

BASIC ELECTRICAL ENGINEERING
(ELE1001)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) What is the magneto-motive force (mmf) of a wire with 100 turns carrying 2 A current?
(a) 200 AT (b) 2 AT (c) 50 AT (d) 100 AT
- (ii) In Thevenin's theorem, to find the Thevenin's equivalent resistance:
(a) All independent current sources are short circuited and independent voltage sources are open circuited.
(b) All independent voltage and current sources are open circuited.
(c) All independent voltage and current sources are short circuited.
(d) All independent voltage sources are short circuited and all independent current sources are open circuited.
- (iii) The number of equations required to solve network by mesh analysis is equal to number of
(a) nodes (b) independent loops (c) branches (d) source
- (iv) The r.m.s. value of a sine wave is 50A. Its peak value is
(a) 150 A (b) 282.8 A (c) 70.7 A (d) 141.4 A
- (v) Calculate the power factor of a circuit with parameters $R = 3\Omega$ and $X_L = 4\Omega$.
(a) 0.6 (b) 1 (c) 0.5 (d) 0.8
- (vi) If the reading of the two wattmeters is equal while measuring power in a 3 phase induction motor then the power factor of the load will be?
(a) 0.8 leading (b) 0.8 lagging
(c) zero (d) unity
- (vii) The number of parallel paths in wave connected armature winding of a 4 pole dc machine is
(a) number of poles (b) half the number of poles
(c) two (d) four

- (viii) The speed of a dc shunt motor can be increased by:
 (a) increasing the resistance in armature circuit
 (b) decreasing the resistance in armature circuit
 (c) increasing the resistance in field circuit
 (d) decreasing the resistance in field circuit
- (ix) The rotor of an induction motor rotates at
 (a) synchronous speed (b) less than synchronous speed
 (c) greater than synchronous speed (d) slip speed
- (x) A transformer steps up the voltage by a factor of 100. The ratio of current in the primary to that in the secondary is:
 (a) 1 (b) 100 (c) 0.01 (d) 0.1

Fill in the blanks with the correct word

- (xi) For a parallel RLC circuit the current at resonance is _____.
- (xii) In a balanced three-phase system, the line currents are _____ degree apart from each other.
- (xiii) The loss which can be calculated from a short circuit test on a transformer is ____.
- (xiv) The speed of a 3 phase, 4 pole induction motor operating at 3% slip is _____.
- (xv) Form factor of pure sinusoidal waveform is _____.

Group - B

2. (a) Determine the value of load resistance R_L in Fig. 1 when maximum power will be transferred through the load resistance and also find the amount of maximum power.

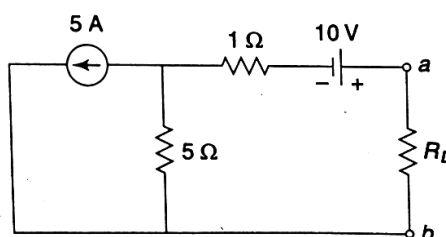


Fig. 1

[[CO1](Analyse/HOCQ)]

- (b) Derive the expression of equivalent inductance of two inductors in series.
 [[CO3](Remember/LOCQ)]
- (c) A coil of 300 turns and carrying current of 2 A is wound uniformly over a steel ring of mean circumference 30 cm and cross-sectional area 10 sqcm. It is connected to a supply of 20 V d.c. If the relative permeability of the ring is 1500. Find (i) reluctance, (ii) mmf and (iii) flux.
 [[CO3](Apply/IOCQ)]

(2 + 3) + 3 + 4 = 12

3. (a) Find current through 1Ω resistance of the circuit given in Fig. 2 using nodal analysis.

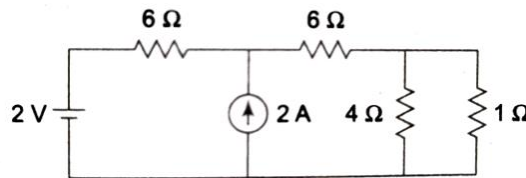


Fig. 2

[[CO1](Analyse/HOCQ)]

[[CO3](Remember/LOCQ)]

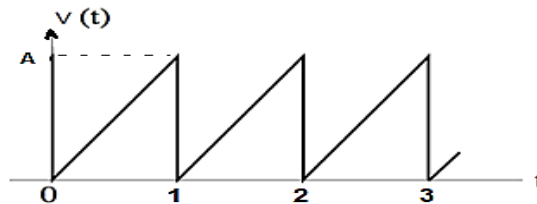
- (b) Explain B-H characteristics of magnetic material.
- (c) An iron ring of mean length 25 cm and cross sectional area 5 sqcm has a winding of 150 turns. A current of 2A flows in the winding to produce a flux of 0.3 mWb. Determine (i) the magnetic field intensity H and (ii) the relative permeability of the iron ring.

