Code No: **R1641023** **R16** **Set No. 1**

IV B.Tech I Semester Regular Examinations, October/November - 2019

POWER SYSTEM OPERATION AND CONTROL

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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PART–A *(14 Marks)*

1. a) What is the significance of incremental cost? [2]
   b) What are the conditions for optimality in an optimal scheduling problem of a short range hydro-thermal system with approximate penalty factors? [2]
   c) List out the constraints regarding the solution of unit commitment problem. [3]
   d) Why should the system frequency be maintained constant? [3]
   e) What is the main difference of ACE in single area and two area LFC systems? [2]
   f) Emphasize the need of reactive power compensation. [2]

PART–B *(4x14 = 56 Marks)*

2. a) How are B-coefficients evaluated for transmission lines of the power system? [7]
   b) The cost curves of two generators may be approximated by second degree polynomials

$$C_1 = 0.1\,P_{G1}^2 + 20\,P_{G1} + \alpha_1$$

$$C_2 = 0.1\,P_{G2}^2 + 30\,P_{G1} + \alpha_2$$

Where α_1 and α_2 are constants

If the total demand on the generators is 200 MW, find the optimum generator settings. How many rupees per hour would you lose if the generators were operated about 15% off the optimum settings? [7]

3. a) Obtain the hydroelectric power plant models with neat diagram. [7]
   b) Derive the condition for optimality of short term hydro thermal scheduling problem. [7]

4. A power system network with thermal power plant is operating by three number of generating units. Determine the most economical units to be committed to a load demand of 6MW with load changes insteps of 1 MW starting from minimum to the maximum load. The minimum and maximum generating capacities and cost curve parameters of the units listed in tabular form as given below:

Unit number	Capacity (MW)		Cost curve parameters		
	Min	Max	a	b	
1	1.0	10.0	0.5	20.0	
2	1.0	10.0	1.50	25.5	
3	1.0	10.0	2.00	30.0	

[14]

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5. a) Explain the effects of change in the frequency and the voltage of a power system. Mention the acceptable ranges of these changes. [7]
   b) Derive the liberalized modeling of a hydraulic turbine. [7]

6. a) Explain the importance of tie-line bias control with necessary expressions. [6]
   b) Describe the combined load frequency control and economic dispatch control with block diagram. [8]

7. a) List out the merits and demerits of different types of compensating equipment for transmission systems. [7]
   b) Explain the effect of series compensation on performance of transmission line. [7]

Code No: **R1641023** **R16** **Set No. 2**

IV B.Tech I Semester Regular Examinations, October/November - 2019

POWER SYSTEM OPERATION AND CONTROL

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B

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PART–A *(14 Marks)*

1. a) What is the significance of penalty factor in economical generation scheduling? [3]
   b) List out the scheduling methods for short-term hydro-thermal co-ordination. [2]
   c) What do you mean by optimal unit commitment problem? [2]
   d) What is meant by control area concept? [2]
   e) What are the merits of multi area LFC system operation? [2]
   f) What are the objectives of load compensation? [3]

PART–B *(4x14 = 56 Marks)*

2. a) How is optimal generation scheduling of thermal units obtained? [7]
   b) Two power plants are connected together by a transmission line and load is connected at plant 2. When 150 MW are transmitted from plant-1, the transmission loss is 10MW. The cost characteristics of two plants are

$$C_1 = 0.05\, P_{G1}^2 + 13\, P_{G1} \text{ Rs/h}$$

$$C_2 = 0.06\, P_{G2}^2 + 12\, P_{G2} \text{ Rs/h}$$

Find the optimum generation for $\lambda = 22$ and $\lambda = 30$. [7]

3. In a two plant operation system, the hydro plant is operate for 8 hrs during each day and the steam plant is operate all over the day. The characteristics of the steam and hydro plants are

$$C_T = 0.02\, P_{GT}^2 + 14\, P_{GT} + 15 \text{ Rs/hr}$$

$$w_H = 0.0025\, P_{GH}^2 + 25\, P_{GH} \text{ m}^3\text{/ sec}$$

When both plants are running, the power flow from steam plant to load is 250 MW and the total quantity of water is used for the hydro plant operation during 8 hrs is 225×10^6 m^3. Find the generation of hydro plant and cost of water used. Neglect the transmission losses. [14]

4. a) What are the differences between economic load dispatch Vs unit commitment [7]
   b) Explain the Priority ordering method for unit commitment [7]

5. a) Describe clearly about proportional plus integral load frequency control system with a block diagram [8]
   b) Explain the effect of saliency in synchronous machine modeling [6]

6. Develop the mathematical model of the change in tie-line power and frequency of two area LFC system with block diagram. [14]

7. a) Explain the effects on uncompensated line under no-load and load conditions. [7]
   b) A 50 kW induction motor has power factor 0.8 and efficiency 0.9 at full load, power factor 0.6 and efficiency 0.7 at half-load. At no-load, the current is 25% of the full-load current and power factor 0.25. Capacitors are supplied to make the line power factor 0.8 at half-load. With these capacitors in circuit, calculate the line power factor at (i) full load, and (ii) no-load. [7]

Code No: **R1641023** **R16** **Set No. 3**

IV B.Tech I Semester Regular Examinations, October/November - 2019

POWER SYSTEM OPERATION AND CONTROL

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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PART–A *(14 Marks)*

1. a) What is meant by economic dispatch problem? [2]
   b) What is the condition for optimality in a hydrothermal scheduling problem when considering transmission losses? [2]
   c) Why is the unit commitment problem important for scheduling thermal units? [2]
   d) What is meant by single area power system? [2]
   e) What is the main difference between load frequency control and economic load dispatch control? [3]
   f) What are the characteristics of an ideal compensator? [3]

