

SRM VALLIAMMAI ENGINEERING COLLEGE

(Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK



M.E-Power System Engineering (I SEM)

PS3162 - Power System operation and Control

Regulation – 2023

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Prepared by

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DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING QUESTION BANK

SUBJECT & SUBJECT CODE: PS3162 - Power System operation & Control

SEM / YEAR: I Sem / I Year

UNIT I –INTRODUCTION				
System load variation: System load characteristics, load curves - daily, weekly and annual, load duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation and Control: Load forecasting, techniques of forecasting, Indian power sector – Past and present status: Recent growth of power sector in India – An overview, A time line of the Indian power sector, Players in the Indian power sector, basics of power system operation and control.				
PART – A				
Q.No	Questions	BT Level	Competence	CO
1.	What is spinning reserve?	BT-4	Analyze	CO1
2.	Write short notes of variable load in a power system.	BT-1	Remember	CO1
3.	Specify the difference between spinning reserve and cold reserve.	BT-2	Understand	CO1
4.	Develop the formula for finding out the start up cost by cooling and Banking method.	BT-3	Apply	CO1
5.	Point out the need for maintaining frequency in a power system.	BT-6	Create	CO1
6.	Summarize short note on effect of variable load in power system.	BT-4	Analyze	CO1
7.	What is the need for maintaining voltage and frequency in a power system?	BT-1	Remember	CO1
8.	Mention few techniques of load forecasting.	BT-1	Remember	CO1
9.	Explain the role of computers in the operation and control of power system.	BT-5	Evaluate	CO1
10.	Define load factor.	BT-1	Remember	CO1
11.	Formulate the need for load forecasting.	BT-3	Apply	CO1
12.	Decide the need for voltage regulation in power systems?	BT-2	Understand	CO1
13.	Define diversity factor.	BT-1	Remember	CO1
14.	Measure the effect of load factor on the cost of generation?	BT-6	Create	CO1
15.	Define the term average load.	BT-1	Remember	CO1
16.	Demonstrate the effects of variable load in power system.	BT-1	Remember	CO1
17.	List out the objective of power system control.	BT-2	Understand	CO1
18.	Distinguish load curve and load duration curve.	BT-5	Evaluate	CO1
19.	List out the functions of load dispatch center.	BT-2	Understand	CO1
20.	Define diversity factor.	BT-1	Remember	CO1
21.	Draw the system load characteristics curve.	BT-2	Understand	CO1
22.	Explain the load duration curve.	BT-4	Analyze	CO1

23.	Discuss the load factor.							BT-5	Evaluate	CO1
24.	Illustrate the significance of load factor and diversity factor.							BT-3	Apply	CO1
PART – B										
1.	i) Define the following: (1) Hot reserve (2) Cold reserve (3) diversity factor. (8) ii) A generating station has the following daily load cycle:							BT-4	Analyze	CO1
	Time (hrs)	0-6	6-10	10-12	12-16	16-20	20-24			
	Load (M W)	20	25	30	25	35	20			
	Draw the load curve and calculate maximum demand, units generated per day, average load, load factor. (8)									
2.	What is the need for load forecasting? Why is the load on the power station is variable? What are the effects of variable load as power system. (16)							BT-1	Remember	CO1
3.	A power station must meet the following demand: Group A:200KW between 8 A.M and 6 P.M Group B:100KW between 6 A.M and 10 A.M Group C:50KW between 6 A.M and 10 A.M Group D:100KW between 10 A.M and 6 P.M and then between 6P.M and 6 A.M. Plot the daily load curve and determine diversity factor, units generated per day and load factor. (16)							BT-5	Evaluate	CO1
4.	What are objectives of modern trend in real time control of power system? Explain the significant features of computer control in power system. (8) (i) Write short notes on load forecasting. (8)							BT-1	Remember	CO1
5.	Describe briefly about plant level and system level control. (16)							BT-5	Evaluate	CO1
6.	Classify and explain cost involved in power system. (16)							BT-2	Understand	CO1
7.	Explain the following terms. (16) i. Maximum Demand ii. Plant use factor iii. Plant capacity factor iv. Reserve capacity							BT-1	Remember	CO1
8.	Explain the need for voltage and frequency regulation in power system. (16)							BT-2	Understand	CO1
9.	Explain the detail about economic dispatch control and automatic voltage regulator. (16)							BT-2	Understand	CO1
10.	Explain the significance of load forecasting in power system planning operation and control. (16)							BT-1	Remember	CO1
11.	Differentiate: Installed reserve and spinning reserve, Hot reserve and cold reserve. (16)							BT-3	Apply	CO1
12.	Evaluate the various stochastically methods for load forecasting. (16)							BT-4	Analyze	CO1
13.	Justify that the Kalman filtering approach to the load forecasting problem is a better way for very short-term forecasting. (16)							BT-6	Create	CO1