[[CO3](Apply/IOCQ)]

5 + 3 + 4 = 12

Group - C

4. (a) Determine the rms value, average value, form factor and peak factor for the following waveform.



[[CO4](Analyse/HOCQ)]

- (b) Prove that the average power consumption in a pure capacitor is zero when a.c. voltage is applied.
- (c) An ac series circuit has $R = 10\Omega$; $L = 0.05H$ and $C = 100\mu F$ and is connected across 250V, 50 Hz sinusoidal supply. Determine impedance, current, power factor of the circuit, power consumed by the circuit and maximum current of the circuit.

[[CO4](Apply/IOCQ)]

4 + 3 + 5 = 12

5. (a) A choke coil is connected in series with a $25\mu F$ capacitor. With a constant supply voltage of 200V the circuit takes its maximum current of 50A at 50Hz frequency. Calculate (i) the resistance and inductance of the choke coil; (ii) the voltage across the capacitor.
- (b) Draw and explain the phasor diagrams of series R-L and series R-C circuits.
- (c) A 320 V, 50 Hz voltage applied to a coil of $L = 0.5 H$ and $R = 250 \Omega$ in series with a capacitor C. What value must C have in order that the total voltage across the coil shall be 250 V?

[[CO4](Analyse/HOCQ)]

[[CO4](Remember/LOCQ)]

[[CO4](Apply/IOCQ)]

4 + 4 + 4 = 12

Group - D

6. (a) Describe the three-phase power measurement with the help of two Wattmeters. Draw the circuit diagram and phasor diagram. Also find the expression of the power factor of a 3-phase load.
- (b) What is back emf?

[[CO4](Remember/LOCQ)]

[[CO2](Remember/LOCQ)]

- (c) A 6-pole Lap wound dc shunt generator has a useful flux per pole of 0.03 Wb. The armature has 400 conductors and resistance of 0.4Ω . Calculate the terminal voltage when the armature is rotating at 1000 rpm and armature current is 40A. [[CO2](Apply/IOCQ)]
(3 + 2 + 2) + 2 + 3 = 12
7. (a) A 400V, 6-pole DC shunt motor has wave wound armature winding with 250 conductors. The armature and field circuit resistances are 0.3Ω and 200Ω respectively and the flux per pole is 0.04Wb. Find the speed and electromagnetic torque developed if the motor draws 10A from the supply. [[CO2](Analyse/HOCQ)]
- (b) Explain why the field flux control method of speed control of a DC motor cannot be used to obtain a speed below the rated speed of the motor. [[CO2](Remember/LOCQ)]
- (c) A three phase load in which each phase consists of resistance of 20Ω , inductance of 0.10 H and capacitance of $100\mu\text{F}$ in series is connected to 200 V, 50 Hz, 3 phase, balanced ac supply. Considering star connection, evaluate (i) line current, (ii) power factor, (iii) active power. [[CO4](Apply/IOCQ)]
4 + 2 + 6 = 12

Group - E

8. (a) A single phase, 50 Hz transformer has 80 turns on the primary winding and 280 in the secondary winding. The voltage induced across the primary winding is 240 Volts. Solve for (i) the maximum flux density in the core, (ii) induced emf in the secondary winding. The net cross- sectional area of the core can be taken as 0.02 m^2 . [[CO5](Apply/IOCQ)]
- (b) Explain the working principle of the 3-phase induction motor. [[CO6](Remember/LOCQ)]
- (c) Explain why the short circuit test is performed on the high voltage side of a transformer. Why is the core loss almost negligible in this test? [[CO5](Analyse/IOCQ)]
4 + 5 + 3 = 12
9. (a) Draw the phasor diagram of a single phase transformer under lagging power factor load. [[CO5](Understand/LOCQ)]
- (b) In a 25 kVA, 2000 V/ 200 V transformer the iron and full load copper losses are 200 W and 400 W respectively. Calculate the efficiency at half load 0.8 power factor lagging. Determine also the maximum efficiency at the same power factor and the corresponding load. [[CO5](Evaluate/HOCQ)]
- (c) A 3-phase induction motor is wound for 4 poles and is supplied from a 3-phase, 50 Hz system. Calculate (i) synchronous speed, (ii) speed of motor when slip is 0.04 and (iii) the rotor frequency when the motor runs at 600 rpm. [[CO6](Apply/IOCQ)]
2 + (2 + 2 + 2) + (1 + 1 + 2) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	32.29	38.54	29.17