Code: A-10 Subject: ELECTRICAL ENGINEERING
Time: 3 Hours Max. Marks: 100

NOTE: There are 11 Questions in all.

> Question 1 is compulsory and carries 16 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.
> Answer any THREE Questions each from Part I and Part II. Each of these questions carries 14 marks.
> Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or best alternative in the following: (2x8)

  a. A two-winding single phase transformer has a voltage regulation of 4.5% at full-load and unity power-factor. At full-load and 0.80 power-factor lagging load the voltage regulation will be

(A) 4.5%. **(B)** less than 4.5%.
(C) more than 4.5%. **(D)** 4.5% or more than 4.5%.

  b. In a dc shunt motor the terminal voltage is halved while the torque is kept constant. The resulting approximate variation in speed $'\omega'$ and armature current $'I_a'$ will be

  (A) Both ω and I_a are doubled. **(B)** ω is constant and I_a is doubled.

  (C) ω is doubled while I_a is halved. **(D)** ω is constant but I_a is halved.

c. A balanced three-phase, 50 Hz voltage is applied to a 3 phase, 4 pole, induction motor. When the motor is delivering rated output, the slip is found to be 0.05. The speed of the rotor m.m.f. relative to the rotor structure is

  (A) 1500 r.p.m. **(B)** 1425 r.p.m.
(C) 25 r.p.m. **(D)** 75 r.p.m.

d. An alternator is delivering rated current at rated voltage and 0.8 power-factor lagging case. If it is required to deliver rated current at rated voltage and 0.8 power-factor leading, the required excitation will be

(A) less. **(B)** more.
  (C) more or less. **(D)** the same.

e. A ceiling fan uses
  (A) split-phase motor.
  (B) capacitor start and capacitor run motor.
  (C) universal motor.
  (D) capacitor start motor.

f. A stepper motor is

  (A) a dc motor. **(B)** a single-phase ac motor.
  (C) a multi-phase motor. **(D)** a two phase motor.

g. The sheath is used in cable to

(A) provide strength to the cable.
(B) provide proper insulation.
(C) prevent the moisture from entering the cable.
(D) avoid chances of rust on strands.

h. The drive motor used in a mixer-grinder is a

(A) dc motor. **(B)** induction motor.
(C) synchronous motor. **(D)** universal motor.

PART I
Answer any THREE Questions. Each question carries 14 marks.

Q.2 a. Can a transformer be used to transform direct voltage and direct current? Justify your answer. **(5)**

b. Three single-phase, 50 KVA, 2300/ 230 V, 60 Hz transformers are connected to form a 3-phase, 4000V / 230-V transformer bank. The equivalent impedance of each transformer referred to low-voltage is $0.012 + j\,0.016\ \Omega$. The 3-phase transformer supplies a 3-phase, 120 KVA, 230 V, 0.85 power-factor (lagging) load.

(i) Draw a schematic diagram showing the transformer connection.
(ii) Determine the winding currents of the transformer.
(iii) Determine the primary voltage (line to line) required. **(3 x 3)**

Q.3 a. How does a salient-pole rotor differ from a cylindrical rotor in synchronous machines. Where are the salient-pole type of synchronous machines used? **(3+3)**

b. A pair of synchronous machines, on the same shaft, may be used to generate power at 60 Hz from the given source of power at 50 Hz. Determine the minimum number of poles that the individual machines could have for this type of operation and find the shaft-speed in r.p.m. **(4+4)**

Q.4 a. Explain the effect of armature reaction on the performance of D.C. motor. **(8)**

b. A 240V dc shunt motor has an armature resistance of 0.4 ohm and is running at the full-load speed of 600 r.p.m. with a full load current of 25A. The field current is constant; also a resistance of 1 ohm is added in series with the armature. Find the speed (i) at the full-load torque and (ii) at twice the full-load torque. **(6)**

Q.5 a. Explain the principle of operation of an induction generator. **(4)**

b. A 400V, 4-pole, 50 Hz, 3-phase, 10 hp, star connected induction motor has a no load slip of 1% and full load slip of 4%. Find the following:
(i) Syn. speed (ii) no-load speed (iii) full-load speed.
(iv) frequency of rotor current at full-load (v) full-load torque. **(5 x 2 = 10)**

Q.6 Write notes on any **TWO** of the following:-

(i) Application of transformers.
(ii) Pulse transformers.
(iii) Single-phase induction motor. **(2 x 7 = 14)**

PART II
Answer any THREE Questions. Each question carries 14 marks.

Q.7 Bring-out the advantageous features of the following:

        (i)   Gas turbines.

        (ii)   Energy Conservation. **(7 x 2 = 14)**

Q.8 a. Why are different levels of voltages used for generation, transmission and distribution of electric power? **(7)**

b. What are the essential differences between H.V. and L.V. switchgears? **(7)**

Q.9 Classify the different types of secondary cells and describe the operating characteristics of any one of them. **(14)**

Q.10 Why are solid-state controllers preferred over conventional controllers? Give examples of their applications and explain their features. **(14)**

Q.11 Write notes on any **TWO** of the following: -

        (i)   Hysteresis motor.

        (ii)   HVDC transmission.

        (iii)   Button cells for low power applications. **(7+7)**

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