Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 41040

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2024.

Sixth Semester

Electrical and Electronics Engineering

EE 3602 – POWER SYSTEM OPERATION AND CONTROL

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the responsibilities of National Load Dispatching Center.
2. Define load shedding.
3. Draw the block diagram of load frequency control of single area system.
4. State the use of tie lines in power system.
5. List any two devices that generate reactive power and two devices that absorbs reactive power.
6. Expand 'SVC' and 'STATCOM' and state their basic functions.
7. Define incremental fuel cost.
8. State the key difference between short term and long term hydro thermal scheduling problem.
9. State any two significant features of PMU.
10. Mention any four major functions of SCADA in power system.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Illustrate the necessity of voltage and frequency regulation in power systems. (7)

(ii) Explain the power scenario in Indian grid. (6)

Or

(b) A power generating plant has the following daily load cycle:

Time (Hours)	12-5 AM	5-9 AM	9 AM-6 PM	6 AM-10 PM	10 PM-12 Midnight
Load(MW)	40	80	160	195	50

Comment on the load curve and load duration curve. Calculate load factor of the plant, maximum demand and energy supplied by the plant in 24 hours. If the plant as installed capacity 250 MW, calculate the capacity factor and utilization factor.

12. (a) (i) Explain the various components of speed governor system of an alternator. (5)

(ii) Illustrate the dynamic analysis of load frequency control of two area system. (8)

Or

(b) An area without any interconnection has the following data:
Plant capacity 4000 MW,
Frequency = 50 Hz
Operating load= 2500 MW,
Speed regulation constant =2 Hz/puMW.
Inertia constant=5 sec.
2% of change in load takes place for 1 % change in frequency.
Determine the maximum change in step load which may be given for the condition that the steady state frequency is not exceeded by more than 0.2 Hz.

13. (a) (i) Explain brushless AC excitation system with neat diagram. (8)

(ii) Explain the components of AVR loop with neat sketches. (5)

Or

(b) Explain any three methods of reactive power injection and compare them.

14. (a) The fuel cost functions for three thermal plants are

$F_1 = 0.4P_1^2 + 10P_1 + 25$ Rs./h

$F_2 = 0.35P_2^2 + 5P_2 + 20$ Rs./h

$F_3 = 0.475P_3^2 + 15P_3 + 35$ Rs./h

The generation limits of the units are

$30 \text{ MW} \leq P_1 \leq 500 \text{ MW}$

$30 \text{ MW} \leq P_2 \leq 500 \text{ MW}$

$30 \text{ MW} \leq P_3 \leq 250 \text{ MW}$

Determine the economic operation of the plants for the demand of 1000 MW.
If the load is equally shared by all the units, calculate the cost. determine the saving obtained by economic operation.

Or

(b) (i) Explain the structure of unit commitment problem. (5)

(ii) Illustrate the priority list method to solve unit commitment problem using suitable example. (8)

15. (a) (i) Explain the need of computer control of power systems. (5)

(ii) Describe the functions of energy control centers with examples. (8)

Or

(b) (i) Explain the various operating states of a power system, with neat state transition diagram. (8)

(ii) Outline the use of weighted least square estimation in power system. (5)

PART C — (1 × 15 = 15 marks)

16. (a) Two synchronous generators operating in parallel. Their capacities are 300 MW and 400 MW. The droop characteristics of their governors are 4% and 5% from no load to full load. Assuming that the generators are operating at 50 HZ at no load, how would be a load of 600 MW shared between them. Calculate the system frequency at this load. Assume free governor action if their droop characteristics are interchanged, comment on the effect on sharing.

Or

(b) The incremental production cost data of two plants are as follows

$$\frac{dF_1}{dP_1} = 2 + P_1$$

$$\frac{dF_2}{dP_2} = 1.5 + P_2$$

Where P_1 and P_2 are power generated in each plant and are expressed in per unit on 100 MVA base. Assume that both the units are in operation and the generation limits of both the units are 100 MW maximum and 10 MW minimum. The loss coefficients on a 100 MVA base are given by the following:

$$B = \begin{bmatrix} 0.1 & -0.05 \\ -0.05 & 0.2 \end{bmatrix}$$

For $\lambda = 2.5$, solve the coordination equations by the iterative method. Comment on the solution obtained.