PART–B *(4x14 = 56 Marks)*

2. a) Derive the expression for general transmission line loss formula. [6]
   b) Three power plants of total capacity 400MW are scheduled for operation to supply total system load of 350 MW. Find the optimum load scheduling. The following are the incremental cost characteristics and the generator constraints.

$$\frac{dC_1}{dP_{G1}} = 20 + 0.13\, P_{G1}, \qquad 25 \le P_{G1} \le 125$$

$$\frac{dC_2}{dP_{G2}} = 40 + 0.25\, P_{G2}, \qquad 30 \le P_{G3} \le 100$$

$$\frac{dC_3}{dP_{G3}} = 30 + 0.2\, P_{G3}, \qquad 50 \le P_{G3} \le 200$$

[8]

3. A two plant system having a thermal station near the load center and a hydro power station at remote location. The characteristics of both stations are

$C_1 = (20 + 0.03)\, P_{GT})P_{GT}$ Rs/hr

$w_2 = (8 + 0.002\, P_{GH})\, P_{GH}$ m^3/sec

& $\gamma_2 = 5 \times 10^{-4}$ Rs./ m^3

The transmission loss co-efficient $\beta_{22} = 0.0005\ MW^{-1}$

Determine the power generation at each station and the power received by the load when $\lambda = 50$ Rs / MWhr. [14]

4. a) What are the constraints used in unit commitment problem? Discuss. [7]
   b) Explain the Dynamic programming method for unit commitment problem. [7]

5. a) Develop the mathematical model of speed governing system for generating system. [7]
   b) A 150 MVA, 60 Hz turbo alternator operator at no load at 3,000 rpm. A load of 30 MW is suddenly applied to the machine and the steam valves to the turbine commence to open after 0.5 sec. due to the time lag in the governor system. assuming inertia constant H= 5.5 kW sec per kVA of generator capacity, determine the frequency to which the generated voltage drops before the steam flow commences to increase to meet the new load. [7]

6. Derive the expression for change in static error frequency and tie line power in an identical two area LFC system with block diagram. [14]

7. a) Explain the voltage regulation without and with compensation. [7]
   b) A 3-Phase, 50 Hz, 2000 V motor develops 500 HP, the p.f being 0.85 lagging and the efficiency 0.9. A bank of capacitors is connected in delta across the supply terminals and the p.f raised to 0.95 lagging. Each of the capacitance units is built of five similar 500 V capacitors. Find the capacitance of each capacitor. [7]

Code No: **R1641023** **R16** **Set No. 4**

IV B.Tech I Semester Regular Examinations, October/November - 2019

POWER SYSTEM OPERATION AND CONTROL

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B

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PART–A *(14 Marks)*

1\. a) Define the incremental transmission loss and give its significance. [2]

b) What is the statement of optimization problem of hydro -thermal system? [2]

c) What are the different constraints that can be considered in unit commitment problem? [3]

d) What is the need of a speed changer? [2]

e) What is meant by tie-line bias control? [2]

f) What is the need of reactive power compensation? [3]

PART–B *(4x14 = 56 Marks)*

2\. a) Derive the expression for optimum generation allocation including the effect of transmission line losses. [7]

b) Two units each of 350 MW in a thermal power plant are operating all the time throughout the year. The maximum and minimum load on each unit is 200 MW and 75 MW respectively. The incremental fuel characteristics for the two units are given as

$$\frac{dC_1}{dP_{G1}} = 15 + 0.08\ P_{G1}\ \text{Rs/ MWhr}$$

$$dC_2\ /\ dP_{G2} = 13 + 0.1\ P_{G2}\ \text{Rs/ MWhr}$$

If the total load 300 MW, find the optimum load scheduling. [7]

3\. a) How is optimal generation scheduling of hydrothermal system stated and solved in the power system? [7]

b) A two-plant system having a steam plant near the load centre and a hydro plant at a remote location. The load is 400 MW for 10 hrs a day and 250 MW, for 14 hrs a day.

The characteristics of the units are

$$C_1 = 150 + 60\ P_{GT} + 0.1\ P^2_{GT}$$

$$\omega = 0.8\ P_{GH} + 0.000333\ {}^{2}_{GH}\ \ m^3/\text{sec}$$

Loss co-efficient $B_{22} = 0.001\ MW^{-1}$

Find the generation schedule, daily water used by hydro plant and daily operating cool of thermal plant for $\gamma_2 = 77.5$ Rs./ m^3. [7]

4. A power system network with thermal power plant is operating by three number of generating units. Determine the most economical units to be committed to a load demand of 5 MW with load changes insteps of 1 MW starting from minimum to the maximum load. The minimum and maximum generating capacities and cost curve parameters of the units listed in tabular form as given below.

Unit number	**Capacity (MW)**		**Cost curve parameters**		
	Min	**Max**	**a**	**b**	**d**
1	1.0	12.0	0.77	23.5	0
2	1.0	12.0	1.60	26.5	0
3	1.0	12.0	2.00	30.0	0

[14]

5. a) How is automatic generation control achieved? Draw the block diagram. [7]

   b) Determine the static frequency drop if the load is suddenly increased by 30 MW on a system having the following data

   Rated capacity, P_r = 400MW
   Operating Load, P_D = 220MW
   Inertia constant, H = 5 Sec
   Governor regulation, R = 2 Hz /p.u MW
   Frequency, f = 50 Hz

   Also find the additional generation. [7]

6. Explain how the integral control scheme results in zero tie-line deviation and zero frequency deviation under steady state condition. Following a step load change in one of the areas of a two area LFC system with block diagram. [14]

7. a) What are the objectives of load compensation? Discuss. [7]

   b) Explain the need for FACTS controllers. [7]