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) Superposition theorem is applicable to
(a) current and voltage calculations (b) power calculations
(c) current and power calculations (d) voltage and power calculations

(ii) Under maximum power transfer condition, the efficiency is
(a) 100% (b) 75% (c) 50% (d) 25%.

(iii) In a pure inductive circuit
(a) The current is in phase with the voltage
(b) The current lags behind the voltage by 90^0
(c) The current leads the voltage by 90^0
(d) The current can lead or lag by 90^0

(iv) 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) $X_L = 0\Omega$

(v) The number of parallel paths in lap connected armature winding of a 4-pole dc machine is
(a) number of poles (b) half the number of poles
(c) two (d) four.

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

(vii) A 3 phase 4 wire system supplies a balanced star load. The current in each phase is 5 A. The current in the neutral wire will be
(a) 5 A (b) 0 A (c) 2.887 A (d) 8.66 A

(viii) In a three phase, delta connected system
(a) $I_L = I_{ph}$ (b) $I_L = 3I_{Ph}$ (c) $I_L = \sqrt{3}I_{Ph}$ (d) $I_L = \sqrt{2}I_{Ph}$

(ix) A 50 Hz three phase induction motor has rated speed of 725 rpm. The number of poles is
(a) 2 poles (b) 6 poles (c) 4 poles (d) 8 poles

(x) The transformer ratings are usually expressed in.....
(a) volts (b) amperes (c) KW (d) KVA.

Group – B

2. (a) Find the current through the 2 Ω resistor in Fig.1 using Norton's theorem.

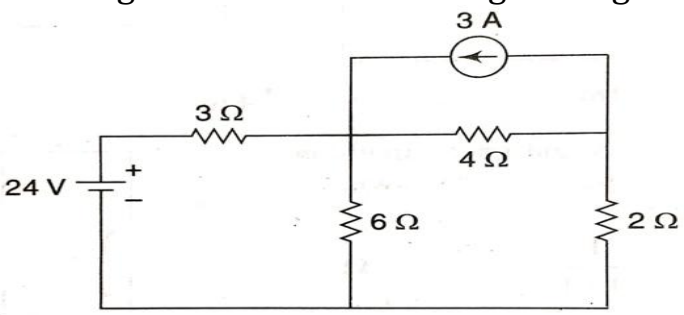

Fig.1

(b) Find the value of R in the circuit of Fig.2 such that maximum power transfer takes place. What is the amount of this power?

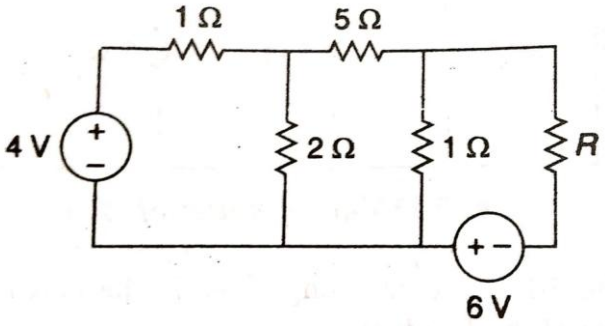

Fig.2

6 + (5 + 1) = 12

3. (a) A coil of 600 turns and of resistance of 20 Ω is wound uniformly over a steel ring of mean circumference 30 cm and cross-sectional area 9 cm^2. It is connected to a supply of 20 V (DC). If relative permeability of the ring is 1600, find (i) the reluctance, (ii) the magnetic field intensity, (iii) the mmf and (iv) the flux.

(b) The combined inductance of two coils connected in series is 0.60 H and 0.40 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 find: (i) the mutual inductance and (ii) the co-efficient of coupling.

8 + 4 = 12

Group – C

4. (a) Compare the average value, RMS value, form factor and peak factor of full wave rectified sine wave and half wave rectified sine wave.

(b) A parallel circuit consists of two branches. One branch consists of a resistance 15 Ω and an inductive reactance of 25 Ω in series; while another branch consists of a resistance of 12 Ω and a capacitive reactance of 10 Ω in series. The circuit is energised by an ac source 100 V, 50Hz. Calculate: (i) current in each branch and the supply current, (ii) power factor of each branch and power factor of the whole circuit, (iii) total power consumed by the parallel combination.