14.	Peak demand of a generating station is 90 MW. The load factor and the plant capacity factor are 0.6 and 0.5 respectively. Determine (a) daily energy produced (b) Installed capacity (c) reserve capacity (d) utilization factor (16)	BT-3	Apply	CO1
15.	Discuss about the load curve and load duration curve. what information are conveyed by a load curve? (16)	BT-4	Analyze	CO1
16.	Explain the reasons for uncertainty in the forecasting load and power system operation and control. (16)	BT-4	Analyze	CO1
17.	Illustrate the load forecasting by least square method. (16)	BT-6	Create	CO1

UNIT II- LOAD FREQUENCY CONTROL

Need for frequency and voltage control - Plant and system level control - modeling of LFC of single area system - static and dynamic analysis - LFC of two area system - static and dynamic analysis - Tie line bias control - development of state variable model of single and two area system, Economic Dispatch Control.

PART – A

Q.No	Questions	BT Level	Competence	CO
1.	What happens to frequency if load on the generator increase?	BT-2	Understand	CO2
2.	Discuss the objective of AGC in multi area control.	BT-3	Apply	CO2
3.	Demonstrate why the frequency and voltage to be regulated in a power system.	BT-2	Understand	CO2
4.	Compare the functions of “speed Governor” and “speed changer” in a speed governing system of a turbine generator set.	BT-3	Apply	CO2
5.	What do you understand by coherent group of generators?	BT-2	Understand	CO2
6.	Show how is the real power in power system controlled.	BT-1	Remember	CO2
7.	What is meant by free governor operation?	BT-5	Evaluate	CO2
8.	Show the function of load frequency control on a power system.	BT-1	Remember	CO2
9.	Define speed droop.	BT-1	Remember	CO2
10.	Draw the dynamic responses of change in frequency for a step load change for single area system.	BT-4	Analyze	CO2
11.	What is the use of secondary loop in ALFC system?	BT-2	Understand	CO2
12.	List the advantages of multi area operation.	BT-1	Remember	CO2
13.	Discuss the principle of tie line bias control.	BT-6	Create	CO2
14.	List out the functions of ALFC.	BT-5	Evaluate	CO2
15.	What is meant by control area?	BT-3	Apply	CO2
16.	What is AFRC with reference to load frequency control? What does it signify?	BT-2	Understand	CO2
17.	Explain the need for state estimation.	BT-4	Analyze	CO2
18.	Reason out the necessity of tie line with frequency bias control of two area system.	BT-1	Remember	CO2

