Code No: **RT41023** **R13** **Set No. 1**

IV B.Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2018

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 THREE questions from Part-B
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PART–A *(22 Marks)*

1. a) Define incremental fuel cost and production cost. [4]
   b) What is the need for short term hydrothermal scheduling problem? [4]
   c) What is unit commitment problem? How it is different from economic dispatch problem. [4]
   d) What is meant by a control area and control area error? [3]
   e) What do you understand by economic dispatch control? [3]
   f) What are the effects of capacitor in series compensation circuit? [4]

PART–B *(3x16 = 48 Marks)*

2. a) Derive general transmission line loss formula and state assumptions made in calculating B- coefficients. [8]
   b) Consider a two bus system as shown in figure 2 (b). The incremental production costs at the two generating station are given by

$$\frac{dC_1}{dP_{G1}} = 5 + 0.005\,P_{G1}$$

$$\frac{dC_2}{dP_{G2}} = 6 + 0.004\,P_{G2}$$

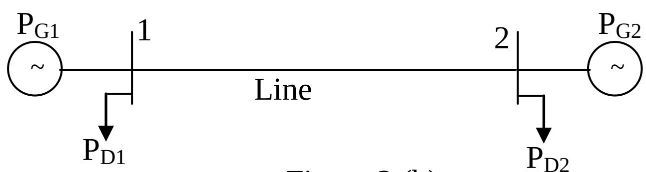

Figure 2 (b)

The B-coefficients in MW^{-1} are given in the matrix form as

$$B = \begin{bmatrix} 0.0002 & -0.00005 \\ -0.00005 & 0.0003 \end{bmatrix}$$

Determine exact and approximate penalty factors at both buses. Given that λ=8. [8]

3. What is the significance of penalty factor in economic scheduling? Using Lagrangian multipliers, develop mathematical expressions for the solution of economic hydrothermal scheduling problem. [16]

4. a) Discuss about different constraints considered in solving a unit commitment problem. [8]
   b) Explain briefly about the different unit commitment solution methods. [8]

5. a) Explain the mathematical modeling of speed governing system and derive the transfer function of speed governor model. State the assumptions made. [8]

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b) A 200 MVA synchronous generator is operating at 3000 rpm, 50Hz. A load of 40MW is suddenly applied to the machine and the steam valve of the turbine opens only after 0.4 sec due to the time lag in the generator action. Calculate the frequency to which the generated voltage drops before the steam flow commences to increase to meet the new load. Given that the value of H of the generator is 5.5 kW-sec/KVA of the generator capacity. [8]

6. For a single area system, show that the static error in frequency can be reduced to zero for single area load frequency control with integral control. [16]

7. a) What are the merits and demerits of shunt and series compensation? [7]
   b) A short transmission line having an impedance of (2+j3) ohms interconnects two power stations A and B both operating at 11 kV; equal in magnitude and phase. To transfer 25 MW at 0.8 p.f. lagging from A to B determine the voltage boost required at plant A. [9]

Code No: **RT41023** **R13** **Set No. 2**

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(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 THREE questions from Part-B

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PART–A *(22 Marks)*

1. a) What are the assumptions for deriving the loss coefficients? [3]
   b) What is meant by short term hydrothermal scheduling? [4]
   c) List various constraints considered in unit commitment problem. [4]
   d) What is the principle of tie-line bias control? [3]
   e) What is the difference between load frequency control and economic dispatch control? [4]
   f) List out the advantages of Static VAR compensator. [4]

PART–B *(3x16 = 48 Marks)*

2. a) What is meant by optimal generation allocation? Derive the conditions for optimal allocation of generation among the generators in a thermal plant including transmission losses. [8]
   b) The fuel cost in Rs/h for a three thermal plants are given by

$$F_1 = 350 + 7.2P_{G1} + 0.004P_{G1}^2,$$
$$F_2 = 500 + 7.3P_{G2} + 0.0025P_{G2}^2,$$
$$F_3 = 600 + 6.74P_{G3} + 0.003P_{G3}^2$$

   P_{G1}, P_{G2}, P_{G3} are in MW. Find the optimal schedule and compare the cost of this to the case when generators share load equally if (i) P_D=450 MW (ii) P_D=800 MW. [8]

3. a) Explain hydroelectric power plant model and discuss functions of its components. [8]
   b) Determine the daily water used by hydro plant and daily operating cost of thermal plant with the load connected for total 24 hrs from the given data: The load connected, P_D = 400MW; Generation of thermal plant, P_{GT} = 200MW; Generation of hydro plant, P_{GH} = 300MW. [8]

4. Explain the unit commitment problem solutions by Dynamic programming approach. [16]

5. a) Explain the modelling of steam turbine and hydro turbine. What are the differences between these two modelling? [8]
   b) Draw the block diagram representation of a single area system and deduce expression for static and dynamic response of system under uncontrolled case. [8]

6. Show that the critical gain magnitude of integral controller of a load frequency control system in terms system parameters is given by $K_{i,\,critical} = \frac{f^0}{8H}\left[\frac{1}{R} + B\right]^2$. [16]

7. a) What are the objectives of reactive power compensation in a transmission system? Explain the behaviour of an uncompensated transmission line under load. [7]

   b) A long transmission line has the constants $A = 0.97\angle 1.2^0$, $B = 84\angle 75^0$, find the additional reactive power requirement at receiving end to meet a load of 63 MW at 0.8 p.f. lagging, when both the sending end and receiving end voltages are to be maintained at 132 kV. [9]