6 + 6 = 12

5. (a) An ac series circuit consisting of a pure resistance of 25 Ω, inductance of 0.15 H and capacitance of 80 μF is supplied from a 230 V, 50 Hz ac source. Calculate the (i) current, (ii) power factor, (iii) active power, (iv) the frequency at which maximum current flows through the circuit and (v) the amount of maximum current in the circuit. Also draw the phasor diagram.

(b) Derive the resonating frequency for the parallel circuit of Fig.3.

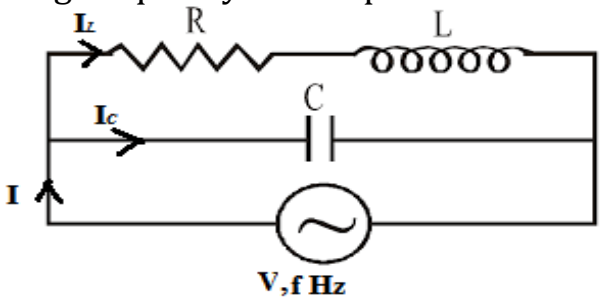

Fig.3

(7 + 1) + 4 = 12

Group – D

6. (a) Show the connection diagram for power measurement in 3 phase system using two wattmeter method. Also derive the expression for power factor with the help of phasor diagram.

(b) Three similar coils connected in star take a total power of 1200W and a power factor of 0.8 lagging from a 3-phase, 400V, 50 Hz supply. Calculate the resistance and inductance of each coil.

(c) Three chokes each of resistance 4 Ω and inductance 0.02 H are connected in delta to a 3-phase, 440V, 50 Hz supply. Calculate the (i) line current, (ii) phase current, (iii) active and reactive power drawn by the chokes.

(2 + 4) + 3 + 3 = 12

7. (a) A 4 pole, DC generator with wave wound armature has 51 slots each having 24 conductors. The flux per pole is 10 mWb. At what speed must the armature rotate to give an induced emf of 240V. What will be the voltage developed, if the winding is lap connected and the armature rotates at the same speed as wave wound armature?

(b) A 500 V DC shunt motor runs at 250 rpm at rated full load condition and takes an armature current of 200 A. The armature resistance is 0.12 Ω. Find the speed

of the motor when the field circuit resistance is increased such that the flux is reduced to 80% of the normal value and the motor is loaded for an armature current of 100 A.

6 + 6 = 12

Group – E

8. (a) Draw the phasor diagram of a single-phase transformer under lagging load condition.

   (b) The following test results were obtained on a 2 kVA, 200/100V,50Hz single phase transformer:
   Open Circuit Test: 200V, 1.2A, 50W
   Short Circuit Test: 20V, 10 A, 60W on H.V. side
   Determine: (i) the circuit constants, (ii) the efficiency at half load and full load at 0.8 power factor lagging.

4 + 8 = 12

9. (a) Explain how a rotating magnetic field is produced in the air gap of a three-phase induction motor.

   (b) What is slip? Deduce a relationship between rotor current frequency and supply frequency in terms of slip.

   (c) A three-phase, 4 pole, 50 Hz induction motor has a slip of 0.8% at no load and 2% at full load. Calculate
   (i) the synchronous speed, (ii) the no-load speed, (iii) the full load speed and (iv) the frequency of rotor current at full load.

4 + 4 + 4 = 12

Department & Section	Submission Link
BT	https://classroom.google.com/c/MzExMjA5ODk0ODcw/a/MzU5MzczNTM2NDkw/details
CE Sec A	https://classroom.google.com/c/MzExMTY5MzI3MDEx/a/MzU5NzEyNzg1NzI3/details
CE Sec B	https://classroom.google.com/c/Mjk4MDY3NDQ5ODg5
CHE	https://classroom.google.com/c/MzExOTI0NjI4MDUw/a/MzU5Mzg1NjUyMTMz/details
EE	https://classroom.google.com/c/MzExMjQ0NTIwNjYz/a/MzYwMDM4NTA0MTgx/details
ME Sec A	https://classroom.google.com/c/MzEwMTI4OTcwMTIx/a/MzU5MzM2NzU3ODE3/details
ME Sec B	https://classroom.google.com/c/MzEyMjc4NzI4Njg0/a/MzU5NDIzMDQ4NDYx/details
BACKLOG (BT, CE, CHE, EE, ME)	https://classroom.google.com/c/MzU5MzYyNzE5Mjg3/a/MzU5MzYyODAwNzM0/details