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

**IV B.Tech I Semester Supplementary Examinations, March 2013**
**POWER SYSTEM OPERATION AND CONTROL**
**(Electrical & Electronics Engineering)**

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

**Answer any FIVE Questions**
**All Questions carry equal marks**
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1. Draw flow chart for economic scheduling with out considering line losses. [16]

2. Derive the coordination equations for economic scheduling including the effect of network losses in a purely thermal system and explain the $\lambda$ - iteration method of solving them with the help of flow chart. [16]

3. Determine the daily water used by hydro plant and daily operating cost of thermal plant with the load connected for total 24 hrs and the total load connected is 300MW and generation of thermal plant is 200MW and also generation of hydro plant is 310MW. [16]

4. Two generating stations A and B have full load capacities of 500MW and 210MW respectively. The inter connector connecting the two stations has an induction motor / synchronous generator (plant C) of full load capacity 50 MW near station A percentage changes of speeds of A, B and C are 5,4 and 2.5 respectively. The loads on bus bars A and B are 250MW and 100MW respectively. Determine the load taken by the set C and indicate the direction of power flow. [16]

5. Two generating stations A and B have full load capacities of 200 MW and 75 MW respectively. The inter connector connecting the two stations has an induction motor/synchronous generator (plant C) of full load capacity of 25 MW. Percentage changes in speeds of A, B and C are 5, 4 and 3 respectively. The loads on the bus bars of A and B are 75 MW and 30 MW respectively. Determine the load taken by the set C and indicate the direction in which the energy is flowing. [16]

6. Two interconnected areas 1 and 2 have the capacity of 200MW and 500MW respectively. The incremental regulation and damping torque co-efficient for each area on its own base are 0.2 pu and 0.08 pu respectively. Find the steady state change in system frequency from a nominal frequency of 50 Hz and the change in steady state tie-line power following a 750MW change in load of area 1. [16]

7. For an isolated power system with integral control has the following data:
   Rating of the generator $P_r$=100 MW
   Nominal operating load $P_D$=50 MW
   Inertia constant H=5.0 sec
   Speed regulation of the governor R=2.5 Hz/ pu MW
   If the load would increase 1 pu for 1 % frequency increase and area is controlled by an integral controller, estimate the critical magnitude of the gain when the load is increased by 10 MW. [16]

8. The load at receiving end of a three-phase, over head line is 25.5 MW, power factor 0.8 lagging, at a line voltage of 33 kV. A synchronous compensator is situated at receiving end and the voltage at both the ends of the line is maintained at 33 kV. The line has a resistance of 4.5 ohms per phase and inductive reactance (line to neutral) of 20 ohms per phase. Calculate the maximum value of power that can be transmitted if the thermal rating of the line is not exceeded. Assuming that without compensation, the line was fully loaded, hence the current under the new condition is unchanged. [16]

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

**IV B.Tech I Semester Supplementary Examinations, March 2013**
**POWER SYSTEM OPERATION AND CONTROL**
**(Electrical & 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 power plants: Heat input - power output curve, Heat rate input, Incremental input, Generation cost and Production cost.
   (b) What are the methods of scheduling of generation of steam plants? Explain their merits and demerits? [8+8]

2. 100 MW, 150 MW and 280 MW are the ratings of three units located in a thermal power station. Their respective incremental costs are given by the following equations:
   dc1/dp1 = Rs(0.15p1 + 12);
   dc3/dp3 = Rs(0.21p3 + 13)
   dc2/dp2 = Rs(0.05p2 + 14)
   Where $P_1$, $P_2$ and $P_3$ are the loads in MW. Determine the economical load allocation between the three units, when the total load on the station is 300 MW. [16]

3. In a two plant operation system, the Hydro plant is operate for 12 hrs. during each day and the hydro plant is operate all over the day. The characteristics of the steam and hydro plants are
   $C_T = 0.3\ P_{GT}{}^2 + 20$ PGT + 5 Rs/hr
   $W_H = 0.4 P_{GH}{}^2 + 20$ PGH $m^3$/ sec
   When both plants are running, the power flow from steam plant to load is 300 MW and the total quantity of water is used for the hydro plant operation during 12 hrs is $180 \times 10^6\ m^3$. Determine the generation of hydro plant and cost of water used. [16]

4. An inter connector with inductive reactance of 25 ohms and negligible resistance of two units of generation with voltages are 33KV and 30KV at its ends. The load of 6MW is to be transferred from 33KV to 30KV side of a inter connector determine the power factor of power transmitter and other necessary conditions between two ends. [16]

5. (a) Two generators rated 250 MW and 500 MW are operating in parallel. The droop characteristics of their governors are 4 % and 5 % from no load to full load If the nominal frequency is 50 Hz at no load, how would a load of 750 MW be shared between them? What is the system frequency?
   (b) What is area control error? What are the various control strategies? [8+8]

6. (a) What are the advantages of inter connected operation of power systems? Explain.

