AMIETE – ET (OLD SCHEME)

Code: AE10 **Subject: ELECTRICAL ENGINEERING**

Time: 3 H **DECEMBER 2009** **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.**

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

a. A 2 KVA transformer has iron loss of 150W and full load copper loss of 250 W. The maximum efficiency of transformer would occur when the total load is

(A) 500 W **(B)** 400 W
(C) 300 W **(D)** 275 W

b. A transformer steps the voltage by a factor 100. The ratio of current in the primary to that of secondary is

(A) 1 **(B)** 100
(C) 0.01 **(D)** 0.1

c. Poles of a DC machine are often laminated to

(A) reduce pulsation loss **(B)** reduce armature reaction
(C) reduce iron weight **(D)** dissipate more heat

d. A 4 pole generator with 16 coils has a two layer lap winding. The pole pitch is

(A) 32 **(B)** 16
(C) 8 **(D)** 4

e. In a 3 phase induction motor, the mechanical power developed in terms of air gap power is

(A) $(S-1)P_g$ **(B)** $P_g/(1-S)$
(C) P_g/S **(D)** $(1-S)/P_g$

f. Most of the generators in thermal power plants run at

(A) 15000 rpm **(B)** 3000 rpm
(C) 1500 rpm **(D)** 1000 rpm

g. A synchronous generator has its field winding on the rotor and armature winding on the stator. When running under steady state condition its air gap field is

(A) Stationary with respect to stator
(B) Rotating at synchronous speed with respect to rotor
(C) Rotating at synchronous speed against direction of rotation
(D) Rotating at synchronous speed in the direction of rotation

h. 66 KV is suitable for transmission of Power over

(A) 30 Km **(B)** 66 Km
(C) 120 Km **(D)** 200 Km

i. One of the basic requirement of a servomotor is that it must produce high torque at all

(A) loads **(B)** frequencies
(C) speeds **(D)** voltages

j. The operation of stepper motor at high speed is referred to as

(A) fast forward **(B)** Slewing
(C) Inching **(D)** Jogging

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

Q.2 a. Starting from first principle develop the equation of emf induced in transformer winding. Show that the primary and secondary voltages are in the ratio of primary and secondary turns and that primary and secondary currents are in inverse ratio of turns. **(8)**

b. A 100 KVA, 2400/240 V, 50 Hz, 1 phase transformer has no load current of 0.64A and a core loss of 700 W, when its high voltage side is energised at rated voltage and frequency. Calculate the two components of no load current. If this transformer supplies a load current of 40A at 0.8 lagging power factor on its low voltage side, determine the primary current and its power factor. Ignore leakage impedance drop. **(8)**

Q.3 a. Explain the construction and working principle of a synchronous motor. **(8)**

b. A 100 KVA, 6.6 KV, 50 Hz, Y connected synchronous generator has no load voltage of 11.4 KV at a certain field current. The generator gives rated terminal voltage at full load 0.75 lagging power factor at the same field current. Calculate the following:
(i) Synchronous reactance (Neglect armature resistance)
(ii) Voltage regulation
(iii) Torque angle
(iv) Electrical power developed **(8)**

Q.4 a. Explain essential part of a DC generator. **(8)**

b. A 220 V, 7.5 KW series motor drives a fan. When running at 400 rpm it draws 30A from mains (220 V). The torque developed by fan varies at square root of speed. Determine power delivered to fan and torque developed by motor. Also calculate the external resistance added in series to armature circuit to reduce the fan speed to 200

rpm and power delivered to fan at this speed. **(8)**

Q.5 a. Discuss the principle of operation of a 3-phase induction motor and draw its equivalent circuit. **(8)**

b. A 6 pole, 50 Hz, 3-phase induction motor running on full load develops a useful torque of 160 Nm when rotor emf makes 120 complete cycles per minute. Calculate shaft power output. If mechanical torque lost in friction and that of core loss is 10 Nm, compute
(i) Copper loss in rotor winding
(ii) input to the motor and
(iii) efficiency
The total stator loss is given to be 800 W. **(8)**

Q.6 a. How AC servomotors are superior to DC servomotors for low power applications? Give the construction and working of AC servomotor. **(8)**

b. An AC operated universal motor has 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 power are respectively 100 V and 300 W. Assuming an armature resistance of 3.5 ohm, compute the following
(i) Effective armature reactance.
(ii) Maximum value of useful flux per pole. **(8)**

Q.7 a. Give the layout of a typical thermal power plant. **(8)**

b. Explain the energy conservation measures for industries. **(8)**

Q.8 a. Explain the main advantages of HVDC transmission over HVAC transmission. Give the main components of HVDC transmission. **(8)**

b. What is inductive interference? How is it caused and what steps are necessary to reduce its effect. **(8)**

Q.9 a. Why are solid state controllers preferred over conventional controllers? Explain their features. **(8)**

b. Explain various types of electric heating with examples. What are advantages of electrically produced heat? **(8)**