

**BASIC ELECTRICAL ENGINEERING
(ELEC 1001)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Kirchhoff's voltage law is used for
 - (a) mesh analysis
 - (b) finding out equivalent current
 - (c) finding out equivalent resistance
 - (d) nodal analysis.
 - (ii) In a balanced 3-phase system, the phase currents are
 - (a) 30° apart
 - (b) 120° apart
 - (c) 60° apart
 - (d) 20° apart.
 - (iii) For reversing the direction of d.c. motor
 - (a) the connection of both armature and field winding are required to be reversed
 - (b) either armature or field winding connection need to be reversed
 - (c) only field flux should be weakened
 - (d) only armature current should be reduced.
 - (iv) In a 3-phase power measurement by two wattmeter method the reading of one of the two watt meters was zero. The power factor of the load must be
 - (a) unity
 - (b) 0
 - (c) 0.5
 - (d) 0.3.
 - (v) Under maximum power transfer condition the efficiency is
 - (a) 100%
 - (b) 75%
 - (c) 25%
 - (d) 50%.
 - (vi) In a series resonant circuit, the current in the circuit is
 - (a) minimum
 - (b) maximum
 - (c) zero
 - (d) infinite.
 - (vii) In a pure capacitive circuit
 - (a) The current is in phase with the voltage
 - (b) The current lags behind the voltage by 90°
 - (c) The current leads the voltage by 90°
 - (d) The current can lead or lag by 90°.

- (viii) The open-circuit test in a transformer is used to measure
 - (a) copper loss
 - (b) friction and windage loss
 - (c) dielectric loss
 - (d) iron loss.
- (ix) Transformer core are laminated in order to
 - (a) reduce hysteresis loss
 - (b) reduce dielectric loss
 - (c) minimize eddy current loss
 - (d) reduce copper loss.
- (x) The rotor of a three phase induction motor rotates at a speed
 - (a) equal to synchronous speed
 - (b) greater than synchronous speed
 - (c) less than synchronous speed
 - (d) equal to slip speed.

Group- B

2. (a) Using star-delta conversion, find the equivalent resistance between terminals A and B in the following network as shown in Fig.1. [(CO1)(Apply/IOCQ)]

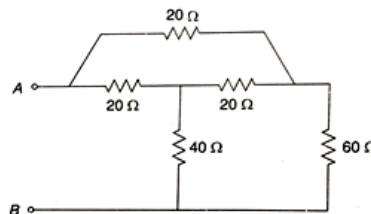


Fig.1

- (b) A coil of 600 turns and of resistance of 40 Ω is wound uniformly over a steel ring of mean circumference 30 cm and cross-sectional area 9 cm². It is connected to a supply of 40 V (DC). If the relative permeability(μ_r) of the ring material is 1200 and $\mu_0 = 4\pi \times 10^{-7}$, then identify (i) the reluctance, (ii) the magnetic field intensity, (iii) the m.m.f and (iv) the flux. [(CO3) (Apply/IOCQ)]

6 + 6 = 12

3. (a) Determine the current passing through $R_L = 2 \Omega$ resistor of the network of Fig.2 using Thevenin's theorem. [(CO1)(Evaluate/IOCQ)]

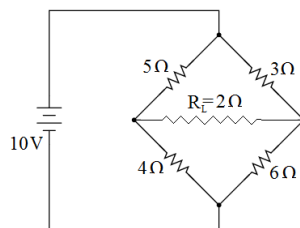


Fig.2

- (b) Define the self-inductance, mutual inductance and coefficient of coupling. Also derive the expression of coefficient of coupling in terms of self- inductances of two coils and mutual inductance between them. [(CO3) (Apply/IOCQ)]

6 + 6 = 12

Group - C

4. (a) Find the RMS and the Average value for the wave form given in Fig.3. Hence find the form factor and peak factor. [(CO4)(Remember/LOCQ)]

