

Code No: **R1942021**

R19

Set No. 1

IV B.Tech II Semester Regular Examinations, April – 2023

POWER SYSTEM OPERATION & CONTROL

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 75

*Answer any FIVE Questions
ONE Question from Each unit
All Questions Carry Equal Marks*

UNIT I

- 1 a) Explain the objectives of optimal operation of generators in the thermal power generating stations? [7]
b) Describe the process of optimum generation allocation by neglecting the line losses? [8]

(OR)

- 2 a) Draw and explain the characteristics between Btu/kWh verses power output of a thermal power station? [7]
b) The fuel cost of two units are given as follows:
 $C_1 = C_1(P_{G1}) = 1.1 + 28P_{G1} + 0.4P_{G1}^2$ Rs./hr
 $C_2 = C_2(P_{G2}) = 1.7 + 38P_{G2} + 0.4P_{G2}^2$ Rs./hr
If the total demand on the generators is 220MW, find the economic load scheduling of the two units? [8]

UNIT II

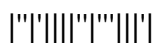
- 3 a) Explain the importance of scheduling of hydro units in the hydro thermal systems? [7]
b) Memorize the thermal unit constraints of unit commitment problem? [8]

(OR)

- 4 a) Explain in detail about the start up cost consideration of unit commitment problem with an example? [7]
b) Describe the priority list scheme of solution for unit commitment problem? [8]

UNIT III

- 5 a) Discuss in detail about the adverse effects with the variation of frequency on the practical power system? [7]
b) Elaborate the incremental power balance of control area with necessary expressions? [8]



(OR)

- 6 a) Derive and explain the mathematical modelling of speed governing system with relevant equations? [7]
b) Obtain and explain the block diagram representation of a generator load model with necessary equations? [8]

UNIT IV

- 7 Analyze the power flow out from control area one of two control areas interconnected through tie line? [15]

(OR)

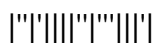
- 8 Describe and analyze the static response of two area system of controlled case with necessary equations? [15]

UNIT V

- 9 a) Memorize and explain the objectives of load compensation? [7]
b) A 3 phase 50Hz, 440V motor develops 120HP, the power factor being 0.6 lagging and efficiency is 92%. A bank of capacitors is connected in delta across the supply terminals and the power factor is raised to 0.97 lagging. Each of the capacitance units is built of four similar 110V capacitors. Find the capacitance of each capacitor? [8]

(OR)

- 10 a) Explain the characteristic features of various compensating equipment for the transmission lines? [7]
b) Analyze the voltage regulation of a load compensated system? [8]



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POWER SYSTEM OPERATION & CONTROL

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 75

*Answer any FIVE Questions
ONE Question from Each unit
All Questions Carry Equal Marks*

UNIT I

- 1 a) Explain the benefits derived from optimal operation of generators in the thermal power generating stations? [7]
b) Describe the process of optimum generation allocation by considering the line losses? [8]
(OR)
- 2 a) Draw and explain the characteristics between Kcal/kWh verses power output of a thermal power station? [7]
b) The fuel cost of two units are given by
 $C_1 = 0.2P_{G1}^2 + 27P_{G1} + 1.5 \text{ Rs./hr}$
 $C_2 = 0.2P_{G2}^2 + 37P_{G2} + 2.5 \text{ Rs./hr}$
If the total demand on the generators is 280MW, find the economical load distribution of the two units? [8]

UNIT II

- 3 a) Describe the objectives and outcomes of optimal scheduling of hydro thermal systems? [7]
b) Write and explain the importance of spinning reserve constraint of unit commitment problem with an example? [8]
(OR)
- 4 a) Explain in detail about the shut down cost consideration of unit commitment problem with an example? [7]
b) Describe the dynamic programming method of solution for unit commitment problem? [8]

UNIT III

- 5 a) Explain in detail why the number of cycles per second will be maintained as constant in the power system? [7]
b) Describe the complete block diagram of an isolated power system? [8]
(OR)



- 6 a) Derive and explain the transfer function modelling of speed governing system with relevant equations? [7]
b) A 120MVA turbo alternator operator on full load operates at 50Hz. A load of 55MW is suddenly reduced on the machine. The steam valves to the turbine commence to close after 0.4s due to the time lag in the governor system. Assuming the inertia to be constant, $H=6.4\text{kW-s}$ per kVA of the generator capacity, find the change in frequency that occurs in this time? [8]

UNIT IV

- 7 Analyze the power flow out from control area two of two control areas interconnected through tie line? [15]
(OR)
8 Describe and analyze the dynamic response of two area system of controlled case with necessary equations? [15]

UNIT V

- 9 a) Memorize and explain in detail about the specifications of load compensating equipment? [7]
b) Analyze the power factor correction with the application load compensation? [8]
(OR)
10 a) Discuss in detail about the advantages and disadvantages of various compensating equipment for the transmission systems? [7]
b) A 3 phase, 50Hz, 3250V motor develops 660HP, the power factor is 0.76 lagging and the efficiency is 93%. A bank of capacitors is connected in delta across the supply terminals and the power factor is raised to 0.9 lagging. Each of the capacitance units is built of five similar 650V capacitors. Find the capacitance of each capacitor? [8]



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Time: 3 hours

Max. Marks: 75

*Answer any FIVE Questions
ONE Question from Each unit
All Questions Carry Equal Marks