   (b) Two areas of a power system network are interconnected by a tie-line, whose capacity is 500 MW, operating at a power angle of $35^0$. If each area has a capacity of 5000 MW and the equal speed regulation of 3 Hz/Pu MW, determine the frequency of oscillation of the power for step change in load. Assume that both areas have the same inertia constants of H = 4 sec. [8+8]

7. Obtain an expression for steady state response of a load frequency controller with integral control. How it is different from with out integral control. [16]

8. What is load compensation? Discuss its objectives in power system. [16]

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Code No: M0223/R07

**Set No. 3**

**IV B.Tech I Semester Supplementary Examinations, March 2013**
**POWER SYSTEM OPERATION AND CONTROL**
**(Electrical & Electronics Engineering)**

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

**Answer any FIVE Questions**
**All Questions carry equal marks**
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1. Two units each of 200 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 50 MW respectively. The incremental fuel characteristics for the two units are given as
$\frac{dC_1}{dP_{G1}} = 15 + 0.08\ P_{G1}$ Rs./ MWhr
$\frac{dC_2}{dP_{G2}} = 13 + 0.1\ P_{G2}$ Rs./ MWhr
If the total load varies between 100 MW and 400 MW, find the incremental fuel cost and allocation of load between two units. [16]

2. The fuel cost functions in Rs./hr. for two thermal plants are given by

$C_1=420+9.2P_1+0.004{P_1}^2,\ 100 \leq P_2 \leq 200$
$C_2=350+8.5P_2+0.0029{P_2}^2,\ 150 \leq P_3 \leq 500$

Where $P_1$, $P_2$, $P_3$ are in MW and plant outputs are subjected to the following limits, Determine the optimal scheduling of generation if the total load is 640.82MW. Estimate value of $\lambda$ = 12Rs. /MWh
$P_{L(pu)} = 0.0346{P_{1(pu)}}^2+0.00643\ {P_{2(pu)}}^2$. [16]

3. In a two plant operation system, the Hydro plant is operate for 12 hrs. during each day and the hydro plant is operate all over the day. The characteristics of the steam and hydro plants are
$C_T = 0.3\ {P_{GT}}^2+20$ PGT + 5 Rs/hr
$W_H = 0.4{P_{GH}}^2+20$ PGH $m^3$/ sec
When both plants are running, the power flow from steam plant to load is 300 MW and the total quantity of water is used for the hydro plant operation during 12 hrs is $180\times10^6\ m^3$. Determine the generation of hydro plant and cost of water used. [16]

4. A 125 MVA turbo alternator operator on full load at 50 Hz. A load of 50 MW is suddenly reduced on the machine. The steam valves to the turbine commence to close after 0.5 sec. due to the time lag in the governor system. Assuming inertia constant H= 6 kW- sec per kVA of generator capacity, calculate the change in frequency that occurs in this time. [16]

5. (a) What are the basic requirements of a load frequency control problem?
   (b) A 500 MVA synchronous generator operates on full load at a frequency of 50 Hz. The load is reduced to 400 MW. The stem valve begins to operate with

a time lag of 0.5 seconds. Determine the change in frequency if H=5 kW-sec per kVA. [8+8]

6. In the block diagram of a two area interconnected system, the system 2 represents a system so large that it is effectively an "infinite bus". The inertia constant $M_2$ is much greater than inertia constant M1 and the frequency deviation in system 2 is zero. The frequency of the tie is 1 pu on a 1000 MW base. Initially, the tie power flow is zero. System 1 has an inertia constant ($M_1$) of 10 on the same base. Load damping and governor action are neglected. Determine the equation for the tie-line power flow swings for a sudden short in area 1 that causes an instantaneous power drop of 0.02 pu (2%), which is restored instantly. Assume that $\Delta P_L$(s)= - 0.02, and find the frequency of oscillation and maximum angular deviation between area 1 and area 2. [16]

