16EE403 POWER SYSTEM OPERATION AND CONTROL

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
5	40	-	8	5	5

Course Description and Objectives:

This course introduces the structure, operation and control aspects of power systems using digital computers. The objective is to understand economic dispatch, unit commitment, load frequency control, Q-V control and acquire the skill of computer conrol of power systems involving SCADA.

Course Outcomes:

The student will be able to:

- analyze the operational features of various components in power system and model the same.
- understand the problem of scheduling the power among the thermal plants optimally.
- commit the appropriate generators to meet the existing loads optimally.
- stabilize the frequency of the system for the given load duration curve, using load frequency control.
- maintain the voltage profile of the given power system using Q-V control.

SKILLS:

- ✓ *Obtain economic dispatch for given load profile.*
- ✓ *Analyze the problem of load frequency control strategy.*
- ✓ *Analyze the importance of voltage control in power system.*
- ✓ *Master the computer control of power system involving SCADA.*

UNIT – 1 **L-10**

LOADS AND CONTROL OF POWER SYSTEM: System load variation, System load characteristics, Reserve requirements - installed reserves, Spinning reserves, Cold reserves, Hot reserves; Overview of system operation, Latest trends in operation and control of power system - Load forecasting, Load dispatching, Advanced control options with deregulation, Smart grid control options and evolution.

UNIT – 2 **L-9**

ECONOMIC DISPATCH AND UNIT COMMITMENT : Incremental cost curve, Co-ordination equations – Without loss and with loss, Solution by direct method and iteration method; Statement of unit commitment (UC) problem, Constraints in UC - Spinning reserve, Thermal unit constraints, Hydro constraints, Fuel constraints and other constraints; UC solution methods – Priority-list methods, Forward dynamic programming approach.

UNIT – 3 **L-10**

ACTIVE POWER – FREQUENCY CONTROL : Fundamentals of speed governing mechanism and modelling, Speed-load characteristics, Load sharing between two synchronous machines in parallel, Concept of control area - LFC control of a single-area system, Static and dynamic analysis of uncontrolled and controlled cases; Multi-area systems - Modelling of two-area system, Static and dynamic analysis of two area system, Uncontrolled case, Tie-line with frequency bias control of two-area system, Derivation; State variable model, Economic dispatch control with LFC.

UNIT – 4 **L-8**

REACTIVE POWER–VOLTAGE CONTROL : Typical excitation system, Static and dynamic analysis, Stability compensation, Generation and absorption of reactive power, Relation between voltage and reactive power, Methods of voltage control, Injection of reactive power, Generator voltage magnitude setting, Static var capacitor, Tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission losses, Numerical problems.

UNIT – 5 **L-8**

COMPUTER CONTROL OF POWER SYSTEMS : Energy control centre - Functions, Monitoring, Data acquisition and control; System hardware configuration, SCADA and EMS functions, Network topology determination, State estimation, Security analysis and control, Various operating states – Normal, alert, Emergency, in-extremis and restorative; State transition diagram showing various state transitions and control strategies.

ACTIVITIES:

- *Study of load – frequency dynamics in single - area control power systems*
- *Study of load – frequency dynamics in two - area control power systems*
- *Economic dispatch without considering loss using MATLAB*
- *Economic dispatch with considering loss using MATLAB*

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS Total hours: 30

1. Finding the effiency of transmission line at different loads.
2. Economic Dispatch without considering loss using MATLAB Software
3. Economic Dispatch with considering loss using MATLAB Software.
4. Economic load dispatch using LAMBDA-ITERATION method.
5. Simulation of single area load frequency control with integral controller.
6. Simulation of single area load frequency control without integral controller.
7. Load – Frequency Dynamics of Two-Area control Power Systems.
8. Determination of ABCD parameters using Transmission line model
9. Determination of Regulation and efficiency of transmission line using Transmission line model
10. Determination of regulation of transmission line including Ferranti effect.

TEXT BOOKS:

1. Kothari, D.P. and Nagrath, I.J., "Modern Power System Analysis", 3rdedition, Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2005.
2. Allen.J.Wood and Bruce F.Wollenberg, "Power Generation, Operation and Control", 1st edition, John Wiley and Sons, Inc., 2004.

REFERENCE BOOK:

1. Olle. I. Elgerd., "Electric Energy Systems Theory – An Introduction", 1st edition, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, Revised edition, 2006.
2. J. Grainger and WD Stevenson Jr, "Power System Analysis", 1st edition, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 2005.
3. Hadi Saadat, "Power System Analysis", 1st edition, Tata Mc-Graw Hill Publishing Company Ltd., New Delhi, 1999.