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**COLLEGE OF ENGINEERING GUINDY, ANNA UNIVERSITY CHENNAI::25**  
**B.E. (FULL TIME) DEGREE END SEMESTER EXAMINATIONS, NOV/DEC. 2011**  
**ELECTRICAL AND ELECTRONICS ENGINEERING BRANCH**  
**FIFTH SEMESTER – (REGULATIONS 2008)**  
**EE 9306: PROTECTION AND SWITCHGEAR**

Time: 3 Hours

Maximum Marks: 100

(Answer all Questions)

**PART – A**

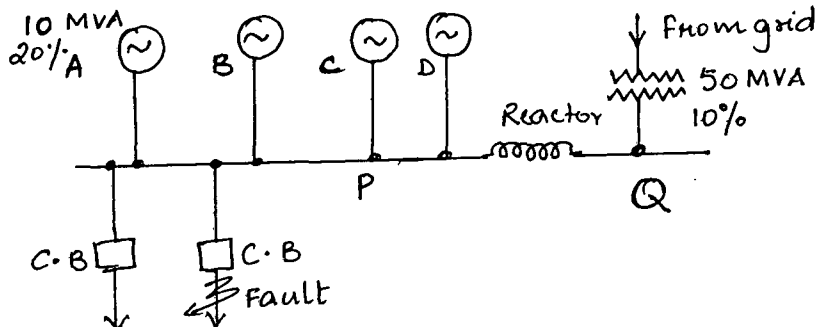
10 x 2 = 20

1. Why neutral grounding is advantageous?
2. The current from neutral to ground connection is 12A. Calculate the Zero phase sequence component in phases.
3. Give the basic arrangement of static directional over current relay.
4. The operating time of a time - distance impedance relay is proportional to the Voltage. Justify.
5. Suggest a protection scheme against inverted running in Diesel engine driven alternator.
6. Why current limiting reactors are necessary?
7. How is an arc quenched between the contacts of a circuit breaker?
8. What is the effect of the power factor on the recovery voltage?
9. Enlist the limitations of Bulk oil circuit breaker.
10. Compare the air circuit breaker with vacuum circuit breaker.

**PART – B**

5 x 16 = 80

11. (i) Derive the fault current and voltage for a L-G fault using symmetrical component method. (8)
- (ii) The 33kV bus-bars of a station are in two sections P and Q separated by a reactor. The section P is fed from four 10MVA generators each having a reactance of 20%. The section Q is fed from the grid through a 50MVA transformer of 10% reactance. The circuit breakers have a rupturing capacity of 500MVA. Find the reactance of the reactor to prevent the circuit breakers from being overloaded if a symmetrical short-circuit occurs on an outgoing feeder connected to A. Take base MVA as 50 MVA (8)



12. a) (i) Explain in detail the principle and types of differential relays. (8)
- (ii) Describe the method of protecting bus-bars by differential relaying. What are the limitations of this method and to what extent these can be overcome. (8)

(OR)

- b) (i) Explain how different distance relay characteristics be achieved with the help of amplitude comparator. (6)
- (ii) Explain the construction, principle and working of induction over-current relay and hence derive its torque equation. (10)
13. a) (i) Explain in detail the protection scheme for internal faults in a three phase delta / star transformer with neat diagrams. (8)
- (ii) A star-connected, 3-phase 10MVA, 6.6kV alternator has a per phase reactance of 10%. It is protected by Merz-Price circulating current principle which is set to operate for fault current not less than 175A. Calculate the value of earthing resistance to be provided in order to ensure that only 10% of the alternator winding remains unprotected. (8)

(OR)

- b) Discuss in detail the different types of faults and the protection scheme against each fault in Transmission lines. (16)
14. a) (i) A 50Hz, 11kV, three-phase alternator with earthed neutral has a reactance of 5 ohms per phase, and is connected to bus-bar through a circuit breaker. The capacitance to earth between the alternator and the circuit breaker is  $0.02\mu\text{F}$  per phase. Assuming the resistance of the generator to be negligible calculate the following: (8)
- Maximum voltage across the contacts of the circuit breaker.
  - Frequency of oscillations.
  - The average rate of rise of re-striking voltage up to the first peak.
- (ii) Explain in detail the problems encountered while interrupting capacitive currents. (8)

(OR)

- b) (i) With relevant theories explain why an arc is inevitable in a circuit breaker. (8)
- (ii) Explain in detail the current chopping in circuit breakers and suggest a remedy. (8)
15. a) (i) Discuss constructional details and operation of a typical low-oil circuit breaker with its relative merits and demerits. (10)
- (ii) Explain with neat sketch the construction and working of Self-compensated explosion pot. (6)

(OR)

- b) (i) Explain in detail the Cross-blast type air circuit breaker. (6)
- (ii) With relative merits and de-merits explain the types and working of  $\text{SF}_6$  circuit breaker. (10)