19.	Define area control error.	BT-1	Remember	CO2
20.	What are the major control loops used in large generators?	BT-3	Apply	CO2
21.	How is the real power in a power system controlled?	BT-6	Create	CO2
22.	What is the disadvantage of high loop gain? How is to be eliminated.	BT-2	Understand	CO2
23.	Comparison between large and small signal analysis.	BT-3	Apply	CO2
24.	Generalize the AGC.	BT-6	Create	CO2
PART – B				
1	Two synchronous generators operating in parallel. Their capacities are 300MW and 400MW. The droop characteristics of their governors are 4% and 5% from no load to full load. Assuming that the generators are operating at 50HZ at no load, how would be a load of 600MW shared between them. What will be the system frequency at this load? Assume free governor action. (16)	BT-2	Understand	CO2
2.	Describe the speed governing mechanism which control the real power flow in the power system and derive the mathematical model. (16)	BT-4	Analyze	CO2
3.	Derive the transfer function model and draw the block diagram for single control area provided with governor system. From the transfer function derive the expression for steady state frequency error for a step load change. (16)	BT-2	Understand	CO2
4.	Draw the schematic diagram of an automatic voltage regulator of a generator and explain them in detail. (16)	BT-1	Remember	CO2
5.	Two 1000KW alternators operate in parallel. The speed regulation of first alternator is 100% to 103% from full load to no load and that of other 100% to 105%. How will the two alternators share load of 1200KW and at what will one machine cease to supply any portion of the load. (16)	BT-4	Analyze	CO2
6.	Explain load frequency control. (16)	BT-3	Apply	CO2
7.	Derive the expression for steady state frequency change for single area system with the following cases. (i) Changes in load with fixed speed (8) (ii) changes in speed with fixed demand. (8)	BT-2	Understand	CO2
8.	Derive an expressing for steady state frequency change and tie line power flow of two area system. (16)	BT-3	Apply	CO2
9.	Two generators rated 200MW and 400Mw are operating in parallel. The droop characteristics of their governors are 4V0 and 5V0, respectively from no-load to full load. Assuming that the generators are operating at 50HZ at no load, how would a load of 600 MW be shared between them? What will be the system frequency at this load? Assume free governor operation. (16)	BT-5	Evaluate	CO2

10.	Develop the state variable model of a two area system and state the advantages of the model. (16)	BT-6	Create	CO2
11.	Draw the block diagram of uncontrolled two area load frequency control system and explain the salient features under static condition. (16)	BT-1	Remember	CO2
12.	Develop the block diagram model of uncontrolled two area load frequency control system and explain the salient features under static conditions. (16)	BT-6	Create	CO2
13.	Develop the state variable model of a single area system and state the advantages of the model. (16)	BT-6	Create	CO2
14.	Explain the static state estimation of power system. (16)	BT-3	Apply	CO2
15.	Illustrate the load sharing between two synchronous machine in parallel through a case study. (16)	BT-4	Analyze	CO2
16.	Evaluate the Need for frequency and voltage control. (16)	BT-5	Evaluate	CO2
17.	A two area system connected by the tie line has the following identical parameters $R=3\text{Hz/pu}$, $B=0.996\text{ MW/Hz}$. A 1000 MW control area 1 is interconnected with a 5000 MW area 2. Base value of area 2 is 5000MW. If a 30MW load is increase in area 1 find the static frequent drop and tie line power change. (16)	BT-4	Analyze	CO2

UNIT III - HYDROTHERMAL SCHEDULING PROBLEM

Hydrothermal coordination – hydroelectric plant models - short term and long-term scheduling problem – gradient approach – Hydro units in series
Hydro-thermal scheduling with pumped hydro plant: Scheduling of systems using Dynamic programming and linear programming Selection of initial feasible trajectory for pumped hydro plant.

PART – A

Q.No	Questions	BT Level	Competence	CO
1.	What is hydrothermal coordination?	BT-2	Understand	CO3
2.	List any two objectives of hydrothermal coordination.	BTL 1	Remember	CO3
3.	What are the main components of a hydroelectric plant model?	BTL 1	Remember	CO3
4.	Define the head of a hydroelectric plant.	BTL 1	Remember	CO3
5.	Write the power output equation of a hydroelectric plant.	BTL 1	Remember	CO3
6.	What is the storage equation of a reservoir?	BTL 1	Remember	CO3
7.	Differentiate between short-term and long-term scheduling.	BTL 2	Understand	CO3
8.	What is meant by short-term hydrothermal scheduling?	BTL 2	Understand	CO3
9.	What is the time horizon typically considered in long-term scheduling?	BTL 2	Understand	CO3
10.	What is the gradient approach in hydrothermal coordination?	BTL 2	Understand	CO3
11.	What is the role of the gradient (λ) in the gradient approach?	BTL 2	Understand	CO3
12.	Define hydro units in series with a simple example.	BTL 1	Remember	CO3
13.	What is hydro-thermal scheduling?	BTL 1	Remember	CO3

