

DECEMBER 2006**Code: A-10****Subject: ELECTRICAL ENGINEERING****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. The eddy current loss in an a-c electric motor is 100 watts at 50 Hz. Its loss at 100 Hz will be
- (A) 25 watts (B) 59 watts
(C) 100 watts (D) 400 watts
- b. The maximum power for a given excitation in a synchronous motor is developed when the power angle is equal to
- (A) 0° (B) 45°
(C) 60° (D) 90°
- c. A commutator in a d.c. machine
- (A) Reduces power loss in armature.
(B) Reduces power loss in field circuit.
(C) converts the induced a-c armature voltage into direct voltage.
(D) Is not necessary.
- d. The speed of a d.c. shunt motor at no-load is
- (A) 5 to 10% (B) 15 to 20%
(C) 25 to 30% (D) 35 to 40%
higher than its speed at rated load.
- e. The efficiency of a transformer is mainly dependent on
- (A) core losses. (B) copper losses.
(C) stray losses. (D) dielectric losses.
- f. When two transformers are operating in parallel, they will share the load as under:
- (A) proportional to their impedances.

- (B) inversely proportional to their impedances.
 (C) 50% - 50%
 (D) 25%-75%
- g. If the voltage is reduced to half, the torque developed by an induction motor will be reduced to
- (A) $\frac{1}{4}$ of original torque. (B) $\frac{1}{2}$ of original torque.
 (C) $\frac{1}{8}$ of original torque. (D) $\frac{1}{16}$ of original torque.
- h. A 3-phase, 400 volts, 50 Hz, 100 KW, 4 pole squirrel cage induction motor with a rated slip of 2% will have a rotor speed of
- (A) 1500 rpm (B) 1470 rpm
 (C) 1530 rpm (D) 1570 rpm
- i. If the phase angle of the voltage coil of a directional relay is 50° , the maximum torque angle of the relay is
- (A) 130° (B) 100°
 (C) 50° (D) 25°
- j. The voltage at the two ends of a transmission line are 132 KV and its reactance is 40 ohm. The Capacity of the line is
- (A) 435.6 MW (B) 217.8 MW
 (C) 251.5 MW (D) 500 MW

Answer any FIVE Questions out of EIGHT Questions.

Each question carries 16 marks.

Q.2 A 50 KVA, 2300/230 V, 60 Hz transformer has a high voltage winding resistance of 0.65Ω and a low-voltage winding resistance of 0.0065Ω . Laboratory tests showed the following results:

Open circuit test: $V = 230 \text{ V}$, $I = 5.7 \text{ A}$, $P = 190 \text{ W}$

Short circuit test: $V = 41.5 \text{ V}$, $I = 21.7 \text{ A}$, $P = \text{No watt meter was used}$.

- a. Compute the value of primary voltage needed to give rated secondary voltage when the transformer is connected as a step-up one and is delivering 50 KVA at a power factor of 0.8 lagging. **(12)**
- b. Compute the efficiency under conditions of part (a). **(4)**

Q.3 A three-phase, 335-hp, 2000V, six pole, 60 Hz, Y-connected squirrel-cage induction motor has

the following parameters per phase that are applicable at normal slips:

$$r_1 = 0.2\Omega. \quad x_1 = x_2^1 = 0.707\Omega,$$

$$r_2^1 = 0.203\Omega. \quad r_c = 450\Omega$$

$$x_\phi = 77\Omega$$

The rotational losses are 4100 watts. Using the approximate equivalent circuit, compute for a slip of 1.5%.

- (i) the line power factor and current.
- (ii) developed torque.
- (iii) efficiency. (8+4+4)

Q.4 A 2300-V, three phase, 60 Hz, star-connected cylindrical synchronous motor has a synchronous reactance of 11Ω per phase. When it delivers 200 hp, the efficiency is found to be 90% exclusive of field loss, and the power-angle is 15 electrical degrees as measured by a stroboscope. Neglect ohmic resistance and determine:

- (i) the induced excitation per phase.
- (ii) the line current \bar{I}_a
- (iii) the power factor (8+4+4)

Q.5 When a 250-V, 50 hp, 1000 rpm d.c shunt motor is used to supply rated output power to a constant torque load, it draws an armature current of 160A. the armature circuit has a resistance of 0.04Ω and the rotational losses are equal to 2 KW. An external resistance of 0.5Ω is inserted in series with the armature winding. For this condition compute

- (i) the speed
- (ii) the developed power
- (iii) the efficiency assuming that the field loss is 1.6 K.W (8+4+4)

Q.6 Give the lay-out of a typical thermal-power plant and briefly explain the working of the super heater and the condenser. (8+4+4)

Q.7 With a neat diagram describe the construction of a lead acid cell and explain the process of charging and discharging of the cell. (8+4+4)

Q.8 a. What are the criteria for the classification of transmission lines as short, medium and long lines? (8)

b. Draw the schematic diagram of a directional overcurrent relay and explain its working. (4)

c. What are the advantages of high voltage transmission and its limitations. (4)

Q.9 Write short notes on **ANY TWO** of the following:

- (i) Capacitor-start motor.
- (ii) Switched reluctance motor.

(iii) Stepper motor.

(8+8)