Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (EE-NEW)/SEM-7/EE-702/2010-11

2010-11
POWER SYSTEMS – 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 any *ten* of the following : $10 \times 1 = 10$

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

   a) 40 MVA b) 30 MVA

   c) 27 MVA d) None of these.

   ii) A synchronous condenser is a/an

   a) *d.c.* generator

   b) induction motor

   c) overexcited synchronous motor

   d) underexcited synchronous motor.

iii) If P_m is the maximum power transferred, the loss of the system is

a) $P_m/4$ b) $P_m/2$

c) $3P_m/4$ d) none of these.

iv) TCSC is a

a) shunt controller

b) series controller

c) combination of (a) & (b)

d) none of these.

v) Series compensation in transmission lines

a) increases stability limit

b) decreases stability limit

c) has no effect on stability limit

d) none of these.

vi) The propagation constant is given by

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

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

vii) A generating unit has an incremental production cost of Rs. 60 per MWh. If the penalty factor for this unit is 1·2, the incremental cost of power delivered is

a) Rs. 50 per MWh

b) Rs. 72 per MWh

c) Rs. 61·20 per MWh

d) Rs. 48 per MWh.

viii) An uncompensated transmission line on open circuit leads to

a) Ferranti effect

b) Line-charging current flowing into generators is more

c) Both (a) & (b)

d) None of these.

ix) In a two plant system, the load is connected to plant no. 2. The loss coefficients

a) B_{11}, B_{12}, B_{22} are non-zero

b) B_{11} is non-zero but B_{12} and B_{22} are zero

c) B_{11} and B_{12} are non-zero but B_{22} is zero

d) B_{11} and B_{22} are non-zero but B_{12} is zero.

x) Load compensation is used to improve

a) voltage profile and power factor

b) voltage profile and reactive power

c) reactive power and power factor

d) none of these.

xi) Lightning arrester should be located

a) near the circuit breaker

b) away from the circuit breaker

c) near the transformer

d) away from the transformer.

xii) Steady state stability of the power system is improved by

a) reducing fault clearing line

b) using double circuit line instead of single circuited line

c) single pole switching

d) decreasing generation inertia.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Explain reflection coefficient, surge impedance and surge impedance loading.

3. Explain why series compensation leads to improvement in system stability. Compare the performances of series and shunt capacitors in a power system.

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

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

5. How do you model the tie-line power flow in a two area system using analytical technique ?

6. Explain the phenomena of lightning and the travelling waves caused by it on transmission lines.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Describe the solution methodology of economic load despatch with transmission loss. What are penalty factor and incremental transmission loss ? 8

b) Determine economic operating point for the following three units when delivering a load of 850 MW : 7

Unit 1 : Coal fired steam unit :

$P_{1max} = 600$ MW, $P_{1min} = 150$ MW

Input-output curve :

$H_1 = 510 + 7 \cdot 2 P_1 + 0 \cdot 00142 P_1^2$ MBtu/hr

Unit 2 : Oil fired steam unit :

$P_{2max} = 400$ MW, $P_{2min} = 100$ MW

Input-output curve :

$H_2 = 310 + 7 \cdot 85 P_2 + 0 \cdot 00194 P_2^2$ MBtu/hr

Unit 3 : Oil fired steam unit :

$P_{3max} = 200$ MW, $P_{3min} = 50$ MW

Input-output curve :

$H_3 = 78 + 7 \cdot 97 P_3 + 0 \cdot 00482 P_3^2$ MBtu/hr

Cost of coal : 1·1 $/MBtu

Cost of oil : 1·0 $/MBtu

8. a) What is basic impulse level ? Derive the expression for reflection and refraction co-efficients for voltage and current travelling waves. 8

b) The line is open circuited with a receiving end voltage of 220 kV. Find the rms value and phase angle of the following :

i) The incident and reflected voltages to neutral at the receiving end.

ii) The incident and reflected voltages to neutral at 200 km from the receiving end.

$\alpha = 0 \cdot 163 \times 10^{-3}$, $\beta = 1 \cdot 068 \times 10^{-3}$ 7

9. a) What is the significance of reactive power in power system ? Prove that voltage regulation in a transmission line mainly depends on reactive power. 2 + 5

b) An inductive load draws power of (2 + j1) MVA at a receiving end bus of a radial three phase line. The receiving end bus voltage is 11 kV at 50 Hz and the system reactance is 0·5 Ω/phase. Calculate

i) the receiving end current

ii) voltage regulation

iii) the sending end voltage and

iv) the short capacity of the system.

Assume the system to be lossless. 8

10. What is FACTS ? What are FACTS controllers ? Classify the FACTS controllers. What is STATCOM ? Why is STATCOM used in load flow ? 3 + 3 + 3 + 3 + 3

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

a) Spinning reserve

b) Exciter and its role in AVR loop of the alternator

c) Bewly's Lattice diagram

d) Gapless surge arrester

e) Hydrothermal scheduling.