Code No. M0223 **R07** **Set No.1**

IV B.Tech I Semester Supplementary Examinations, February/March, 2012
POWER SYSTEM OPERATION AND CONTROL
(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. a) What is an incremental fuel cost? How is it used in thermal plant operation? [8]
   b) A power system with two generating units supplying a total load of 110 MW. The incremental fuel cost characteristics of two units are
   $$IC_1 = 15 + 0.08\,P_{G1}$$
   $$IC_2 = 13 + 0.1\,P_{G2}$$
   Determine the saving in fuel cost in Rs/hr due to economic scheduling as compared to equal distribution of the same load between the two units. Neglect the losses. [8]

2. a) Discuss and define the loss formula coefficients. [8]
   b) Discuss the objective of economic scheduling when losses considered. [8]

3. a) 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]
   b) Write the advantages of operation of hydrothermal combinations. [8]

4. a) Derive the transfer function of an excited system and represent in a block diagram. [8]
   b) Derive the model of a speed governing system and represent it by a block diagram. [8]

5. Explain the dynamic response of load frequency control of an isolated power system with a neat block diagram. Draw the plots of change in frequency with respect to time with and without making approximations in the analysis. [16]

6. a) Explain load frequency control problem in a Multi-area power system. [8]
   b) Derive an expression for steady-state change of frequency and tie-line power transfer of a two-area power system. [8]

7. a) Obtain an expression for steady state response of a load frequency controller with integral control. How it is different from without integral control. [10]
   b) Explain about the economic load dispatch control. [6]

8. a) Write short notes on compensated and uncompensated transmission lines [8]
   b) Explain briefly about the shunt and series compensation of transmission systems. [8]

Code No. M0223 **R07** **Set No.2**

IV B.Tech I Semester Supplementary Examinations, February/March, 2012

POWER SYSTEM OPERATION AND CONTROL

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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1. 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) The fuel cost in \$/h for a three thermal plants are given by

   $$F_1 = 350 + 7.2P_{G1} + 0.004P_{G1}^2 \quad \text{Rs/h}$$
   $$F_2 = 500 + 7.3P_{G2} + 0.0025P_{G2}^2 \quad \text{Rs/h}$$
   $$F_3 = 600 + 6.74P_{G3} + 0.003P_{G3}^2 \quad \text{Rs/h}$$

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

2. a) Give various uses of general loss formula and state the assumptions made for calculating B_{mn} coefficients. [8]

   b) Derive the condition for economic scheduling of generators in a plant by considering the losses in the system. Also explain the significance of penalty factor. [8]

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

4. a) Explain the state space model of a synchronous machine. [8]

   b) Derive the transfer function of an excited system and explain. [8]

5. a) Discuss in detail the importance of a load frequency problem. [8]

   b) Find the static frequency drop if the load is suddenly increased by 25 MW on a system having the following data:
   Rated capacity P_r = 500MW,Operating Load P_D = 250MW, Frequency f = 50 Hz,
   Inertia constant H = 5 sec, Governor regulation R = 2Hz /(pu) MW
   Also, find the additional generation. [8]

6. a) Draw the block diagram of load frequency control in two-area control system and explain. [8]
   b) Derive an expression for steady-state change of frequency and tie-line power transfer of a two-area power system. [8]

7. a) Distinguish between load frequency control and economic dispatch control. [7]
   b) Derive the transfer function, $F(s)/P_D(s)$, for a proportional and integral control of a single area system and explain it. [9]

8. a) Describe in detail off load and on load tap changing transformers.
   b) Discuss in detail about the generation and absorption of reactive power in power system components. [8]

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POWER SYSTEM OPERATION AND CONTROL

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Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Derive the condition for economic scheduling of generators in a plant by excluding the losses in the system. [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. [8]

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

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

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

2. a) What is a penalty factor? Explain the significance of penalty factor in optimal scheduling of generators. [8]

   b) The incremental fuel costs in $/MWh for two units are given below:

$$\frac{dF_1}{dP_{G1}} = 0.01P_{G1} + 2.0$$

$$\frac{dF_2}{dP_{G2}} = 0.012P_{G2} + 1.6$$

   The limits on the plants are P_{min}=20 MW, P_{max}=125 MW. Obtain the optimal schedule if the load varies from 50 to 250 MW. [8]

