ROLL NO. _____

Code: AE105 Subject: PRINCIPLES OF ELECTRICAL ENGINEERING

AMIETE – ET (New Scheme)

Time: 3 Hours **December - 2017** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **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: (2×10)

a. Hysteresis loss is given by - $P_h \propto f^m.Bmax^n$
Where

	m	n
(A)	1.6	2
(B)	1.6	1
(C)	2	1.6
(D)	1	1.6

b. Two mutually coupled coils act as an ideal transformer only if its core resistance is
(A) zero **(B)** of low value
(C) of high value **(D)** Infinite

c. The function of the shunt in an ammeter is to –
(A) bypass the current **(B)** increase the current in the coil
(C) decrease the voltage drop **(D)** increase the meter resistance

d. In DC machines, lap winding is used for
(A) low voltage, low current **(B)** low voltage, high current
(C) high voltage, low current **(D)** high voltage, high current

e. Which of the following DC generator can build up without any residual magnetism in the poles?
(A) Compound generator **(B)** Self-excited generator
(C) Series generator **(D)** Shunt generator

f. Which of the following parameters is treated as the most important point to keep under constant watch during the operation of a transformer?
(A) Cu-loss **(B)** Temperature
(C) Primary voltage **(D)** Exciting current

g. A 4-pole,1500rpm, alternator will generate e.m.f. at
(A) 60Hz **(B)** 50Hz
(C) 40Hz **(D)** 20Hz

h. In a capacitor start motor, the phase displacement between starting and running winding is-
(A) 0° **(B)** 45°
(C) 60° **(D)** 90°

i. The starting current of an induction motor is five times the full load current while the full load slip is 4%. The ratio of starting torque to full-load torque is-
(A) 0.8 **(B)** 1.2
(C) 1.0 **(D)** 0.6

j. Condensers in thermal power plants are used for condensing
(A) Steam to water **(B)** Water to ice
(C) Hydrogen gas to liquid hydrogen **(D)** Carbon dioxide to dry ice

---

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

Q.2 a. State and explain Ohm's law for magnetic circuit. **(4)**

b. Define the following terms: **(6)**
(i) magnetomotive force (ii) permeability
(iii) reluctance

c. Calculate the effective length and cross-sectional area of the airgap in an inductor with 300 turns required to have an induced emf of 100 V with a current of 10 A at 50 Hz. Assume maximum gap density of 1Wb/m^2 and that the iron requires 10% of the total ampere-turns. Take E = 4.44 fϕ_mT, where f = frequency, ϕ_m = max. flux , T= no. of turns. Ignore leakage and fringing. **(6)**

Q.3 a Define leakage flux. Mention the methods of reducing leakage flux in transformers. **(4)**

b. For a transformer, draw:
(i) approximate equivalent circuit,
(ii) simplified equivalent circuit
(iii) phasor diagram for part (ii). **(2x3)**

c. A 1-ϕ transformer has secondary and primary turns 180 and 90 respectively, and their respective resistances are 0.233 Ω and 0.067 Ω. Calculate the equivalent resistance of (i) the primary in terms of secondary, (ii) the secondary in terms of primary
(iii) total resistance of the transformer in terms of the primary **(6)**

Q.4 a. Write short note on :
(i) Armature reaction
(ii) Commutation with respect to a DC machine **(4x2)**

b. A shunt motor runs on no-load at 700 r.p.m at a 440 V supply. The resistance of the shunt circuit is 240 Ω. The following table gives a relationship between flux and shunt current :

Shunt Current (A)	0.5	0.75	1.0	1.25	1.5	1.75	2.0
Flux per pole (mWb)	6.0	8.0	9.4	10.2	10.8	11.2	11.5

Calculate the additional resistance required in the shunt circuit to raise no-load speed to 1000 rpm. **(8)**

Q.5 a. Define and clearly explain the term steady state stability limit of a synchronous machine. **(6)**

b. Draw V-curves for both synchronous motor and generator operating at constant load under variable excitation. Also indicate Stability limit on the curve. **(4)**

c. Explain the operation of synchronous motor and generator with the help of phasor diagram. **(6)**

Q.6 a. Derive expression for mechanical power and electromagnetic torque of an induction motor and establish relationship between them. **(8)**

b. The per phase parameters of the equivalent circuit for a 400 V, 33 kW, 60 Hz, 3 - ϕ, Y-connected, 4-pole, 1755 rpm induction motor are: $R_1 = 0.2\Omega$, $X_1 = j0.5\Omega$, $X_m = j20\Omega$, $R_2' = 0.1\Omega$, $X_2' = j0.2\Omega$. If the mechanical losses (windage and friction) are 650 W and iron losses are 300 W, determine (i) synchronous speed; (ii) slip; (iii) input current and power factor; (iv) Input power. **(4x2)**

Q.7 a. Distinguish between cage rotor and slip ring rotor of an induction motor. **(5)**

b. Explain in brief, the connection diagram and working principle of a split-phase type single phase induction motor. Also draw its torque-speed characteristics. **(6)**

c. How does an Induction generator work? **(5)**

Q.8 a. Explain the significance and importance of power system analysis. **(4)**

b. A 3 - ϕ, 11 kV, 50 Hz line of resistance 3 Ω/ph and reactance of j7 Ω/ph supplies a transformer of 11kV/400V, having negligible resistance and reactance of j2 Ω/ph referred to 11 kV. The transformer supplies a 400 V feeder of resistance 0.01 Ω/ph and reactance of j0.005 Ω/ph. If V_R, the receiving-end voltage is 400 V, calculate the sending end voltage V_s, when the 3 - ϕ load delivered is 250 kW at unity power factor. **(12)**

Q.9 a. What are the advantages and disadvantages of Moving Iron type of instruments? **(6)**

b. Describe the various effects produced by current or voltage to generate deflecting (or operating) torque in measuring instruments. **(6)**

c. Why is earthing essential? **(4)**