

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech(EE/OLD)/SEM-6/EE-602/2013

2013

POWER SYSTEMS - II

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 positive sequence component of voltage at the point of fault becomes zero when it is a

- a) three phase fault
- b) line to line fault
- c) LLG fault
- d) line to ground fault.

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- ii) A distance relay is said to be inherently directional if its characteristic on R-X diagram
 - a) is a straight line off-set from the origin
 - b) is a circle that passes through the origin
 - c) is a circle that encloses the origin
 - d) always a separate directional relay is required.
- iii) A Buchholz relay is actuated by
 - a) oil
 - b) gas
 - c) current
 - d) none of these.
- iv) In load flow study Z_{BUS} matrix is a
 - a) null matrix
 - b) sparse matrix
 - c) full matrix
 - d) unity matrix.
- v) For transient stability analysis, as long as equal area criterion is satisfied, the maximum angle to which rotor can oscillate is
 - a) 90°
 - b) 45°
 - c) greater than 90°
 - d) less than 90° .

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- vi) Nuclear power station is normally used for
- a) peak load
 - b) base load
 - c) average load
 - d) any load.
- vii) At slack bus, which one of the following combinations of variables is specified ?
- a) $|V|, \delta$
 - b) P, Q
 - c) $P, |V|$
 - d) $Q, |V|$
- viii) Zero sequence currents can flow from a line into a transformer bank if the windings are in
- a) grounded star-delta
 - b) delta-star
 - c) star-grounded star
 - d) delta-delta.

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- ix) For a turbo alternator of 100 MVA, the inertia constant is 5. The value of H for an alternator of 50 MVA is
- a) 8
 - b) 12
 - c) 10
 - d) 15.
- x) A large size synchronous generator is protected against overloads by
- a) over-current relay
 - b) MHO relay
 - c) temperature sensitive relay
 - d) Buchholz relay.

GROUP - B

(Short Answer Type Questions)

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

2. Discuss rotor dynamics and swing equation as applied to the synchronous machines used in a power system.
3. Differentiate between cross blast and axial blast technology in air blast circuit breakers.
4. Explain the equal area criteria of testing transient stability.

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5. Explain the function of a "surge tank" in Hydro-electric power plant.
6. What are the positive, negative and zero sequence components of current/voltage and what are the relations between them ?
7. Write a short note on Buchholz relay.
8. What is 'accelerating factor' ? Why is it used in load flow studies ? 2 + 3
9. What are the factors to be considered for site selection of
 - a) Thermal power plant
 - b) Hydroelectric power plant ? $2 \times 2 \frac{1}{2}$

GROUP - C

(Long Answer Type Questions)

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

10. a) Explain clearly the basic principle of operation of a differential relay, What is meant by per cent bias ? How is this achieved in practice in differential relay ?2 + 2 + 2

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- b) Determine the time of operation of a relay of rating 5A and having a relay setting of 125%, TMS = 0.6. It is connected to a supply circuit through a CT 400/5 ratio. The fault current is 4000 A.

PSM are :	2	4	5	8	10	20
Operating time (sec) :	10	5	4	3	2.8	2.4

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11. Distinguish between voltage control bus and swing bus. What do you mean by Jacobian Matrix ? Discuss the NR method of solving SLFE and develop the corresponding flow chart.

4 + 3 + 3 + 5

12. a) What are the principal types of transient disturbances on a power system ? Explain how a sudden change in mechanical input could cause transient instability ?

2 + 5

- b) A generator is connected to a constant voltage bus through an external reactance of 0.3 per unit. The synchronous reactance of the generator is 0.2 per unit and the voltage magnitude of the constant voltage bus is 1.0 per unit with its angle being 0° . The generator delivers 0.9 per unit power to the constant voltage bus when the angle of its terminal voltage is 15° . A circuit breaker opens the generator due to fault from the infinite bus when the system is operating with $P_m = P_e = 0.9$ per unit. Calculate critical clearing angle and internal voltage of generator.

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13. a) Draw a schematic diagram of Nuclear power plant showing all the major components. 7
- b) Explain the working principle of Hydro-electric power plant describing all the major components. 8
14. a) What do you mean by symmetrical and unsymmetrical faults in a 3-phase power system ? 7
- b) The line currents in a three phase power system are $I_a = 10 \angle 90^\circ$, $I_b = 10 \angle -90^\circ$ and $I_c = 10 \angle 0^\circ$.
Determine the symmetrical components of the line current. 8
15. Write short notes on any *three* of the following : 3 × 5
- a) Boiling water reactor
 - b) Non-conventional energy sources
 - c) MHO relay
 - d) Voltage controlled bus
 - e) Analysis of coal.

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