3. a) Explain the hydroelectric power plant model and discuss the functions of its components. [8]

   b) What is hydrothermal scheduling? Obtain the condition for optimal scheduling of hydrothermal plants. [8]

4. a) Derive the transfer function of speed governor model. State the assumptions made. [8]

   b) Derive the generator load model and represent it by a block diagram. [8]

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5. a) Briefly explain the control area concept and control area error [6]
   b) A power system has load of 1250 MW at 50 Hz. If 50 MW load is tripped, find the steady state frequency deviation when (i) there is no speed control (ii) the system has a reserve of 200 MW spread over 500 MW of generation capacity with 5 % regulation on this capacity. All the generators are operating with valves wide open. Due to dead band, only 80 % of governors respond to load change. Assume load damping constant B=1.5. [10]

6. Two areas are connected via an inter tie line. The load at 50 Hz, is 15000 MW In area 1 and 35000 in area 2. Area 1 is importing 1500 MW from area 2. The load damping constant in each area is B=1.0 and the regulation R=6 % for all units. Area 1 has a spinning reserve of 800 MW spread over 4000 MW of generation capacity and area 2 has a spinning reserve of 1000 MW spread over 10000 MW generation. Determine the steady state frequency, generation and load of each area and tie-line power for
   a) Loss of 1000 MW in area2, with no supplementary control.
   b) Loss of 1000 MW in area2, with supplementary controls provided on generators with reserve. [8+8]

7. 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]

8. A 3-Φ overhead line has resistance and reactance per phase of 25Ω and 90Ω respectively. The supply voltage is 145 kV while the load end voltage is maintained at 132 kV for all loads by an automatically controlled synchronous phase modifier. If the kVAr rating of the modifier has the same value for zero loads as for a load of 50 MW, find the rating of the Synchronous Phase modifier. [16]

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POWER SYSTEM OPERATION AND CONTROL

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

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1. a) Explain how the incremental production cost of a thermal power station can be determined. [8]

   b) Explain the various factors to be considered in allocating generation to different power stations for optimum operation. [8]

2. a) Derive general transmission line loss formula and state assumptions made for calculating B- coefficients. [8]

   b) Consider a two bus system as shown in figure 1. The incremental production costs at the two generating station are given by

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

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

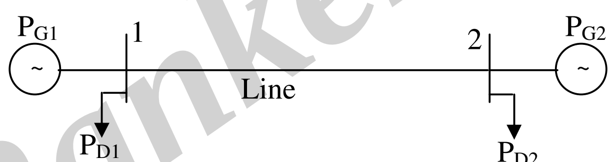

Figure 1.

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

3. Explain the hydro-thermal economic scheduling problem. Derive the necessary equations. [16]

4. a) Derive the model of a speed governing system and represent it by a block diagram. [8]

   b) Briefly explain swing equation with simplified diagram. [8]

5. An isolated generator and its control have the following parameters:
   i). Generator inertia constant=5 second
   ii). Governor time constant τ_g =0.25 seconds
   iii). Turbine time constant τ_T =0.6 seconds
   iv). Governor speed regulation=0.05 p.u
   v). Load damping constant B=0.8

   The turbine rated output is 200 MW at 50 Hz. The load suddenly increases by 50 MW. Find the steady state frequency deviation. Plot the frequency deviation as a function of time. [16]

6. a) Explain how the tie-line power deviation can be incorporated in two-area system block diagram. [8]
   b) What are the features of the dynamic response of a two-area system for step load disturbances? [8]

7. a) Discuss the merits of proportional plus integral load frequency control of a system with a neat block diagram. [8]
   b) Discuss the importance of combined load frequency control and economic dispatch control with a neat block diagram. [8]

8. a) Describe the effects of connecting the series capacitors in transmission system. [8]
   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. [8]