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

IV B.Tech I Semester Regular/Supplementary Examinations, March - 2021

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 current distribution factor? [3]
   b) What is the need of optimal scheduling of hydro thermal system? [3]
   c) List out the unit commitment solution methods? [2]
   d) Define the control area. [2]
   e) What is meant by Tie-Line bias control? [2]
   f) List out the objectives of the load compensation. [2]

PART–B *(4x14 = 56 Marks)*

2. a) Draw and explain the input output characteristics of thermal power station? [5]
   b) Consider the following IC curves:
   P_{G1}= -110+55(IC_1)+2(IC_1)^2;
   P_{G2}=-150+65(IC_2)-2.8(IC_2)^2;
   P_{G3}=-90+45(IC_3)-1.2(IC_3)^2.
   The IC's are in Rs./MWh and P_G's are in MW. The total load at a certain hour of the day is 440MW. Neglect transmission losses and do the optimum generation scheduling within the accuracy of ± 0.06MW by taking all P_G's as real and positive? [9]

3. a) Explain in detail about the short term coordination and its economic operation? [7]
   b) A two plant system having a steel plant near the load center and a hydro plant at a remote location. The load is 450MW for 14 hours a day and 400MW for 10 hours a day. The units have the characteristics of C_1=125+45P_{GT}+0.074P^2_{GT} Rs/hr; ω_2= 0.4P_{GH}+0.00281P^2_{GH} m^3/s; The loss coefficient B_{22}= 0.001MW^{-1}. Find the generation schedule, daily water used by the hydro plant and daily operating cost of the thermal plant for γ_j= 80.5 Rs./m^3-hr? [7]

4. a) Compare the unit commitment with the economic load dispatch? [5]
   b) Explain the constraints for plant commitment schedules? [9]

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

5. a) Draw and explain the load verses speed characteristics of speed governor system? [7]
   b) Find the static frequency drop if the load is suddenly increased by 25MW on a system having rated capacity of 450MW, operating load of 200MW, inertia constant of 5s, governor regulation of 2Hz /p.u MW and the frequency of 50Hz. Also find the additional generation? [7]

6. a) Explain the steady state response of two area controlled system. [7]
   b) Two areas of a power system network are inter connected by a tie line, whose capacity is 220MW, operating at a power angle of 45^0. If each area has a capacity of 2200MW and equal speed regulation co efficiency of 3Hz/p.u.MW, find the frequency of oscillation of the power for a step change in load. Assume that both areas have the same inertia constants of H=4s. If a step load change of 110MW occurs in one of the areas, determine the change in the tie line power? [7]

7. a) Discuss how the load balancing is done by using load compensators with necessary equations? [7]
   b) A 3 phase 500HP, 50Hz, 11kV star connected induction motor has a full load efficiency of 75% at lagging power factor of 0.6 and is connected to a feeder. If the power factor of the load is desired to be corrected to 0.85 lagging, find the size of the capacitor bank in KVAr and the capacitance of each unit if the capacitors are connected in delta and in star? [7]

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

IV B.Tech I Semester Regular/Supple Examinations, March - 2021

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 incremental fuel cost and production cost. [3]
   b) What is meant by maximum hydro efficiency method? [3]
   c) What are the advantages of dynamic programming approach? [2]
   d) What is the necessity of keeping frequency constant? [2]
   e) What is the need of LFC and EDC? [2]
   f) What are the specifications of load compensator? [2]

PART–B *(4x14 = 56 Marks)*

2. a) Derive the expression for the penalty factor in optimal allocation with losses? [7]
   b) Incremental fuel costs in Rs/MWh for two units in a plant are given by $(dC_1/dP_1)=0.1\ P_1+20$ and $(dC_2/dP_2)=0.12\ P_2+16$. The minimum and maximum loads on each unit are to be 20 MW and 125 MW respectively. Determine incremental fuel cost and the allocation of load between units for the minimum cost when loads are (i) 100 MW, (ii) 150MW. Assume both the units are operating. [7]

3. a) Obtain the solution of short term hydro-thermal scheduling problem with necessary equations? [7]
   b) A two plant system that has a hydro plant near the load center and a steam plant at a remote location. The load is 380MW for 16 hours a day and 240MW for 8 hours a day. The characteristics of the units are $C_1=155+55P_{GT}+0.7P^2_{GT}$ Rs./hr $\omega_2= 0.6P_{GH}+0.000381P^2_{GH}$ m^3/s; The loss coefficient $B_{22}= 0.001MW^{-1}$. Find the generation schedule, daily water used by the hydro plant and the daily operating cost of thermal plant for $\gamma_j= 70.5$ Rs./m^3-hr? [7]

4. a) What is meant by optimal unit commitment problem? Explain. [7]
   b) Analyze the cost function formulation with necessary equations? [7]

5. a) Obtain the block diagram model of speed-governor system by deriving the equations? [7]
   b) A 500MW generator has a speed regulation of 4.2%. If the frequency drops by 0.14Hz with an un changed reference, find the increase in the turbine power. And also find how much the reference power setting should be changed if the turbine power remains constant? [7]

6. Develop the block diagram of load frequency control of two area system. [14]

7. a) Analyze the voltage and current profiles of an un compensated line without load? [7]
   b) A star connected 420HP, 2200V, 50Hz motor works at power factor of 0.6 lagging. A bank of mesh connected condensers is used to raise the power factor to 0.9 lag. Find the capacitance of each unit and the total number of units required , if each unit is rated 440V, 50Hz, the motor efficiency is 85%? [7]

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

IV B.Tech I Semester Regular/Supplementary Examinations, March - 2021

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 incremental fuel rate curve? [3]
   b) What is the need of reserve capacity maintenance? [3]
   c) What is significance of startup cost in unit commitment problem? [2]
   d) List out the equipment which will be effected by variable frequency? [2]
   e) What is the need of LFC of two area system? [2]
   f) What is meant by natural impedance of the line? [2]