Code No: **RT41023** **R13** **Set No. 3**

IV B.Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2018

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 THREE questions from Part-B
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PART–A *(22 Marks)*

1. a) Draw the fuel cost curve and heat rate curve of thermal power plants and give its significance. [4]
   b) Why hydrothermal coordination is required? [3]
   c) Explain the priority list method in the unit commitment problem. [4]
   d) What are the objectives of load frequency Control? [4]
   e) Why Proportional plus Integral control of single area is required? [3]
   f) What are the specifications of load compensator? [4]

PART–B *(3x16 = 48 Marks)*

2. a) Derive the conditions for optimal power allocation between generators in a thermal power plant neglecting losses. Discuss demerits of this method. [8]
   b) The fuel input characteristics for two thermal plants are given by:
   $F_1 = (8P_1 + 0.024P_1^2 + 80) \times 10^6$ KCal/hr; $F_2 = (8P_2 + 0.004P_2^2 + 120) \times 10^6$ KCal/hr
   Where P_1 and P_2 are in MW. Assuming the cost of fuel as Rs. 100/ton, calorific values of fuel at each plant are 4000 K-cal/hr, calculate the incremental production cost characteristic in Rs/MWhr at each plant. [8]

3. Explain the short term hydrothermal economic load scheduling problem by deriving coordination equations with and without including transmission losses. [16]

4. Explain with the aid of suitable example the forward dynamic programming approach to unit commitment problem. Give the flow chart for it. [16]

5. a) Draw the block diagram of load frequency control in two area control system and explain. [8]
   b) A 500 MVA synchronous generator operates on full load at a frequency of 50 Hz. The load is reduced to 400 MW. The steam valve begins to operate with a time lag of 0.5 seconds. Determine the change in frequency if H=5 kW-sec/KVA. [8]

6. a) Explain economic dispatch control problem in detail. [6]
   b) Show that the steady change in frequency in load frequency control of an isolated power can be reduced to zero if the change in controlling force applied to the speed changer is equal to the change in load demand. [10]

7. a) What is load compensation? Discuss its objectives in power system. [7]
   b) A three-phase induction motor delivers 500 hp at an efficiency of 0.91, the operating power factor being 0.76 lagging. A loaded synchronous motor with a power consumption of 100 KW is connected in parallel with the induction motor. Calculate the necessary kVA and the operating power factor of the synchronous motor if the overall power factor is to be unity. [9]

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Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B
*****

PART–A *(22 Marks)*

1. a) What is a penalty factor? What is its importance in optimal operation of generators in thermal power stations? [4]
   b) Name various components of hydroelectric power plant. [4]
   c) What is the need of unit commitment problem in power system? [4]
   d) Write transfer function of speed governor systems and represent in a block diagram. [4]
   e) What is the need of integral control in single area LFC System? [3]
   f) What is the need of reactive power control in power system? [3]

PART–B *(3x16 = 48 Marks)*

2. a) Explain the following terms with reference to thermal power plant:
   (i) Heat rate curve (ii) Fuel cost curve
   (iii) Incremental fuel cost curve (iv) Incremental production cost curve [8]
   b) Three plants of load capacity 425 MW are scheduled for operation to supply a total load of 300 MW. Find the optimum load scheduling if the plants have the following incremental cost characteristics and generation constraints. Neglect the losses.

$$\frac{dC_1}{dP_{G1}} = 30 + 0.15\,P_{G1} \quad \text{Rs/MWh}, \quad 25 \le P_{G1} \le 125$$

$$\frac{dC_2}{dP_{G2}} = 40 + 0.20\,P_{G2} \quad \text{Rs/MWh}, \quad 30 \le P_{G2} \le 100$$

$$\frac{dC_3}{dP_{G3}} = 15 + 0.18\,P_{G3} \quad \text{Rs/MWh}, \quad 50 \le P_{G3} \le 200$$

[8]

3. Explain gradient search method approach to solve short-term hydrothermal scheduling problem. [16]

4. a) Enumerate various steps involved in priority list method. [8]
   b) Solve the following unit commitment problem using priority list method for a system load of 600 MW.

Unit No.	Min	Max	Unit data (MBtu/h)
1	100	500	$500+7\,F_1+0.0015\,F_1 * F_1$
2	110	350	$300+8\,F_2+0.002\,F_2 * F_2$
3	75	225	$100+8\,F_3+0.005\,F_3 * F_3$

[8]

5. a) Obtain the transfer function and block diagram representation of First order turbine and generator models. [8]
   b) Obtain the mathematical modeling of tie line power in an interconnected system and its block diagram. [8]

6. a) Distinguish between load frequency control and economic dispatch control. [7]
   b) Obtain an expression for steady state response of a load frequency controller with integral control. [9]

7. a) Describe the reactive power compensation in transmission systems. [7]
   b) A 3-ϕ feeder having a resistance of 3 Ω and reactance of 10 Ω supplies a load of 2 MW at 0.85 p.f. lag. The receiving end voltage is maintained at 11 kV by means of static condenser drawing 2.1 MVAr from the line. Calculate the sending end voltage and power factor. What is the regulation and efficiency of the feeder? [9]