7. For an isolated power system with integral control has the following data:
   Rating of the generator $P_r$=100 MW
   Nominal operating load $P_D$=50 MW
   Inertia constant H=5.0 sec
   Speed regulation of the governor R=2.5 Hz/ pu MW
   If the load would increase 1 pu for 1 % frequency increase and area is controlled by an integral controller, estimate the critical magnitude of the gain when the load is increased by 10 MW. [16]

8. What is load compensation? Discuss its objectives in power system. [16]

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**Code No: M0223/R07** **Set No. 4**

**IV B.Tech I Semester Supplementary Examinations, March 2013**
**POWER SYSTEM OPERATION AND CONTROL**
**(Electrical & Electronics Engineering)**

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

**Answer any FIVE Questions**
**All Questions carry equal marks**
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1. Two units each of 200 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 50 MW respectively. The incremental fuel characteristics for the two units are given as
$\frac{dC_1}{dP_{G1}} = 15 + 0.08\ P_{G1}$ Rs./ MWhr
$\frac{dC_2}{dP_{G2}} = 13 + 0.1\ P_{G2}$ Rs./ MWhr
If the total load varies between 100 MW and 400 MW, find the incremental fuel cost and allocation of load between two units. [16]

2. Give algorithm for economic allocation of generation among generators of a thermal system taking into account transmission losses. Give steps for implementing this algorithm and also derive necessary equations. [16]

3. Explain different constraints to be considered for mathematical modeling of hydro thermal scheduling. [16]

4. Two generators rated 200 MW and 400 MW are operating in parallel. The droop characteristics of their governors are 4% and 5% respectively from no load to full load. Assuming that the generators are operating at 50 Hz at no load, how would a load of 600 MW be shared between them? If the load reduces to 400MW how it will be shared among the generators and what will be the system frequency. Assume free governor operation the speed changes of a governor are reset so that the load of 400MW is shared among the generators at 50Hz in the ratio of their ratings. What are the no load frequencies of the generators. [16]

5. (a) Two generators rated 250 MW and 500 MW are operating in parallel. The droop characteristics of their governors are 4 % and 5 % from no load to full load If the nominal frequency is 50 Hz at no load, how would a load of 750 MW be shared between them? What is the system frequency?
   (b) What is area control error? What are the various control strategies? [8+8]

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, with the supplementary control, the steady state frequency, generation and load of each area and tie-line power for the following cases:

(a) Loss of 500 MW generation in area 1, carrying parts of spinning reserve.

(b) Loss of 1500 MW generation in area 1, not carrying spinning reserve.

(c) Tripping of tie-line, assuming no change to inter change schedule of supplementary control.

(d) Tripping of tie-line, and changing schedule of supplementary control to zero. [16]

7. (a) Explain economic dispatch control problem in detail.

   (b) Explain how the frequency error in the load frequency control problem is reduced to zero. [8+8]

8. A regional step-down substation is connected with a power center via a single circuit 110 kV line, 80 km long having a resistance of 28 ohms and reactance of 34 ohms. The maximum rated load (MVA) of the substation is $S_D$=22+j20. The operating conditions of power consumers require that at this load voltage drop across the line should not exceed 6 %. In order to reduce the voltage drop, standard single phase 0.66 kV, 40 kVAR capacitors are to be switched in series in each phase of the line as shown in figure 8. Determine the required number of capacitors, rated voltage and installed capacity of the capacitor bank. Make these calculations disregarding the power loss in the line. [16]

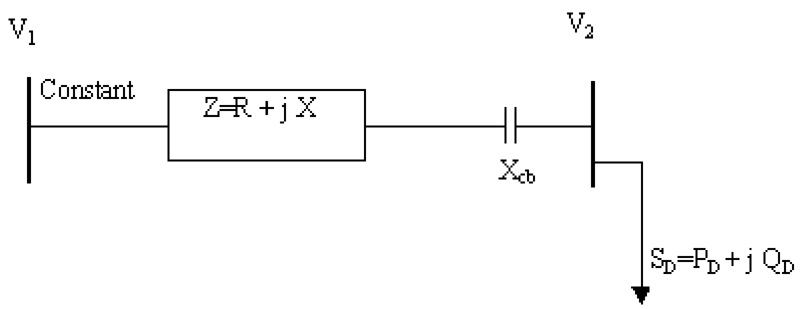


Figure 8

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