# 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 in
(a) loop analysis
(b) node analysis
(c) determination of equivalent resistance
(d) determination of equivalent voltage

(ii) For additive flux of two coils connected in series the equivalent inductance can be expressed as
(a) $L_1+L_2-M$ (b) $L_1+L_2+2M$
(c) $L_1+L_2+M$ (d) $L_1+L_2-2M$

(iii) Capacitor having lowest capacitance is
(a) air (b) paper
(c) mica (d) plastic

(iv) Which of the following rule is used to determine the direction of rotation of D.C motor?
(a) Coloumb's Law (b) Lenz's Law
(c) Fleming's Right-hand Rule (d) Fleming's Left-hand Rule

(v) The electric field inside the hollow cylinder is
(a) zero (b) same as that on the surface
(c) less then that of the surface (d) infinite

(vi) Power factor of an A.C. circuit is equal to
(a) $R/X_L$ (b) $R/X_c$ (c) R/Z (d) Z/R

(vii) In a transformer electric power is transformed from one circuit to another circuit without change in
(a) voltage (b) current (c) frequency (d) turns

(viii) In a three-phase system, the emf's are
(a) 30° apart (b) 40° apart
(c) 90° apart (d) 120° apart

(ix) Starter in d.c. motor is used to
(a) reduce starting current (b) increase starting current
(c) increase the speed (d) reduce the speed

(x) The rotor of an induction motor cannot run at synchronous speed, because if it did so, then
(a) Rotor emf would be zero (b) rotor current would be zero
(c) rotor torque would be zero (d) all of the above.

## Group – B

2. (a) Find the current through 10Ω resistance in the circuit shown in Fig.1 using Thevenin's Theorem. [(CO1) (Analyze/IOCQ)]

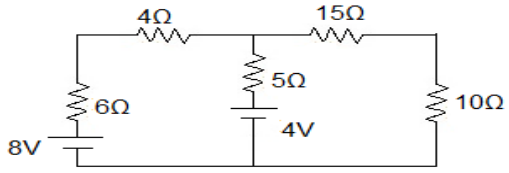



***Fig. 1***

(b) Prove the Maximum Power Transfer theorem for a DC network. [(CO1) (Understand/LOCQ)]

(c) State Norton's theorem. [(CO1) (Remember/LOCQ)]

**5 + 5 + 2 = 12**

3. (a) Deduce the expression for the torque developed in a dc motor. [(CO2) (Remember/LOCQ)]

(b) A 120V dc shunt motor having an armature circuit resistance of 0.2Ω and field circuit 60Ω, draws a line current of 40A at full load. The brush drop is 3V and rated full load speed is 1800 rpm.
Calculate (i) the speed at half load, (ii) the speed at 125% of full load.
[(CO2) (Evaluate/HOCQ)]

**4 + (4 + 4) = 12**

## Group – C

4. (a) Two capacitors having capacitances of 10 μF and 15 μF respectively, are connected in series across a 200V d.c. supply. Calculate (i) the energy store on each capacitor (ii) the potential difference across each capacitor. [(CO3) (Evaluate/HOCQ)]

(b) State and proof Gauss's law. [(CO3) (Remember/LOCQ)]

(c) Derive the expression of Capacitance of Parallel plate capacitor. [(CO3) (Understand/LOCQ)]

**4 + 4 + 4 = 12**

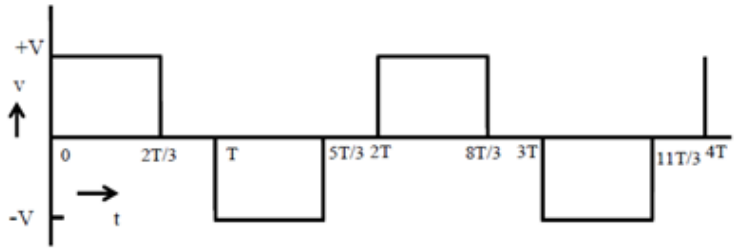
5. (a) An iron ring of mean circumference 50cm has an air gap of 0.1cm and a winding of 300 turns. If the permeability of iron is 400 when a current of 1A flows through the coil, find the flux density in the air gap. [(CO3) (Analyze/IOCQ)]

   (b) Write down the similarities and dissimilarities of magnetic circuit and electric circuit. State and proof the Ampere's circuital Law. [(CO3) (Remember/LOCQ)]

**8 + 4 = 12**

## Group – D

6. (a) Find the average and rms value of the waveform shown below:




[(CO4) (Apply/IOCQ)]

   (b) An ac. series circuit consisting of a pure resistance of 25Ω, inductance of 0.15H and a capacitance of 80μF is connected across a 230V, 50Hz ac supply.Calculate (i) impedance (ii) current (iii) total power consumed by the circuit (iv) power factor (v) resonant frequency (vi) current under resonance condition. [(CO4) (Apply/IOCQ)]

**(2 + 2) + 8 = 12**

7. (a) A 3-phase 230V load has a power factor of 0.8 lag. Two wattmeter are used to measure power which shows the input to be 10KW. Find the reading of each wattmeter. [(CO4) (Apply/IOCQ)]

   (b) Show that, in a three phase star connected system $V_L = \sqrt{3}\, V_{ph}$ and $I_L = I_{ph}$. [(CO4)(Understand/LOCQ)]

**6 + 6 = 12**

## Group – E

8. (a) Derive the expression for the EMF induced in a transformer. [(CO5) (Understand/LOCQ)]

   (b) Draw the phasor diagram of a single phase transformer at lagging power factor. [(CO5) (Analyze/IOCQ)]

   (c) A single phase transformer has a no load current of 2.5A at 0.5 power factor lag. Calculate the primary current and the power factor when a load connected across the secondary draws a current of 100A at 0.8 power factor lag. The primary and secondary turns of the transformer are 500 and 1000 respectively. [(CO5) (Evaluate/HOCQ)]

**3 + 4 + (3 + 2) = 12**

9. (a) A 4 pole 3-phase ,275 KW ,440 V ,50 Hz induction motor is running with a slip of 4%. Find (a) synchronous speed (b) rotor speed (c) frequency of rotor induced EMF. [(CO6) (Evaluate/HOCQ)]

(b) Explain how rotating magnetic field is produced in a 3-phase Induction Motor. [(CO6) (Analyze/IOCQ)]

**6 + 6 = 12**

---

| Cognition Level | LOCQ | IOCQ | HOCQ |
|---|---|---|---|
| Percentage distribution | 33.33% | 42.71% | 23.96% |

**Course Outcome (CO):**

After the completion of the course students will be able to:

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

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

| Department & Section | Submission Link |
|---|---|
| **BACKLOG** | Joining Code: hrlza5b<br>Submission Link:<br>https://classroom.google.com/c/NDYyMDM2NTM3Mzg1/a/NDYyMDM2NTM4MDg5/details |