

Code: AE-10

Subject: ELECTRICAL ENGINEERING

JUNE 2007

Time: 3 Hours

Max. Marks: 100

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

- a. A 220/440 V, 50 Hz, 5 KVA, single phase transformer operates on 220V, 40Hz supply with secondary winding open circuited. Then
- (A) Both eddy current and hysteresis losses decreases.
(B) Both eddy current and hysteresis losses increases.
(C) Eddy current loss remains the same but hysteresis loss increases.
(D) Eddy current loss increases but hysteresis loss remains the same.
- b. A synchronous motor is operating on no-load at unity power factor. If the field current is increased, power factor will become
- (A) Leading & current will decrease
(B) Lagging & current will increase.
(C) Lagging & current will decrease.
(D) Leading & current will increase.
- c. A d.c. shunt motor runs at no load speed of 1140 r.p.m. At full load, armature reaction weakens the main flux by 5% whereas the armature circuit voltage drops by 10%. The motor full load speed in r.p.m. is
- (A) 1080 (B) 1203
(C) 1000 (D) 1200
- d. The introduction of interpoles in between the main pole improves the performance of d.c. machines, because
- (A) The interpole produces additional flux to augment the developed torque.
(B) The flux waveform is improved with reduction in harmonics.
(C) The inequality of air flux on the top and bottom halves of armature is removed.
(D) A counter e.m.f. is induced in the coil undergoing commutation.

- e. The rotor power output of a 3-phase induction motor is 15 KW and corresponding slip is 4%. The rotor copper loss will be
- (A) 600 W. (B) 625 W
(C) 650 W (D) 700 W
- f. The direction of rotation of hysteresis motor is reversed by
- (A) Shift shaded pole with respect to main pole
(B) Reversing supply lead
(C) Either A or B
(D) Neither A nor B
- g. A 1.8°step, 4-phase stepper motor has a total of 40 teeth on 8 pole of stator. The number of rotor teeth for their rotor will be
- (A) 40 (B) 50
(C) 100 (D) 80
- h. Low head plants generally use
- (A) Pelton Turbines (B) Francis Turbine
(C) Pelton or Francis Turbine (D) Kaplan Turbines
- i. The charging reactance of 50 Km length of line is 1500Ω. The charging reactance for 100Km length of line will be
- (A) 1500 Ω (B) 3000 Ω
(C) 750 Ω (D) 600 Ω
- j. Electric ovens using heating elements of _____ can produce temperature upto 3000°C.
- (A) Nickel (B) Graphite
(C) Chromium (D) Iron

Answer any FIVE Questions out of EIGHT Questions.

Each question carries 16 marks.

- Q.2** a. What are the conditions for satisfying parallel operation of single phase transformer? Deduce an expression for the load shared by the two transformers in parallel when the transformers have equal voltage ratio. (8)
- b. The following data were obtained on a 20KVA, 50Hz, 2000/200V distribution transformer
Open Circuit Test (on L.V. side): 200V, 4A, 120W
Short Circuit Test (on H.V. side): 60V, 10A, 300W
Draw the approximate equivalent circuit of the transformer referred to H.V. Side. (8)

- Q.3** a. Explain two important functions served by the damper winding in a synchronous motor. State the various applications of synchronous motor. (7)
- b. The efficiency of a 3-phase 400V, star connected synchronous motor is 95% and it takes 24A at full load and unity power factor. What will be the induced e.m.f. and total mechanical power developed at full load and 0.9 power factor leading? The synchronous impedance per phase is $(0.2+j2)\Omega$. (9)
- Q.4** a. Explain the process of building up of voltage in d.c. shunt generator and give the conditions to be satisfied for voltage built-up. (7)
- b. A 200V shunt motor with a constant main field drives a load, the torque of which varies at square of the speed, when running at 600 r.p.m., it takes 30A. Find the speed at which it will run and the current it will draw, if a 20Ω resistor is connected in series with armature. Neglect motor losses. (9)
- Q.5** a. Why does the induction motor not rotate at synchronous speed? (3)
- b. Describe with the aid of diagram of connection, phasor diagram and torque-slip characteristics, the working of capacitor-start single phase induction motor. (5)
- c. A 3-phase induction motor has a starting torque of 100% and a maximum torque of 200% of full load torque. Find
 (i) Slip at maximum torque.
 (ii) Full load slip.
 Neglect the stator impedance (8)
- Q.6** a. Explain the principle of operation of two phase servo motor. Draw its torque-slip characteristics. (8)
- b. A universal motor (a.c. operated) has a 2-pole armature with 960 conductors. At a certain load the motor speed is 5000 r.p.m. and the armature current is 4.6A. The armature terminal voltage and input are respectively 100 V and 300 W. Compute the following, assuming an armature resistance of 3.5Ω .
 (i) Effective armature reactance
 (ii) Max. value of useful flux per pole. (8)
- Q.7** a. Write short note on following: (8)
 (i) Condenser in Thermal power plant
 (ii) Control of nuclear reactor
- b. Explain some energy conservation measures for industries. (8)

Q.8 a. Describe the construction, principle of operation and advantages of SF₆ circuit breaker.

(8)

b. Using normal Π method, find the sending end voltage and voltage regulation of a 250Km, 3 phase, 50Hz transmission line delivering 25MVA at 0.8 lagging p.f. to a balanced load to 132KV. The line conductors are spaced equilaterally 3m apart. The conductor resistance is 0.11 Ω /Km and its effective diameter is 1.6 cm. Neglect leakage. **(8)**

Q.9 Write short note on any two of the following:-

- (i) Application of dielectric heating
- (ii) Speed control of D.C. motor using chopper
- (iii) Differential Relay

(8+8)