14.	What is a pumped hydro plant?	BTL 1	Remember	CO3
15.	Define pumped hydro storage.	BTL 1	Remember	CO3
16.	What is meant by dynamic programming?	BTL 1	Remember	CO3
17.	What is linear programming?	BTL 1	Remember	CO3
18.	What is an initial feasible trajectory in a pumped hydro plant?	BTL 1	Remember	CO3
19.	State the main objective of hydro-thermal scheduling with pumped hydro storage.	BTL 1	Remember	CO3
20.	Explain the role of pumping and generating modes in a pumped hydro plant.	BTL 2	Understand	CO3
21.	Explain how dynamic programming can be used for hydro-thermal scheduling.	BTL 2	Understand	CO3
22.	Explain the importance of constraints in linear programming-based hydro-thermal scheduling.	BTL 2	Understand	CO3
23.	Describe the basic steps involved in selecting an initial feasible trajectory for a pumped hydro plant.	BTL 2	Understand	CO3
24.	Explain the difference between generating mode and pumping mode in a pumped hydro storage plant.	BTL 2	Understand	CO3
PART – B				
1.	Explain the hydroelectric plant power output equation to determine the power generated for a given water discharge, turbine efficiency, and effective head.	BTL 3	Apply	CO3
2.	Use the reservoir storage equation to calculate the final reservoir storage when the initial storage, inflow, turbine discharge, and spillage are given.	BTL 3	Apply	CO3
3.	Summarize the gradient approach to determine the optimum allocation of hydro generation among two hydro units for a specified load demand.	BTL 3	Apply	CO3
4.	Discuss the hydrothermal coordination principle to schedule hydro and thermal generation for a given load demand and available water.	BTL 3	Apply	CO3
5.	Examine the effect of reservoir storage constraints on the short-term hydrothermal scheduling problem for a given operating period.	BTL 4	Analyze	CO3
6.	Compare short-term and long-term hydrothermal scheduling with respect to time horizon, water availability, generation cost, and operating constraints.	BTL 4	Analyze	CO3
7.	Examine the operation of hydro units connected in series and explain how the discharge and reservoir levels affect the generation of downstream units.	BTL 4	Analyze	CO3
8.	Examine the impact of changes in the gradient (λ) on the optimal generation schedule of hydro units in a hydrothermal coordination problem.	BTL 4	Analyze	CO3
9.	Determine the optimal hydro-thermal generation schedule using dynamic programming for a given load demand, water availability, and generating-unit constraints.	BTL 3	Apply	CO3

10.	Apply linear programming to determine the optimal generation schedule of hydro, thermal, and pumped hydro units for a given load profile.	BTL 3	Apply	CO3
11.	Apply the pumping and generating constraints of a pumped hydro plant to determine its operating schedule for a given 24-hour load demand.	BTL 3	Apply	CO3
12.	Determine an initial feasible trajectory for a pumped hydro plant using given reservoir limits, pumping capacity, generating capacity, and initial storage.	BTL 3	Apply	CO3
13.	Analyze the effect of pumped hydro operation on the total operating cost of a hydro-thermal system under peak and off-peak load conditions.	BTL 4	Analyze	CO3
14.	Analyze the performance of dynamic programming and linear programming approaches for hydro-thermal scheduling in terms of constraints, computational effort, and optimality.	BTL 4	Analyze	CO3
15.	Analyze the feasibility of a selected initial trajectory for a pumped hydro plant considering reservoir storage, pumping, generating, and final storage constraints.	BTL 4	Analyze	CO3
16.	Analyze how changes in the initial reservoir storage affect the optimal scheduling of a pumped hydro plant and thermal generating units.	BTL 4	Analyze	CO3
17.	Analyze the impact of pumped hydro storage on peak-load management, thermal generation, and overall operating cost in a hydro-thermal scheduling problem.	BTL 4	Analyze	CO3

UNIT IV - UNIT COMMITMENT AND ECONOMIC DISPATCH

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, numerical problems. Incremental cost curve, coordination equations without loss and with loss, solution by direct method and λ -iteration method. Gradient method- Newton's method – Base point and participation factor method. Economic dispatch controller added to LFC control.