UNIT I

- 1 a) Explain the characteristics of thermal power station for optimal operation? [7]
b) Elaborate the general transmission line loss formula and its applications? [8]

(OR)

- 2 a) Derive and explain the importance of cost curve in the economic operation of power system? [7]
b) If two plants having cost characteristics as
 $C_1 = 0.5P_{G1}^2 + 62P_{G1} + 134$ Rs./hr.
 $C_2 = 0.14P_{G2}^2 + 42P_{G2} + 104$ Rs./hr.
They have to meet the load cycle as 0 to 7 hours – 8MW, 19 to 24hrs - 77MW. Find the economic schedule for the different load conditions. If a cost of Rs. 420 is involved in taking either plant out of service or to return to service, find whether it is more economical to keep both plants in service for the whole day or to remove one of them during light load service? [8]

UNIT II

- 3 a) Explain the mathematical formulation of hydro thermal scheduling problem? [7]
b) In a two plant operation system, the hydro plant operates for 9 hours during each day and the steam plant throughout the day. The characteristics of the steam and hydro plants are
 $C_T = 0.028P_{GT}^2 + 17P_{GT} + 14$ Rs./hr.
 $W_H = 0.004P_{GH}^2 + 25P_{GH}$ m³/s.
When both plants are running, the power flow from the steam plant to the load is 185MW and the total quantity of water used for the hydro plant operation during 9 hours is 210×10^6 m³. Determine the generation of a hydro plant and cost of the water used. Neglect the transmission losses? [8]

(OR)



- 4 a) Compare the thermal unit constraints and hydro constraints of unit commitment problem? [7]
b) Elaborate and compare the effectiveness of priority ordering method with dynamic programming solution of unit commitment problem? [8]

UNIT III

- 5 a) Discuss in detail about the load frequency control with respect to the kinetic energy equation? [7]
b) Obtain the block diagram of an isolated power system from governor, turbine and load models? [8]

(OR)

- 6 a) Explain the importance of speed governor setting with speed verses load characteristics? [7]
b) Describe the effect of proportional and integral controller on the single area power system? [8]

UNIT IV

- 7 Derive the relevant equations and analyze the static response of two area uncontrolled system? [15]

(OR)

- 8 Explain in detail about the objectives procedure and outcomes of economic dispatch control? [15]

UNIT V

- 9 a) What is meant by compensated transmission line? Explain with phasor diagram? [7]
b) Memorize the need of FACTS controllers in the transmission networks? [8]

(OR)

- 10 a) Analyze the voltage regulation of an un compensated system? [7]
b) A 35.4kW induction motor has 0.86 power factor and efficiency of 0.88 at full load, 0.5 power factor and efficiency of 0.67 at half load. At no load, the current is 22% of the full load current and power factor is 0.2. Capacitors are supplied to make the line power factor 0.9 at half load. With these capacitors in the circuit, find the line power factor at full load and no load? [8]

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Time: 3 hours

Max. Marks: 75

*Answer any FIVE Questions
ONE Question from Each unit
All Questions Carry Equal Marks

UNIT I

- 1 a) Draw and explain the incremental fuel cost curve of thermal power station? [7]
b) Derive and explain in detail about the role of loss coefficients in the economic operation of power systems? [8]
(OR)
- 2 a) Discuss in detail about the incremental fuel and production costs with examples? [7]
b) A fixed load of 420MW is supplied by two 215MW generators 1 and 2 for which the fuel cost characteristics are given as:
 $C_1 = 0.08P_{G1}^2 + 21P_{G1} + 32.2$ Rs./hr.
 $C_2 = 0.09P_{G2}^2 + 17P_{G2} + 42.2$ Rs./hr.
The real power generations of the 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 two generators? [8]

UNIT II

- 3 a) Obtain and explain the solution of hydro thermal scheduling problem with necessary equations? [7]
b) Discuss in detail about the advantages of operation of hydro thermal combinations? [8]
(OR)
- 4 a) Describe the cost function formulation of unit commitment problem? [7]
b) Write and explain the step by step procedure for unit commitment table by using dynamic programming approach? [8]



UNIT III

- 5 a) Derive the steady state speed regulation of a generator from governor characteristics? [7]
b) Explain the dynamic response single area power system with uncontrolled case? [8]
(OR)
- 6 a) Discuss in detail about the properties and factors to be considered in the selection of control area? [7]
b) Describe the block diagram representation of single area power system with proportional plus integral control? [8]

UNIT IV

- 7 Derive the relevant equations and analyze the dynamic response of two area uncontrolled system? [15]
(OR)
- 8 a) What is meant by tie line bias control? Explain in detail with relevant equations? [7]
b) Two inter connected area 1 and area 2 have the capacity of 2100 and 528MW respectively. The incremental regulation and damping torque coefficient for each area on its own base are 0.3p.u and 0.7p.u respectively. Find the steady state change in the system frequency from a nominal frequency of 50Hz and the change in steady state tie line power following a 770MW change in the load of area 1? [8]

UNIT V

- 9 a) Explain in detail about the effect of load compensation on the voltage regulation? [7]
b) List out and explain about various load compensating devices used in the power systems? [8]
(OR)
- 10 a) What are various FACTS devices used for compensation? Explain their functions? [7]
b) A synchronous motor improves the power factor of a load of 286kW from 0.68 lagging to 0.86 lagging and at the same time carries an additional load of 134kW. Find the leading kVAr supplied by the motor, kVA rating of the motor and the power factor at which the motor operates? [8]