CS/B.TECH(EE-NEW)/SEM-7/EE-703A/2013-14

2013

POWER SYSTEM - III

Time Allotted : 3 Hours | *Full Marks* : 70

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. Choose the correct alternatives for the following : $10 \times 1 = 10$

i) The capacitance and inductance per unit length of a line operating at 110 kV are 0·1 μF and 2 mH respectively. The surge impedance of the line is

a) 40 MVA b) 30 MVA

c) 25 MVA d) None of these.

ii) For a long uncompensated line, the limit to the line loading is governed by

a) thermal limit b) voltage drop

c) stability limit d) corona loss.

iii) The state variables in a power system are

a) voltage and current

b) voltage and phase angle

c) current and phase angle

d) reactive power and active power.

iv) Ferranti effect occurs in transmission line when the line is

a) short and loaded b) long and loaded

c) long and unloaded d) none of these.

v) Load frequency control is achieved by properly matching the individual machine's

a) reactive power

b) generated power

c) turbine input

d) turbine and generator relays.

vi) The coefficient of reflection for current for an open ended line is

a) 1·0 b) 0·5

c) – 1·0 d) 0.

vii) Unit of regulation for AGC is

a) MW/Hz b) unitless

c) Hz/MW d) r.p.s.

viii) A valve type lightning arrestor in a substation should be placed

a) close to the circuit breaker

b) away from the circuit breaker

c) close to the transformer

d) away from the transformer.

ix) A synchronous condenser is

a) a d.c. generator

b) an induction motor

c) an overexcited synchronous motor

d) an underexcited synchronous motor.

x) The propagation constant is given by

a) $\gamma = \sqrt{Z/Y}$ b) $\gamma = \sqrt{(ZY)}$

c) $\gamma = \sqrt{(Z+Y)}$ d) $\gamma = \sqrt{(Z-Y)}$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. a) What do you mean by 1·2/50 μs lightning surge ? 2

b) How is the rating of surge arrestor determined for each phase in a 3-phase 220 kV system ? 3

3. A power system has two synchronous generators. The governor-turbine characteristics corresponding to the generators are $P_1 = 50\,(50 - f)$, $P_2 = 100\,(51 - f)$, where f denotes the system frequency in Hz and P_1, P_2 are respectively, the power outputs (in MW) of turbines 1 and 2. Assuming the generation and transmission network to be lossless, calculate the system frequency for a total load of 400 MW.

4. State the advantages of static VAR compensation systems over the other methods of voltage control.

5. Specify and explain the types of generating stations which may be used to supply peak load.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

6. a) Derive the expression for the reactive power output of a synchronous generator. Show that voltage regulation in transmission line mainly depends on reactive power. 4 + 5

b) An inductive load draws power of ($2 + jL$) MVA at a receiving end bus of a radial three phase line. The receiving end bus voltage is 11 kV (*L-L*) at 50 Hz. the system reactance is 0·5 Ω/phase. Calculate

i) the receiving end current

ii) the regulation

iii) the sending end voltage.

Assume the system to be lossless. 6

7. a) Explain AGC in two-area system and formulate the expression of steady state frequency deviation for a certain load change in area - 1. 10

b) Derive the condition for economic operation of multi-generator system considering network losses. 5

8. a) A two-area power system has the following characteristics :

Area 1	Area 2
R_1 = 0·01 pU	R_2 = 0·02 pU
D_1 = 0·8 pU	D_2 = 1·0 pU
Base MVA = 500	Base MVA = 500

There is a tie flow between the areas. If these is a load change of 100 MW in Area 1, what is the new steady state frequency and change in tie flow. Assume nominal frequency of 50 Hz. Draw the frequency response to load change with or without AGC. 7

b) An isolated power system runs with a 600 MVA generating unit having angular momentum of 7·6 pU MW/pU frequency/second. The unit supplies a load of 400 MVA. The change in load is 2% for a 1% change in frequency. Determine the frequency response of change in frequency with reference to a 1000 MVA base for a step increase in load of 10 MVA. 8

9. a) Derive the expressions for the reflection and refraction co-efficients for voltage and current travelling waves. 5

b) A surge of 100 kV travelling in a line of natural impedance 600 ohms arrives at a junction with two lines of surge impedances 800 ohms and 200 ohms respectively. Determine the surge voltages and currents transmitted into each branch line. 5

c) Explain the different components of a turbine speed governor with the help of a neat sketch. 5

10. Write short notes on any *three* of the following : 3 × 5

a) Unit commitment

b) Spinning reserve

c) Bewley's lattice diagram

d) FACTS and FACTS controllers.