Part-A

Q.No	Questions	BT Level	Competence	COs
1	List the various constraints of unit commitment problem.	BT-1	Remember	CO4
2	What is the objective of economic dispatch problem?	BT-4	Analyze	CO4
3	Draw the incremental fuel cost curve.	BT-2	Understand	CO4
4	Why cascading outages are preferred?	BT-4	Analyze	CO4
5	Write the significance of Unit Commitment.	BT-2	Understand	CO4
6	Draw the incremental cost curve of a thermal power Plant.	BT-1	Remember	CO4
7	Write the equality and inequality constraints considered in the economic dispatch problem.	BT-3	Apply	CO4
8	What is meant by FLAC?	BT-1	Remember	CO4
9	What is minimum up and minimum down time in unit Commitment?	BT-6	Create	CO4
10	Define participation factor.	BT-1	Remember	CO4
11	What is participation factor with respect to economic load dispatch?	BT-5	Evaluate	CO4
12	Write the co-ordination equation taking losses into account.	BT-3	Apply	CO4
13	What is meant by incremental cost curve	BT-1	Remember	CO4
14	Compare with unit commitment and Economic load dispatch.	BT-2	Understand	CO4

15	List the few constraints that are accounted in unit commitment problem.	BT-2	Understand	CO4
16	What is meant by priority list method?	BT-1	Remember	CO4
17	Mention the assumption made in the formation of loss formula.	BT-6	Create	CO4
18	What are the advantages of using forward dynamic programming method?	BT-2	Understand	CO4
19	In what way the fuel constraints are dealt with unit commitment.	BT-1	Remember	CO4
20	What is difference between load frequency controller and economic dispatch controller?	BT-3	Apply	CO4
21.	Illustrate the spinning reserve.	BT-6	Create	CO4
22.	Define crew constraints.	BT-1	Remember	CO4
23.	Discuss the system blackout problem.	BT-4	Analyze	CO4
24.	What are the techniques for the solution of the unit commitment problem?	BT-2	Understand	CO4
Part-B				
1.	Discuss the dynamic programming method in optimal unit commitment. (16)	BT-1	Remember	CO4
2.	The fuel inputs per hour of plants 1 and 2 are given as $F_1 = 0.2P_1^2 + 40P_1 + 120$ Rs/hr, $F_2 = 0.25P_2^2 + 30P_2 + 150$ Rs/hr Determine the economic operating schedule and the corresponding cost of generation. The maximum and the minimum loading on each unit are 100MW and 25MW. Assume the transmission losses are ignored and the total demand is 180MW. Also determine the saving obtained if the load is equally shared by both the units. (16)	BT-6	Create	CO4
3.	With the help of Flow chart explain Economic dispatch by λ Iteration method without loss. (16)	BT-4	Analyze	CO4
4.	Explain the priority list method of solving unit commitment Problem. State merits and limitations of this method. (16)	BT-3	Apply	CO4
5.	Analyze the coordination equation for economic dispatch including losses and give the steps for economic dispatch calculation, neglecting losses. (16)	BT-5	Evaluate	CO4
6.	The fuel cost functions for three thermal plants in \$/h are given by $F_1 = 0.004P_{g1}^2 + 5.3P_{g1} + 500$ $F_2 = 0.006P_{g2}^2 + 5.5P_{g2} + 400$ $F_3 = 0.009P_{g3}^2 + 5.8P_{g3} + 200$ where P_{g1} , P_{g2} , P_{g3} are in MW. Find the optimal dispatch and the total cost when the total load is 925 MW with the following generator limits. $100\text{MW} \leq P_{g1} \leq 450\text{MW}$, $100\text{MW} \leq P_{g2} \leq 350\text{MW}$, $100\text{MW} \leq P_{g3} \leq 225\text{MW}$. (16)	BT-6	Create	CO4
7.	Discuss with a neat flow chart the procedure for finding BT-4 the solution for unit commitment problems using forward DP method. (16)	BT-4	Analyze	CO4

