers , Wiley Eastern Ltd.*
8. *B K Bose : Modern Power Electronics and AC Drives, Pearson Edn (Asia)*