PART–B *(4x14 = 56 Marks)*

2. a) Derive the co-ordination equation of optimal allocation of total load among different units? [7]
   b) A system consists of two plants connected by a tie line and a load is located at plant-2. When 100 MW are transmitted from Plant-1, a loss of 10 MW takes place on the tie line. Determine the generation schedule at both the plants and the power received by the load when λ of the system is 25 Rs/MWh and the incremental fuel costs are given by the equation $(dC_1/dP_1)=0.03\ P_1+17$ Rs/MWh and $(dC_2/dP_2)=0.06\ P_2+19$ Rs/MWh. [7]

3. a) Explain the advantages of combined operation of hydro-thermal plants? [7]
   b) A two plant system has a thermal station near the load center and a hydro station at the remote location. The characteristics of the stations are $C_1= (22+0.048P_{GT})\ P_{GT}$Rs./hr; $W_2= 7.6P_{GH}+0.000481P^2_{GH}$ m^3/s and $\gamma_2=$ Rs. $5*10^{-4}/m^3$, the transmission loss coefficient $B_{22}=0.0022MW^{-1}$. Find the power generation at each station and the power received by the load when λ= 60Rs./MWh? [7]

4. a) Write the algorithm for unit commitment using dynamic programming approach? [7]
   b) Explain the startup cost and shut down cost considerations in unit commitment problem? [7]

5. a) Discuss how an isolated power system is modeled? Draw speed governor and turbine load models? [7]
   b) Two generating stations one and two have full load capacities of 250 and 150MW respectively at a frequency of 50Hz. The two stations are interconnected by an induction motor and synchronous generator set with a full load capacity of 20MW. The speed regulation of station one , station two and the induction motor synchronous generator set are 2%, 4.8% and 2.9% respectively. The loads on the respective bus bars are 70MW and 50MW respectively. Find the load taken by the motor generator set? [7]

6. a) Draw and explain the block diagram of the load frequency control and economic dispatch control of the power system? [7]
   b) Two interconnected area one and area two have the capacity of 1500 and 750MW respectively. The incremental regulation and the damping torque coefficient for each area on its own base are 0.4 p.u and 0.8 p.u respectively. Find the steady state change in the system frequency from the nominal frequency of 50Hz and the change in the steady state tie line power following a 700MW change in the load of area one? [7]

7. a) Derive the expression for the maximum power of the un compensated line under load? [7]
   b) Discuss the need of FACTS controllers in the reactive power control? [7]

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

IV B.Tech I Semester Regular/Supplementary Examinations, March - 2021

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
****

PART–A *(14 Marks)*

1. a) Define heat rate curve and cost curve. [3]
   b) Write the statement of optimization problem of the hydro thermal system? [3]
   c) List out the constraints in unit commitment. [2]
   d) What will happen if the frequency variation is beyond permissible limits? [2]
   e) Draw the block diagram of two area controlled case. [2]
   f) What is meant by an ideal reactive power compensator? [2]

PART–B *(4x14 = 56 Marks)*

2. a) Analyze the economic load dispatch by neglecting the losses? [7]
   b) A constant load of 420MW is supplied by two 220MW generators 1 and 2 for which the fuel cost characteristics are C_1= $0.04P^2_{G1}$+$22P_{G1}$+28 Rs./hr; C_2= $0.08 P^2_{G2}$+$12 P_{G2}$+38 Rs./hr. The real power generations of units P_{G1} and P_{G2} are in MW. Find the most economical load sharing between the generators, the saving in Rs./day there by obtained compared to the equal load sharing between the two generators? [7]

3. a) Obtain the block diagram of hydro electric power plant model. [7]
   b) In a two plant operation system, the hydro plant operates for 6 hours during each day and the steam plant operates throughout the day. The characteristics of the steam and hydro plants are C_T= $0.028P^2_{GT}$+$12P_{GT}$+10 Rs./hr and ω_H=$0.004 P^2_{GH}$+$26 P_{GH}$ m^3/s. When both plants are running, the power flow from the steam plant to the load is 195MW and the total quantity of water used for the hydro plant operation during 6 hours is 210 x $10^6 m^3$. Find the generation of a hydro plant and the cost of the water used by neglecting the transmission losses? [7]

4. a) Explain the spinning reserve and startup cost constraints of the unit commitment problem? [7]
   b) Discuss the advantages and disadvantages of priority list method in solving the unit commitment problem? [7]

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

5. a) Obtain the modeling of steam turbine and generator. [7]
   b) A 120MVA turbo generator on full load operates at 50Hz. A load of 45MW is suddenly reduced on the machine. The steam valves to the turbine commence to close after 0.5s due to the time lag in the governor system. Assuming the inertia to be constant, H=6.2kW-s/kVA of the generator capacity, find the change in the frequency that occurs in this time? [7]

6. a) By drawing the model graphs, explain the frequency deviation, tie-line power change proportional to the step change in the second area? [7]
   b) Two interconnected area one and area two have the capacity of 1500 and 750MW respectively. The damping torque coefficient for each area on its own base is 0.6 p.u. Find the steady state change in the system frequency from the nominal frequency of 50Hz and the change in the steady state tie line power following a 650MW change in the load of area one without governor control action? [7]

7. a) Explain how the voltage regulation is improved by load compensation with necessary equations? [7]
   b) A synchronous motor having a power consumption of 55kW is connected in parallel with a load of 220kW having lagging power factor of 0.6. If the combined load has power factor of 0.85, what is the value of leading reactive kVAr supplied by the motor and at what power factor it is working? [7]