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
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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)   In a series R-L-C circuit, current will lag the voltage if
   (a) $X_L > X_C$ (b) $X_L < X_C$ (c) $X_L = X_C$ (d) $X_L = 0 \ \Omega$

   (ii)   AC voltmeter is normally calibrated in
   (a) average value   (b) instantaneous value
   (c) peak value   (d) RMS value

   (iii)   Kirchhoff's voltage law is used for
   (a) Mesh analysis   (b) Finding out equivalent current
   (c) Finding out equivalent resistance   (d) Nodal analysis

   (iv)   At maximum efficiency of the transformer
   (a) Iron loss = Copper loss   (b) Iron loss > Copper loss
   (c) Iron loss < Copper loss   (d) Iron loss = 2 × Copper loss

   (v)   If the peak value of a sine wave is 100 volts, then its rms value will be
   (a) 70.7 V   (b) 141.42 V   (c) 100 V   (d) 57.73 V

   (vi)   Open-circuit test in a transformer is performed basically to determine
   (a) Copper loss   (b) Iron loss
   (c) Windage loss   (d) Dielectric loss

   (vii)   For a wave connected dc machine, for number of poles = 4, the number of parallel path is
   (a) 4   (b) 2   (c) 8   (d) 16

   (viii)   The magnetic energy stored in a coil is given by
   (a) $\frac{1}{2}LI^2$ (b) $\frac{1}{2}IL^2$ (c) $\frac{1}{2}BH^2$ (d) $\frac{1}{2}HB^2$

(ix) Eddy current loss in a transformer can be reduced by using
(a) laminated core (b) silicon steel
(c) oil (d) solid steel

(x) In a balanced 3-phase system, the emfs are
(a) 30° apart (b) 60° apart
(c) 90° apart (d) 120° apart

Group- B

2. (a) Identify the current through 20Ω resistance in the circuit shown in Fig.1 using Superposition Theorem.
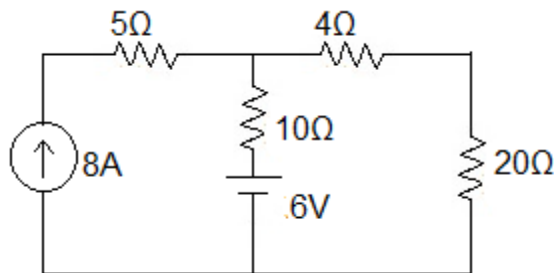

Fig.1 [(CO1) (Apply/IOCQ)]

(b) The combined inductance of the two coils connected in series is 0.8 H and 0.3 H, depending on the relative directions of currents in the coils. If one of the coils, when isolated, has a self-inductance of 0.15 H, then identify (i) mutual inductance (ii) coefficient of coupling. [(CO3) (Apply/IOCQ)]

6 + 6 = 12

3. (a) Using Source transformation show that Thevenin's theorem & Norton's theorem are related to each other. [(CO1) (Remember/LOCQ)]

(b) A coil of 400 turns and of resistance of 16 Ω is wound uniformly over a steel ring of mean circumference 24 cm and cross-sectional area 8 cm². It is connected to a supply of 20 V (DC). If the relative permeability(μ_r) of the ring material is 1200 and $\mu_0 = 4\pi \times 10^{-7}$ H/m, then identify (i) the reluctance,(ii) the magnetic field intensity, (iii) the magneto motive force,(iv) the flux and flux density.
[(CO3) (Apply/IOCQ)]

4 + 8 = 12

Group - C

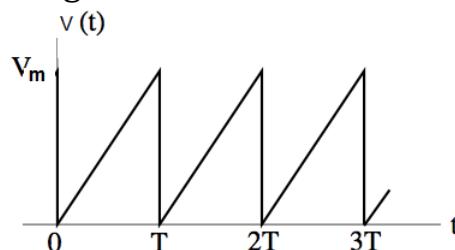4. (a) Find the RMS and Average value for the wave form given in Fig.2

Fig.2. [(CO4) (Remember/LOCQ)]

(b)   In an alternating circuit, the impressed voltage is given by V = (80+j40) volt, and the current through the circuit is I = (3-j4) amp. Justify whether the circuit is capacitive or inductive with reason. [(CO4) (Evaluate/HOCQ)]

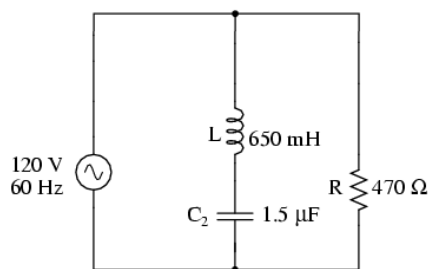(c)   Solve the parallel circuit shown in Fig.3, to find the total current and total power absorbed.