8.	Explain the Forward Dynamic Programming method of solving unit commitment problem with neat flow chart. (16)	BT-3	Apply	CO4
9.	Describe the flow chart for obtaining the optimum dispatch strategy of N bus system taking in to account the system transmission losses. (16)	BT-4	Analyze	CO4
10.	Give λ iteration algorithm for solving economic scheduling problem without losses. (16)	BT-5	Evaluate	CO4
11.	Summarize the Economic dispatch controller added to LFC control. (16)	BT-6	Create	CO4
12.	Explain with a neat flow chart, to find economic generation for the unit commitment problem. (16)	BT-4	Analyze	CO4
13.	i) The cost characteristics of three plants of a system are $C_1=0.05P_1^2 + 17.0P_1 + 160$ Rs/hour $C_2=0.06P_2^2 + 14.4P_2 + 200$ Rs/hour $C_3=0.08P_3^2 + 9.0P_3 + 240$ Rs/hour Where P_1, P_2, P_3 are in MW. The incremental transmission losses for the network with respect to plants 1,2 and 3 are 0.05,0.10 and 0.15 MW per MW of generation. Find the optimal dispatch for a total load of 100MW and its incremental cost of received power. (16)	BT-5	Evaluate	CO4
14.	The input output curve characteristics of three units are $F_1=750+6.49P_{g1}+0.0035P_{g1}^2$. $F_2=870+5.75P_{g2}+0.0015P_{g2}^2$. $F_3=620+8.56P_{g3}+0.001P_{g3}^2$. The fuel cost of unit 1 is 1.0 Rs/MBtu, 1.0 Rs/MBtu for unit 2 and 1.0 Rs/MBtu for unit 3. Total load is 800MW. Use the participation factor method to calculate the dispatch for a load is increased to 880MW. (16)	BT-4	Analyze	CO4
15.	Explain briefly the constraints on unit commitment problem. (16)	BT-4	Analyze	CO4
16.	Generalize the forward dynamic programming approach and Incremental cost curve.	BT-5	Evaluate	CO4
17.	Evaluate the Base point and participation factor method. (16)	BT-5	Evaluate	CO4

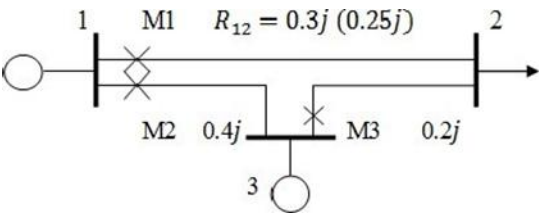
UNIT V – POWER SYSTEM SECURITY

Need for power system Security- - Contingency analysis – linear sensitivity factors – AC power flow methods – contingency selection – concentric relaxation – bounding-security constrained optimal power flow-Interior point algorithm-Bus incremental costs.

Part-A

Q.No	Questions	BT Level	Competence	Cos
1.	What is state estimation?	BT-5	Evaluate	CO5
2.	List the methods of state estimation.	BT-1	Remember	CO5
3.	State the need for power system state estimation.	BT-1	Remember	CO5
4.	Describe the function of state estimation.	BT-4	Analyze	CO5
5.	What is mean by state vector?	BT-2	Understand	CO5