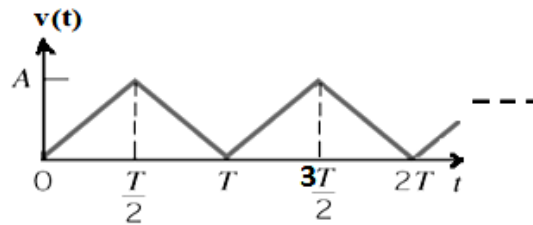


Fig.3

- (b) Two coils having impedance of $Z_1 = (10 + j5)$ and $Z_2 = (8 + j6)$ are connected in parallel across an AC voltage source of 200V. Solve for (i) the current flowing through each coil, (ii) the total current, (iii) the overall power factor and (iv) the total active power consumed by the circuit. [(CO4)(Apply/IOCQ)]
(2 + 2 + 1 + 1) + (2 + 2 + 1 + 1) = 12
5. (a) What is resonance? Develop an expression for resonant frequency of a series RLC circuit. [(CO4)(Remember/LOCQ)]
 (b) A supply voltage of 300 V, 50 Hz is applied to a series R-C circuit. If the reactive power absorbed by the capacitor be 150 VAR at 150V, determine (i) the value of the resistance and capacitance, (ii) circuit current, (iii) power factor and (iv) active power drawn by the circuit. [(CO4)(Evaluate/HOCQ)]
 (c) A coil has a resistance of 10Ω and draws a current of 5A when connected across 100V, 50Hz source. Solve for the values of (i) inductance, (ii) power factor and (iii) reactive power of the coil. [(CO4)(Apply/IOCQ)]
3 + (2 + 1 + 1 + 1) + (2 + 1 + 1) = 12

Group - D

6. (a) Derive the Torque equation of DC Motor. [(CO2)(Create/HOCQ)]
 (b) Three impedances each of resistance 10Ω and series inductive reactance of 5Ω are connected (i) in star and (ii) in delta across a three phase 400 V supply. Find the line current and total power in each case. [(CO4)(Understand/LOCQ)]
6 + 6 = 12
7. (a) Explain the method of power measurement of a balanced three phase system by two wattmeter method. Draw the neat circuit diagram. [(CO4) (Remember/LOCQ)]
 (b) An 8 pole lap connected armature has 40 slots with 12 conductors per slot, generates a voltage of 5000 volts. Determine the speed at which it is running if the flux per pole is 50 mWb. Also calculate the terminal voltage at full load of 20A if the armature resistance is 0.5Ω and the machine is running as shunt generator having a shunt field resistance of 250Ω . [(CO2) (Evaluate/HOCQ)]
5 + 7 = 12

Group - E

8. (a) A 4 kVA, 200/400 V, 50 Hz single phase transformer gives the following test results:
 OC Test (on low voltage side) : 200V, 0.8 A, 50W
 SC Test (on high voltage side) : 17.5V, 10A, 40W

Solve for the equivalent circuit parameters and the full load efficiency at 0.8 power factor. Also obtain the load for which maximum efficiency occurs.

[(CO5)(Apply/IOCQ)]

- (b) Explain how a rotating field is produced in the air gap of a 3-phase induction motor.

[(CO6)(Understand/LOCQ)]

(4 + 2 + 2) + 4 = 12

9. (a) Develop the condition for maximum efficiency in transformer.

[(CO5)(Apply/IOCQ)]

- (b) A 1kVA, single phase transformer has an iron loss of 12W, and full load copper loss of 18W. Solve for (i) the efficiency of the transformer at 0.8 power factor at half load and (ii) the load at which maximum efficiency occurs.

[(CO4)(Apply/IOCQ)]

- (c) A 3-phase, 4 pole, 50 Hz induction motor is running at 1455 rpm. Find

(i) synchronous speed

(ii) slip speed

(iii) slip and

(iv) frequency of rotor induced e.m.f.

[(CO6)(Understand/LOCQ)]

4 + (2 + 2) + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	29.17	52.08	18.75

Course Outcome (CO):

After the completion of the course students will be able to

- Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
- Analyse DC Machines; Starters and speed control of DC motors.
- Analyse magnetic circuits.
- Analyse single and three phase AC circuits.
- Analyse the operation of single phase transformers.
- Analyse the operation of three phase induction motors.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question