Fig.3   [(CO4) (Apply/IOCQ)]

4 + 3 + (3 + 2) = 12

5.   (a)   Find the resonance frequency of the circuit shown in Fig.4
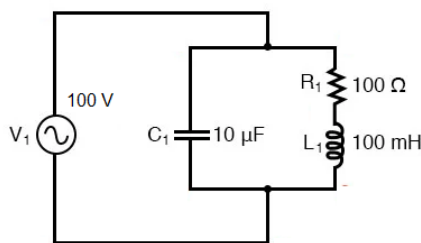

Fig.4   [(CO4) (Remember/LOCQ)]

(b)   A 5μF capacitor is connected in series with a variable inductor and a fixed resistor to a 100V, 100 Hz source. Evaluate the value of inductance for which the current will be –
        (i) 3A, 0.8 lagging and (ii) 3A, 0.8 leading.   [(CO4) (Evaluate/HOCQ)]

(c)   A choke coil is connected to 240V a.c. supply. When the frequency of supply is 50Hz, an ammeter connected in series with the choke coil reads 60A. On increase the frequency to 80 Hz, the same ammeter reads 40A. Solve the circuit to find out the value of inductance, resistance and p.f of the coil.
      [(CO4) (Apply/IOCQ)]

4 + 3 + (2 + 2 + 1) = 12

Group - D

6.   (a)   Build the Torque equation of a DC Motor.   [(CO2) (Create/HOCQ)]

(b)   Three chokes each of resistance 40 Ω and inductance 0.3H are connected in star to a 3-phase 440V balanced supply. Find out (i) phase current, (ii) line current, (iii) power factor and (iv) the active power and reactive power.
      [(CO2) (Remember/LOCQ)]

6 + (1 + 1 + 2 + 1 + 1) = 12

7.   (a)   Illustrate the three-phase power measurement with the help of two wattmeters. Draw the circuit diagram and phasor diagram. Also find the expression of power factor of a 3-phase load. [(CO4) (Understand/LOCQ)]

(b) A shunt wound dc generator has an induced voltage of 200 V. The terminal voltage is 180 V. Determine the load current if the field and armature resistances are 100 Ω and 0.1 Ω respectively. [(CO2) (Evaluate/HOCQ)]

7 + 5 = 12

Group - E

8. (a) Explain the operating principle of 3-phase induction motor.
[(CO6) (Understand/LOCQ)]
(b) The open circuit (O.C.) and short circuit (S.C.) tests conducted on a 230/115V, 1000VA transformer gave the following readings:

O.C. Test :	230 V	0.45 A	30 W
S.C. Test :	19.1 V	8.7 A	42.3 W

Solve for the parameters of the equivalent circuit w.r.t HV side of the transformer and the efficiency of the transformer at full load 0.8 power factor.
[(CO5) (Apply/IOCQ)]
(c) The maximum efficiency of a transformer occurs at full load and the total loss (core loss & copper loss) during full load is 1000W. Estimate the total loss during half load. [(CO5)(Evaluate/HOCQ)]

4 + (3 + 3) + 2 = 12

9. (a) The voltage applied to the stator of a 3-phase, 4-poleinduction motor has a frequency of 50Hz. The frequency of the EMF induced in the rotor is 1.5Hz. Calculate slip and speed at which the motor is running.
[(CO6) (Remember/LOCQ)]
(b) Explain why the induction motor cannot runs at synchronous speed.
[(CO6) (Understand/LOCQ)]
(c) A 50 kVA transformer has a core loss of 400W and full load copper loss of 800W. If the power factor of the load is 0.8, solve for: (i) the full load efficiency; (ii) the load in kVA at which maximum efficiency occurs; (iii) the maximum efficiency.
[(CO5)(Apply/IOCQ)]
(d) "Short circuit test of the transformer is being carried out by giving supply voltage to the HV side of the transformer." Justify the statement.
[(CO5) (Evaluate/HOCQ)]

2 + 2 + 6 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	34.37%	43.75%	21.88%

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
CSE A	Joining Code: 3crimqs Submission Link: https://classroom.google.com/c/NDE1MTA4NTQ2NDU5/a/NDczMzYyMzI2ODg4/details
CSE B	Joining Code: wct65q7 Submission Link: https://classroom.google.com/c/NDA1MjEyNjQyMjQx/a/NDY2ODIwODAxOTk1/details
CSE C	Joining Code: exipu2t Submission Link: https://classroom.google.com/c/NDA2MDEwNzM2MjMx/a/NDU5NTkyMzY1NjY4/details
ECE A	Joining Code: uyfx74l Submission Link: https://classroom.google.com/c/NDAwOTEyNDA4MTcz/a/NDU5NTkyODM2NDIy/details
ECE B	Joining Code: doek3ts Submission Link: https://classroom.google.com/c/NDA1MjI2ODkxMjM5/a/NDY2ODI1OTY2ODEx/details
ECE C	Joining code: gwnlihb Submission Link: https://classroom.google.com/c/NDA2MDQzOTgxNjI5/a/NDczNzk5OTk3MzE5/details
AEIE	Joining Code: 5skkpuk Submission Link: https://classroom.google.com/c/NDAwOTExNDM5Nzk4/a/NDY2ODE5ODMyMTI3/details
CSBS	Joining code: pztfp6r Submission Link: https://classroom.google.com/u/0/w/NDA2MDA5Mjc4OTkx/tc/NDY2ODI2NjI4NDA0
IT	Joining code: 7nqzjbm Submission Link: https://classroom.google.com/c/NDA2MDQzOTY1NjE4/a/NDY3MTY1NTY4NzYy/details
BACKLOG (new syllabus) for all Departments	Joining Code: hrlza5b Submission Link: https://classroom.google.com/c/NDYyMDM2NTM3Mzg1/a/NDYyMDM2NTM4MTc5/details