



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH (EE)/SEP.SUPPLE/SEM-7/EE-702/2012

2012

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 any *ten* of the following :

10 × 1 = 10

i) The capacity factor of a plant is equal to

- | | |
|--|--|
| a) $\frac{\text{maximum load}}{\text{average load}}$ | b) $\frac{\text{average load}}{\text{maximum load}}$ |
| c) $\frac{\text{maximum load}}{\text{plant capacity}}$ | d) $\frac{\text{average load}}{\text{plant capacity}}$ |

ii) If α is the angle of voltage wave at which an R - L circuit is switched on and θ is the impedance angle of the R - L circuit, there will be no transient when the circuit is switched on, if

- | | |
|---------------------------------|---------------------------------|
| a) $\alpha = 0$ | b) $\alpha = 90^\circ - \theta$ |
| c) $\alpha = 90^\circ + \theta$ | d) none of these. |



- iii) A synchronous condenser is a/an
- a) *dc* shunt generator
 - b) induction motor
 - c) overexcited synchronous motor
 - d) underexcited synchronous motor.
- iv) 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.
- v) Two neighbouring power system networks having different frequencies may be interconnected through
- a) 800 kV HDVC link
 - b) 400 kV AC link
 - c) 765 kV AC link
 - d) 1200 kV AC link.
- vi) The unit of Lagrange Multiplier λ used in economic dispatch solution is
- a) Rs/hr
 - b) Rs/MW
 - c) Rs/MWh
 - d) none of these.



- vii) Insulation level of line conductor depends on
- a) corona
 - b) switching surge
 - c) lightning
 - d) none of these.
- viii) Penalty factor in economic operation of power system is to be considered when
- a) generation losses are considered
 - b) turbine losses are considered
 - c) transmission losses are considered
 - d) none of these.
- ix) Which of the following VAR compensators can be used for both heavy and light load conditions ?
- a) SVC
 - b) Shunt reactor
 - c) Shunt capacitor
 - d) Series capacitor.
- x) Tie-line bias control is used to
- a) minimize steady state frequency deviation only
 - b) minimize steady state tie-line deviation only
 - c) minimize both steady state frequency and tie-line deviation
 - d) increase power exchange capacity through tie-line.



xi) If the penalty factor of a generating plant is unity its incremental transmission loss is

- | | |
|--------|----------|
| a) 1.0 | b) - 1.0 |
| c) 0.0 | d) 0.5. |

xii) Phase constant of a line is given by

- | | |
|--------------------------------|----------------------------------|
| a) $\omega \sqrt{\frac{L}{C}}$ | b) ωLC |
| c) $\omega \sqrt{LC}$ | d) $\omega \sqrt{\frac{C}{L}}$. |

xiii) Reflection coefficient of a transmission line having characteristic impedance of 300 ohm terminated to a load of impedance 300 ohm is

- | | |
|-------|---------|
| a) +1 | b) - 1 |
| c) 0 | d) 0.5. |

xiv) Ground wire is used for protection of overhead lines against

- | | |
|------------------------|------------------------|
| a) switching surge | b) lightning |
| c) short-circuit fault | d) open-circuit fault. |



GROUP – B

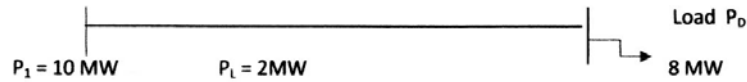
(Short Answer Type Questions)

Answer any *three* of the following.

3 × 5 = 15

2. a) What do you understand by Heat Rate Curve ?
- b) Determine the incremental cost of received power and the penalty factor of the plant shown in figure below, if the incremental cost of production is given by

$$\frac{dF_1}{dP_1} = 0.1P_1 + \frac{\text{Rs } 3.0}{\text{MWhr}}$$



2 + 3

3. a) What are the conditions for free governor operation in a power generating plant ?
- b) The combined frequency regulation of machines in area of capacity 1500 MW and operating at a nominal frequency of 60 Hz is 0.1 p.u. on its own base capacity. Find the regulation in Hz/MW.
4. Specify a surge wave. What are the different causes of over voltage in transmission lines ?
5. Compare shunt and series compensation of transmission lines.

2 + 3

2 + 3

**GROUP – C****(Long Answer Type Questions)**

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

6. What do you mean by FACTS ? What are its advantages ? Briefly describe different series and shunt connected FACTS controllers for power system. Explain how SVC controls the voltage of a power system bus to which it is connected.

$2 + 2 + 6 + 5$

7. a) What do you mean by 'unit commitment' and 'load scheduling' ?
 b) For a plant consisting of two units, the incremental fuel cost in Rs/MWh are

$$\frac{dC_1}{dP_{G_1}} = 0.2P_{G_1} + 40, \quad \frac{dC_2}{dP_{G_2}} = 0.25P_{G_2} + 30$$

Assume that both the units are operating all the times and total load varies from 40 MW to 250 MW. The maximum and minimum loads on each unit are 125 MW and 20 MW. Find the saving in fuel cost in Rs/hour for the optimal scheduling of a total load of 130 MW as compared to equal distribution of the same load between the two units.

$5 + 10$

8. a) Formulate the generator-load model giving relation between the change in frequency as a result of change in generation, when the load changes by a small amount. Hence draw the block diagram representing load frequency control of an isolated power system.



- b) For an isolated single area power system consider the following data :

Area Capacity = 1000 MW

Nominal Operating Load = 500 MW

Inertia Constant = 5 seconds

Regulation = 5% = 2.5 Hz/pu MW

Nominal Frequency = 50 Hz

Load decreases by 1% for decrease in frequency by 1%.

- i) Find the gain and time constant of the power system representing with a first order transfer function.
- ii) If it is an uncontrolled area, find out the change in frequency due to an increase of load by 75 MW.

$$(6 + 2) + (4 + 3)$$

9. a) Explain briefly how a power system is protected against surges. Also explain Bewley Lattice diagram for the calculation of overvoltage at any point.
 - b) A transmission line of 500 ohms surge impedance is connected to a cable of 60 ohms surge impedance at the other end. If a surge of 500 KW travels along the line to the junction point, find the voltage built-up at the junction.
- $$(5 + 5) + 5$$
10. Write short notes on any *three* of the following : $3 \times 5 = 15$
 - a) Restructuring and Deregulation in electrical power system
 - b) Pumped Storage plant
 - c) AVR with modern excitation system of the alternator
 - d) Short-term hydrothermal scheduling
 - e) Lightning arrester.

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