EE-703A

POWER SYSTEM -III

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. $10 \times 1 = 10$

(i) A synchronous condenser is a/an

(A) d.c. generator (B) induction motor
(C) overexcited synchronous motor (D) underexcited

(ii) Which statement is true

(A) peak diversity factor and group diversity factor are always equal
(B) peak diversity factor always less than group diversity factor
(C) peak diversity factor cannot be less than group diversity factor
(D) peak diversity factor may be more or less than group diversity factor

(iii) The units of speed regulation of governor are

(A) Hz (B) Hz per MVA
(C) Hz per MW (D) none of these

(iv) The reactive power transfer over a line mainly depends on

(A) power angle (B) sending end voltage V_S
(C) receiving end voltage V_R (D) $|V_S| - |V_R|$

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(v) When a long transmission line is supplying peak load

(A) shunt capacitance and charging current predominate
(B) the inductance of the line results in substantial voltage drop
(C) the resistance of the line causes large voltage drop
(D) voltage regulation may be negative

(vi) The reflection coefficient for the voltage wave in overhead transmission lines is given as

(A) $\frac{R_0}{R_0 - R_L}$ (B) $\frac{R_L}{R_0 - R_L}$ (C) $\frac{R_L - R_0}{R_L + R_0}$ (D) $\frac{R_L + R_0}{R_0 - R_L}$

(vii) Dynamic response in a two-area system may be represented by a _____ order Transfer Function.

(A) first (B) second (C) third (D) none of these

(viii) Statistically which type of cloud causes more stroke?

(A) negatively charged (B) positively charged
(C) both equal (D) unpredictable

(ix) The state variables in Power System are

(A) voltage and current (B) voltage and phase angle
(C) current and phase angle (D) reactive power and active power

(x) The optimal scheduling problem in the case of a thermal power plant is

(A) static optimization problem
(B) dynamic optimization problem
(C) static as well as dynamic optimization problem
(D) none of these

(xi) In the ALFC loop, incremental frequency can be reduced using _____ controller.

(A) differential (B) integral (C) proportional (D) all of these

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. What do you mean by distributed and dispersed generation? What are reasons for growing interest worldwide on these types of generation? 5

3. A power system has two synchronous generators. The governor-turbine characteristics corresponding to the generators are $P1 = 50(50 - f)$, $P2 = 100(51 - f)$ where f denotes the system frequency in Hz, and $P1$ and $P2$ are respectively the power outputs (in MW) of turbines 1 and 2. Assuming the generators and transmission network to be lossless, the system frequency for a total load of 400 MW is
(a) 47.5 Hz (b) 48.0 Hz (c) 48.5 Hz (d) 49.0 Hz. 5

4. Explain reflection coefficient, surge impedance and surge impedance loading. 5

5. Explain Bewley's Lattice Diagram. 5

6. What are the advantages of series compensation? What are the problems associated with series capacitors? 5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) Obtain the economic operation schedule for the three thermal units delivering a total load of 750 MW without considering generator limit and network losses. The given data for the units are as under: 8+7

Unit 1 : $P_{max} = 600$ MW, $P_{min} = 150$ MW
$F1(P1) = 570 + 7.5\ P_1 + 0.0017\ P_1^2$ Rs/hr.
Unit 2 : $P_{max} = 500$ MW, $P_{min} = 125$ MW
$F_2(P_2) = 380 + 7.8\ P_2 + 0.002\ P_2^2$ Rs/hr.
Unit 3 : $P_{max} = 600$ MW, $P_{min} = 150$ MW
$F_3(P_3) = 200 + 7.9\ P_3 + 0.005\ P_3^2$ Rs/hr.

(b) What do you mean by (i) penalty factor and (ii) incremental transmission loss. Explain.

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8. (a) What is a series capacitor compensation? What are the relative advantages and disadvantages of series compensation and shunt compensation.
(b) Show that a line where both series compensation and shunt compensation are present will have the following expression for the SIL value:

$$\text{SIL} = \text{SIL without compensation} \times \sqrt{\frac{1 - K_{sh}}{1 - K_{se}}},$$

where X_{sh} and X_{se} are the respective degree of shunt and series compensation

9. (a) Explain the necessity of keeping frequency constant in power system. 4
(b) Explain why supplementary control is slower than governor control.
(c) What is Tie-line? Derive a model for the representation of Tie-line for frequency control analysis for two-area.

10.(a) What is basic impulse level? Derive the expression for reflection and refraction co-efferent for voltage and current travelling wave.
(b) A 220 kV transmission line has a surge impedance 350 Ω. The line terminal at 50 MVA, 220/66 kV transformer may be represented by a lumped inductance of 20 H and a capacitance of 0.004 μF in parallel. A rectangular surge 1500 kV travels along the line towards the transformer. Calculate the transmitted voltage into transformer.
(c) What is a surge arrester?

11.(a) Derive expression for the current and voltage surges travelling on transmission lines when a short circuit is encountered at the receiving end.
(b) A 220 kV transmission line has a surge impedance of 350 ohm. The line terminates at 50 MVA, 220/66 kV transformer which may be represented by a lumped inductance of 20 H and a capacitance of 0.004 microfarad in parallel. A rectangular surge of 1500 kV travels along the line towards the transformer. Calculate the transmitted voltage into the transformer.
(c) What is surge arrester?

12. Write short notes on any *three* of the following:
(a) FACTS and FACTS controllers
(b) Spinning Reserve
(c) Exciter and its role in AVR loop of the alternator
(d) Gapless Surge Arrester
(e) Hydrothermal Scheduling.