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Question Paper Code : 81291

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

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 — ($10 \times 2 = 20$ marks)

1. Differentiate load curve and load duration curve.
2. Compare the load shedding and Islanding.
3. What do you understand by load frequency control?
4. Why are economic dispatch recommended?
5. How voltage and reactive power inter related?
6. Draw the V-I characteristics of the SVC.
7. Differentiate minimum up and minimum down time in unit commitment problem.
8. List the few constraints that are accounted in unit commitment problem.
9. What are the hierarchical levels used in EMS?
10. In what way PMU system monitoring is useful?

PART B — ($5 \times 13 = 65$ marks)

11. (a) (i) Analyze the need for voltage and frequency regulation in power system. (5)
(ii) A generating station has maximum demand of 400 MW. The annual load factor is 65% and capacity factor is 50%, analyse the reserve capacity of the plant. (8)

Or

- (b) Discuss the computational methods in load forecasting and explain in detail about quadratic fitting techniques of load forecasting.

12. (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.

Or

- (b) Examine the tie line with frequency bias control and deduce state variable model for two area system.
13. (a) With a neat block diagram representation, discuss static and dynamic analysis of AVR loop.

Or

- (b) A 415 kV line is fed through an 132/415 kV transformer from a constant 132 KV supply. At the load end of the line, the voltage is reduced by another transformer of ratio 415/132 kV. The total impedance of line is $40 + j 80$ ohms, both transformers are equipped with tap changing; the product of the two off nominal setting is unity. If the load on the system is 200 MW at 0.8 p.f lagging. Calculate the settings of the tap changers required to maintain the voltage at 132 KV.
14. (a) The fuel inputs per hour of plants 1 and 2 are given as

$$F_1 = 0.2 P_1^2 + 40 P_1 + 120 \text{ Rs/hr}$$

$$F_2 = 0.25 P_2^2 + 30 P_2 + 150 \text{ Rs/hr}$$

Calculate the economic operating schedule and the corresponding cost of generation. The maximum and the minimum loading on each unit are 100 MW and 25 MW. Assume the transmission losses are ignored and the total demand is 180 MW. Also determine the saving obtained if the load is equally shared by both the units.

Or

- (b) Obtain the priority list of unit commitment using full load average production cost for the given data for the load level of 900 MW

$$F_1 = 392.7 + 5.544 P_1 + 0.001093 P_1^2$$

$$F_2 = 217 + 5.495 P_2 + 0.001358 P_2^2$$

$$F_3 = 65.5 + 6.695 P_3 + 0.004049 P_3^2$$

P_1, P_2, P_3 are in MW

Generation limit are: $150 \leq P_1 \leq 600$ MW; $100 \leq P_2 \leq 400$ MW.

Obtain the optimum unit commitment table.

15. (a) Summarize the hardware configurations of EMS and explain the various functions of energy control centre.

Or

- (b) (i) Draw a state transition diagram of a power system showing different sets of operating states classified according to security level. (5)
- (ii) Explain the state transition that may occur due to system disturbances and the different control action that can be taken to improve the security level of the system. (8)

PART C — (1 × 15 = 15 marks)

16. (a) Four units to be committed to serve 1 hr load pattern as given in table 1 and 2. Find the optimum unit commitment. Use forward dynamic programming method. Fuel cost of each unit is 2.15 Rs/MBtu. (15)

Table 1

Unit	Max (MW)	Min (MW)	Inc. Heat rate (Btu/K wh)	No load cost Rs/h	Start up cost Rs	Inc. cost Rs/Mwh
1	80	25	10440	213	350	20.88
2	250	60	9000	585.62	400	18
3	300	75	8730	684.74	—	17.46
4	60	20	11900	252	0	23.8

Table 2

Period	1	2
Load (MW)	450	600

Or

- (b) The load at the receiving end of a 3 phase OHL is 25 MW at 0.8 p.f lag at a line voltage of 33kV. The line has a resistance 5 ohm per phase and an inductive reactance at 20 ohm per phase, Calculate the sending end voltage. (15)

A synchronous compensator connected at the receiving end and the voltage at both end of the line is maintained at 33 kV. Calculate

- (i) The MVAR of the compensator
- (ii) Transmission losses and efficiency with and without compensator and
- (iii) The maximum load that can be transmitted with the compensator.

