

Code: AE10
Time: 3 Hours

Subject: ELECTRICAL ENGINEERING
Max. Marks: 100

DECEMBER 2007

NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or best alternative in the following: (2x10)

- a. In DC generators, armature reaction is produced actually by
 (A) Its field current. (B) Armature conductors.
 (C) Field pole winding. (D) Load current in armature.
- b. Two transformers operating in parallel will share the load depending upon their
 (A) Rating. (B) Leakage reactance.
 (C) Efficiency. (D) Per-unit impedance.
- c. As compared to shunt and compound DC motors, the series DC motor will have the highest torque because of its comparatively _____ at the start.
 (A) Lower armature resistance. (B) Stronger series field.
 (C) Fewer series turns. (D) Larger armature current.
- d. A 400kW, 3-phase, 440V, 50Hz induction motor has a speed of 950 r.p.m. on full-load. The machine has 6 poles. The slip of the machine will be _____.
 (A) 0.06 (B) 0.10
 (C) 0.04 (D) 0.05
- e. Reduction in the capacitance of a capacitor-start motor, results in reduced
 (A) Noise. (B) Speed.
 (C) Starting torque. (D) Armature reaction.
- f. Regenerative braking
 (A) Can be used for stopping a motor.
 (B) Cannot be easily applied to DC series motors.
 (C) Can be easily applied to DC shunt motors
 (D) Cannot be used when motor load has overhauling characteristics.
- g. At present level of technology, which of the following method of generating electric power from sea is most advantageous?
 (A) Tidal power. (B) Ocean thermal energy conversion
 (C) Ocean currents. (D) Wave power.
- h. If the field circuits of an unloaded salient pole synchronous motor gets suddenly open circuited, then
 (A) The motor stops.
 (B) It continues to run at the same speed.
 (C) Its runs at the slower speed.
 (D) It runs at a very high speed.
- i. Electric resistance seam welding uses _____ electrodes.
 (A) Pointed (B) Disc.
 (C) Flat (D) Domed
- j. For LV applications (below 1 kV), _____ cables are used.

- (A) Paper insulated. (B) Plastic.
(C) Single core cables. (D) Oil filled.

**Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.**

- Q.2** a. Explain the construction and working principle of a transformer. (4+4)
- b. A 3-phase transformer bank consisting of a three one-phase transformer is used to step-down the voltage of a 3-phase, 6600V transmission line. If the primary line current is 10A, calculate the secondary line voltage, secondary line current and output kVA for the following connections:
(i) Y/ Δ and (ii) Δ /Y. The turns ratio is 12. Neglect losses. (8)
- Q.3** a. What are the two types of constructions that are employed in synchronous machines? Explain the two machines and give with reasons which of them are simple to model and analyze. (2+4+2)
- b. A 3300V, delta-connected motor has a synchronous reactance per phase (delta) of 18Ω . It operates at a leading power factor of 0.707 when drawing 800kW from the mains. Calculate its excitation emf. (8)
- Q.4** a. Explain the characteristics of DC motors. Also give their applications. (6+3)
- b. The magnetization characteristic of 4-pole DC series motor may be taken as proportional to current over a part of the working range, on this basis the flux per pole is 4.5 mWb/A. The load requires a gross torque proportional to the square of the speed equal to 30 Nm at 1000 rev/min. The armature is wave-wound and has 492 conductors. Determine the speed at the which the motor will run and current it will draw when connected to a 220V supply, the total resistance of the motor being 2.0Ω . (7)
- Q.5** a. Explain the different methods of starting an induction motor. (8)
- b. A 150kW, 3000V, 50Hz, 6-pole star-connected induction motor has a star-connected slip-ring rotor with a transformation ratio of 3.6 (stator/rotor). The rotor resistance is 0.1Ω /phase and its per phase leakage inductance is 3.61 mH. The stator impedance may be neglected. Find (i) the starting current and torque on rated voltage with short-circuited slip-rings, and (ii) the necessary external resistance to reduce the rated voltage starting current to 30A and the corresponding starting torque. (8)
- Q.6** a. What are the two advantages of stepper motors? Give a few applications of them & explain permanent magnet stepper motors. (2+2+4)
- b. An ac operated universal motor has a 2-pole armature with 960 conductors. At a certain load the motor speed is 5000 rpm and the armature current is 4.6A; the armature terminal voltage and input are respectively 100 V and 300 W. Calculate the following quantities assuming an armature resistance of 3.5Ω .
(i) Effective armature reactance
(ii) Max. value of useful flux/pole. (8)
- Q.7** a. Explain the three main blocks of a solid state relay. (8)
- b. What is meant by grading of cables? Explain the two methods of grading. (8)
- Q.8** a. Explain the features of a nuclear power plant with a suitable diagram. (6)
- b. Explain the term "cogeneration" and give two possible ways of cogeneration. (2+2)
- c. Write a short note on solar energy. (6)
- Q.9** a. What are the advantages of electrically produced heat? Explain the various types of electric heating with their applications. (2+6)
- b. Explain the salient features of electrical propulsion. (8)

