POWER SYSTEM OPERATION AND CONTROL

VII Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB28	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Demonstrate economic operation of power systems, hydrothermal scheduling.
II. Illustrate modeling of turbines, generators and automatic controllers.
III. Discuss single area and two area load frequency control.
IV. Analyze reactive power control and load modeling.

COURSE OUTCOMES:

CO 1 **Recall the knowledge of engineering science including electrical circuits, control systems and electrical machines in power system operation and control.**
CO 2 **Determine economic scheduling of generation in a power system to supply specific amount of demand.**
CO 3 **Outline the problems related to the economic dispatch of power plant scheduling, strategies for minimizing transmission line losses and penalties imbibed.**
CO 4 **Calculate the cost of generation, economic dispatch of power among 'n' thermal units using incremental cost curves and coordinate equation using iteration method.**
CO 5 **Develop the mathematical models of the mechanical and electrical components involved in the operation of power systems under steady and dynamic conditions.**
CO 6 **Model excitation system using the fundamental characteristics and transfer function method.**
CO 7 **Analyze the static performance of the system with automatic generation control, excitation voltage and reactive power control in an interconnected power system.**
CO 8 **Design a compensation scheme in a transmission line for imparting knowledge of various controllers with its evolution, principle of operation and applications.**
CO 9 **Determine the optimal location of power capacitors for power factor improvement with economic justification.**
CO 10 **Demonstrate the importance of load compensation in symmetrical as well as unsymmetrical loads with its characteristics.**
CO 11 **Solve different numerical problems related to Economic Load Dispatch, Load Frequency Control and reactive power control.**

MODULE-I	ECONOMIC OPERATION OF POWER SYSTEMS	Classes: 12

Optimal scheduling of thermal power system: Optimal operation of generators in thermal power stations, heat rate curve, cost curve, incremental fuel and production costs, input output characteristics, optimum generation allocation without and with transmission line losses coefficients, general transmission line loss formula, unit commitment; Optimal scheduling of hydrothermal system: Hydro electric power plant models, scheduling problems, short term hydro thermal scheduling problem.

MODULE-II	MODELING OF GOVERNOR, TURBINE AND EXCITATION SYSTEMS	Classes: 09

Modeling of governor: Mathematical modeling of speed governing system, derivation of small signal transfer function; Modeling of turbine: First order turbine model, block diagram representation of steam

turbines and approximate linear models; Modeling of excitation system: Fundamental characteristics of an excitation system, transfer function, block diagram representation of IEEE type-1 model.

MODULE-III	SINGLE AREA AND TWO AREA LOAD FREQUENCY CONTROL	Classes: 09

Load frequency control of single area system: Necessity of keeping frequency constant, definitions of control area, single area control, block diagram representation of an isolated power system, steady state analysis, dynamic response, uncontrolled case.

Load frequency control of two area system: Uncontrolled case and controlled case, tie line bias control; Load frequency controllers: Proportional plus integral control of single area and its block diagram representation, steady state response, load frequency control and economic dispatch.

MODULE-IV	COMPENSATION FOR POWER FACTOR IMPROVEMENT AND REACTIVE POWER CONTROL	Classes: 09

Voltage control: Equipment for voltage control, effect of series capacitors, line drop compensation, effect of AVR, power factor control using different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (fixed and switched), power factor correction, capacitor allocation, economic justification, procedure to determine the best capacitor location; Reactive power control: Reactive power compensation in transmission systems, advantages and disadvantages of different types of compensating equipment for transmission systems; Uncompensated and compensated transmission lines: Shunt and series compensation.

MODULE-V	LOAD COMPENSATION	Classes: 06

Load Compensation: characteristics of loads, factors associated with loads, relation between the load factor and loss factor; specifications of load compensator; Classification of loads: Residential, commercial, agricultural and industrial loads and characteristics.

Text Books:

1. C L Wadhwa, “Electrical power systems”, New age International, 3rd Edition, 2005.
2. I J Nagarath, D P Kothari, “Modern power system analysis”, Tata McGraw-Hill, 2nd Edition, 2006.

Reference Books:

1. Singh S N, “Electric Power Generation, Transmission and Distribution”, Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 2002.
2. T J E Miller, “Reactive power control in Electrical system”, Wiley Interscience Publication, 1982.
3. V K Mehta and Rohit Mehta, “Principles of Power System”, S Chand, 3rd revised Edition, 2015.
4. Turan Gonen, “Electrical Power Distribution System Engineering”, CRC Press, 3rd Edition, 2014.
5. V Kamaraju, “Electrical Power Distribution Systems”, TMH, Publication, Edition, 2009
6. O I Elgerd, “Electrical Energy Systems Theory”, Tata McGraw-Hill, 2nd Edition, 2007.

Web References:

1. https://www.electrical4u.com/working-or-operating-principle-of-dc-motor
2. https://www.freevideolectures.com
3. https://www.ustudy.in › Electrical Machines
4. https://www.freeengineeringbooks.com

E-Text Books:

1. https://www.textbooksonline.tn.nic.in
2. https://www.freeengineeringbooks.com
3. https://www.eleccompengineering.files.wordpress.com
4. https://www.books.google.co.in