

SECTION A [40 MARKS]

Attempt **ALL** the Questions in this Section.

For questions 1 to 10 write the correct alternative in the answer booklet provided

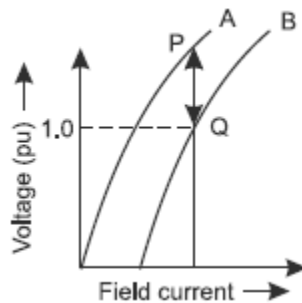
(2 marks @)

1. In an alternator the eddy current and hysteresis losses occur in
 - (a) Iron of field structure only
 - (b) Iron of armature structure only.
 - (c) Both (a) and (b)
 - (d) None of above.
2. The rotors preferred for alternators coupled to hydraulic turbines are
 - (a) Salient pole type
 - (b) Cylindrical rotor type
 - (c) Solid rotor type
 - (d) any of above.
3. An alternator having 8 poles rotating at 250 rpm will have
 - (a) 60 Hz
 - (b) 50 Hz
 - (c) 25 Hz
 - (d) 50/3 Hz
4. For a three-phase, 4-pole alternator the winding is placed in 96 slots. The No. of slots/pole/phase will be
 - (a) 2
 - (b) 4
 - (c) 8
 - (d) 16
5. What is the key feature of a universal motor that enables it to operate on AC power efficiently?
 - (a) Commutator
 - (b) Series-wound field
 - (c) Laminated stator
6. Compared to an induction motor, a universal motor offers:
 - (a) Higher starting torque
 - (b) Lower cost
 - (c) Higher efficiency
7. In which of the following cases the wave form generated will be close to sine wave form.
 - (a) distributed winding with short pitch coils
 - (b) distributed winding with full pitch coils

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- (c) concentrated winding with full pitch coils
- (d) same in all above.

8. Unbalanced three-phase stator currents cause
- (a) Vibrations.
 - (b) Heating of rotor.
 - (c) Double frequency currents in the rotor.
 - (d) all of the these.
9. Curve *A* and *B* in the figure denote open circuit and full load zero power factor characteristics of a synchronous generator. Where *Q* is a point on the *Z pf* characteristics at 1.0 pu voltage. The vertical distance *PQ* in the figure gives the voltage drop across



- (a) Synchronous reactance.
 - (b) Armature reaction reactance.
 - (c) Leakage reactance.
 - (d) Potier reactance.
10. By performing slip test we can determine
- (a) Slip.
 - (b) positive-sequence reactance and negative-sequence reactance.
 - (c) direct-axis reactance and quadrature axis reactance.
 - (d) Sub-transient reactance.
11. Two alternators are operating in parallel. What will happen when the excitation of *A* is increased?
- (a) Alternator will burn out
 - (b) wattless component will change
 - (c) Power output will reduce
 - (d) the machines will stop

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12. Which of the following is not an essential condition for parallel operation of two alternators?

- (a) Identical terminal voltage for two machines
- (b) Same phase sequence for two machines
- (c) Same kVA rating for two machines
- (d) Same frequency of voltage generated.

13. Synchronizing current means

- (a) The total current supplied to the load by the alternators operating in parallel.
- (b) The current circulating in the local circuit of two alternators operating in parallel which brings the alternators in synchronism once they are out of it.
- (c) The current supplied by the synchronous generator.
- (d) All of the above.

14. The governor droop characteristics of two 300 MW and 400 MW alternators appearing in parallel are 4% and 5%, respectively. If the alternators operate at no-load at 50 Hz, the frequency at which they would operate with a total load of 600 MW is

- (a) 48.06 Hz.
- (b) 47.06 Hz.
- (c) 49.66 Hz.
- (d) 47.66 Hz.

14. An infinite bus-bar has

- (a) Constant voltage.
- (b) Constant frequency.
- (c) Constant current
- (d) both (a) and (b)

15. Synchronous motors are not self-starting because

- (a) Starters cannot be used on these machines.
- (b) Starting winding is not provided on these machines
- (c) the direction of rotation is not reversed.
- (d) the direction in instantaneous torque reverses after half cycle.

16. A pony motor is basically a:

- (a) DC series motor
- (b) DC shunt motor

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- (c) Double winding AC/DC motor (d) small induction motor.

17. Slip rings in a synchronous motor carry:

- (a) DC (b) AC (c) both a and b (d) no current.

18. A Syn. motor working on leading p.f. at no-load is known as

- (a) Condenser (b) Syn. Condenser (c) Inverter (d) convertor.

19. The armature current in a syn. motor will be least when p.f. is

- (a) zero (b) unity (c) leading (d) lagging

20. Power developed by a syn. motor will be maximum when the load angle is

- (a) Zero (b) 45° (c) 90° (d) 120°

SECTION B [60 MARKS]

Attempt **ONLY THREE** Questions in this Section.

Question 1

- a) Explain the significance of maintaining the correct phase sequence in a three-phase synchronous generator's e.m.f. **(3 marks)**
- b) Describe the construction features of the stator in a synchronous generator. **(6 marks)**
- c) Explain how damper windings control hunting in a synchronous generator? **(5 marks)**
- d) Discuss the key considerations for parallel operation of alternators under loaded conditions. **(6 marks)**

Question 2

- a) What do you mean by single-layer and double-layer winding? **(4 marks)**
- b) Why do we prefer short-pitched windings? **(3 marks)**
- c) Discuss how voltage regulation of an alternator can be determined in the laboratory setting using the synchronous impedance method or emf method. **(7 marks)**

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- d) A 3-phase, 20-pole, 50Hz alternator has single-layer winding with full-pitch coils. The coils are connected in 60° phase group and each coil is having six turns. If the flux per pole is 0.025 Wb, determine the rms value of emf induced per phase.

(6 marks)

Question 3

- a) Discuss alternating current winding designs in electrical machines. **(8 marks)**
b) Name and differentiate the two main parts of a synchronous machine. **(4 marks)**
c) Define excitation as applied to synchronous motors. **(2 marks)**
d) Discuss the three main classifications of excitation systems in synchronous motors.

(6 marks)

Question 4

- a) What is meant by the term synchronizing? **(2 marks)**
b) What are necessary conditions for parallel operation of three-phase alternators? **(4 marks)**
c) Discuss the use of synchroscope in the parallel operation of three-phase alternators. **(6 marks)**
d) The drop characteristics of the governors of two alternators having rating 300 MW and 400 MW operating in parallel are of 3% and 4%, respectively. If the generators operate at no-load at 50 Hz. What will be the frequency at which they would operate with a total load of 600 MW. Also comment on the results. **(8 marks)**

Question 5

- a) Define a synchronous machine. **(2 marks)**
b) Briefly explain the three categories of synchronous machines. **(6 marks)**
c) Explain the construction of synchronous machines. **(9 marks)**
d) List **three** features of synchronous motors. **(3 marks)**