6.	List down the different method for standard scheme of measurement.	BT-3	Apply	CO5
7.	Differentiate the least square state estimation and weighted square state estimation.	BT-3	Apply	CO5
8.	Define static state estimation.	BT-1	Remember	CO5
9.	Why weighted least square method used for state estimation?	BT-6	Create	CO5
10.	What is meant by probabilistic static estimation?	BT-3	Apply	CO5
11.	What are the sources of bad data?	BT-2	Understand	CO5
12.	Differentiate Load flow analysis and State estimation.	BT-1	Remember	CO5
13.	What is meant by virtual measurement?	BT-5	Evaluate	CO5
14.	How bad data identified?	BT-4	Analyze	CO5
15.	What is meant by DC state estimation?	BT-2	Understand	CO5
16.	What are the approximation for DC state estimation.	BT-1	Remember	CO5
17.	What is meant by network observability?	BT-6	Create	CO5
18.	Demonstrate the importance of state estimation in power System.	BT-1	Remember	CO5
19.	Write down application of state estimation.	BT-3	Apply	CO5
20.	What do you mean by static state and dynamic state estimation modes?	BT-2	Understand	CO5
21.	Discuss the optimal power flow.	BT-3	Apply	CO5
22.	Explain the contingency selection.	BT-4	Analyze	CO5
23.	Describe the Bus incremental costs.	BT-6	Create	CO5
24.	Explain the Contingency analysis.	BT-4	Analyze	CO5
Part-B				
1.	Estimate two random variables by least square estimation method for a given measurement vector z as follows $\begin{bmatrix} 0.5 \\ 1 \end{bmatrix} \begin{bmatrix} 1 & 1 \end{bmatrix}$ $Z = \begin{bmatrix} 0.45 \end{bmatrix}; H = \begin{bmatrix} 1 & 0 \end{bmatrix}$ $\begin{bmatrix} 0.51 \\ 0 \end{bmatrix} \begin{bmatrix} 0 & 1 \end{bmatrix}.$ (16)	BT-1	Remember	CO5
2.	Estimate two values random variables x by weighted least square estimation method $\begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} 0.5 \end{bmatrix}$ $W = \begin{bmatrix} 0 & 0.5 & 0 \end{bmatrix}; H = \begin{bmatrix} 1 & 0 \end{bmatrix}; Z = \begin{bmatrix} 0.45 \end{bmatrix}$ $\begin{bmatrix} 0 & 0 & 0.1 \end{bmatrix} \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} 0.51 \end{bmatrix}.$ (16)	BT-3	Apply	CO5
3.	Explain the security monitoring using state estimation with necessary diagram. (16)	BT-4	Analyze	CO5
4.	Discuss the least square state estimation in detail. (16)	BT-3	Apply	CO5
5.	Explain the neat flow chart DC state estimation in power system. (16)	BT-1	Remember	CO5
6.	Briefly explain different methods of state estimation in power system with suitable example. (16)	BT-6	Create	CO5
7.	Explain different methods of bad data detection and identification in power system state estimation. (16)	BT-1	Remember	CO5
8.	Derive the maximum likelihood weighted least square estimation. Explain with an example. (16)	BT-3	Apply	CO5
9.	Briefly explain the detection and identification of bad measurements and pseudo measurement.	BT-4	Analyze	CO5
10.	Explain network observability and pseudo measurement. (16)	BT-3	Apply	CO5

11.	Elaborate the weighted square state estimation method. (16)	BT-1	Remember	CO5																
11.	Formulate how bad data are detected, identified and suppressed in power system state estimation. (16)	BT-4	Analyze	CO5																
12.	Write down the application power system state estimation and Cleary explain anyone supplication with suitable example. (16)	BT-6	Create	CO5																
13.	List the various contingencies that are generally considered for steady state security analysis. Explain the major functions of system security control. (16)	BT-5	Evaluate	CO5																
14.	Explain various method of power system state estimat and write the application of power system state estimation. (16)	BT-4	Analyze	CO5																
15.	Find state of the given three bus system using DC state estimation model. (16) <table border="1" data-bbox="315 932 899 1163"><thead><tr><th>Quantity measured</th><th>Metering point</th><th>Error variance</th><th>Meter reading</th></tr></thead><tbody><tr><td>Real power from bus 1 to 2</td><td>M1</td><td>0.0001</td><td>0.72</td></tr><tr><td>Real power from bus 1 to 3</td><td>M2</td><td>0.0001</td><td>0.09</td></tr><tr><td>Real power from bus 3 to 2</td><td>M3</td><td>0.0001</td><td>0.65</td></tr></tbody></table>	Quantity measured	Metering point	Error variance	Meter reading	Real power from bus 1 to 2	M1	0.0001	0.72	Real power from bus 1 to 3	M2	0.0001	0.09	Real power from bus 3 to 2	M3	0.0001	0.65	BT-6	Create	CO5
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16.	Explain the bounding-security constrained optimal power flow-Interior point algorithm. (16)	BT-4	Analyze	CO5																
17.	Evaluate the Interior point algorithm and Bus incremental costs. (16)	BT-5	Evaluate	CO5																

COURSE OUTCOMES

1. Explain about the operation and control of power system and List the past and present status of Indian power sector.
2. Develop the static and dynamic model of Load Frequency Control in single and two area system.
3. Analyze the problems associated with hydro thermal Scheduling and to construct the algorithm for feasible load management.
4. Distinguish between various methods involved in unit commitment and economic dispatch problems.
5. Define about the power system security factors and analyse the algorithms used for optimal power.