2016

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 x 1=10]

　i)　If V is the voltage source and RL is the load resistance then what is the maximum power that can be dissipated in the load resistance ?

　　　a) V^2/ R_L　　　b) $V^2/ 2 R_L$　　　c) $V^2 R_L$　　　d) $V^2/4R_L$

　ii)　The efficiency in case of maximum power transfer theorem is

　　　a) 100%　　　b) 50%　　　　c) less than 50%　　　d) 50% - 100%

　iii)　The equivalent capacitance across a-b terminals is
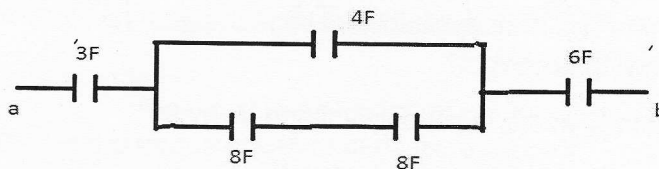
　　　a) 1.8F　　　b) 1.6F　　　c) 12.2 F　　　d) 17 F

　iv)　What is the unit of magnetic flux density ?

　　　a) Tesla　　　b) Weber　　　c) Newton　　　d) Weber per meter

v) If coefficient of coupling is = 1 then the mutual inductance between two coils of self-inductances 2mH and 8mH will be

a) 5 mH   b) 10 mH   c) 4 mH   d) 16 mH

vi) If a dc series motor is started at no load, the speed will be

a) very low   b) rated speed   c) very high   d) half the rated speed

vii)
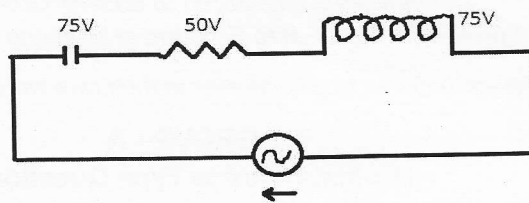
In the above circuit the potential difference across different elements are given. What is the power factor of the circuit ?
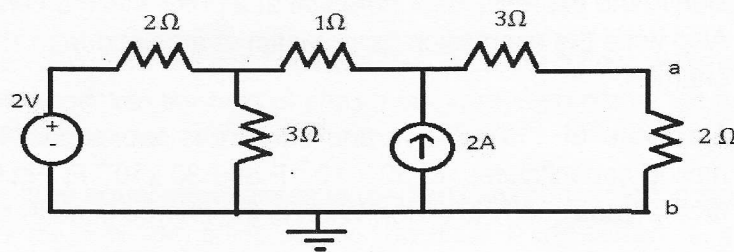
a) 0   b) 0.5   c) 1   d) cannot be determined

viii) Lamination in core is used to minimize

a) copper loss   b) hysteresis loss
c) eddy current loss   d) all of the above

ix) In a transformer exciting current is made up to two components; namely magnetizing current(I_m) and active component of no load current (I_c). With negligible leakage impedance drop, which of the following is correct?

a) both I_m and I_c lag supply voltage V_1 by 90°

b) both I_m and I_c stay in phase with V_1

c) I_m lags V_1 by 90° and I_c leads V_1 by 90°

d) I_m lags V_1 by 90° and I_c stays in phase with V_1

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x)   The full load slip of a 60Hz, 12 pole squirrel cage induction motor is
     5%, its full load speed is _____ rpm.

     a) 600   b) 570   c) 500   d) 475

GROUP - B

2 a) Using Thevenin's theorem find the current flowing through 2Ω
      resistor connected between terminal a and b in the following
      circuit:-

   b) State Superposition theorem. Find the current in 50Ω resistor in
       the following figure using Superposition theorem.
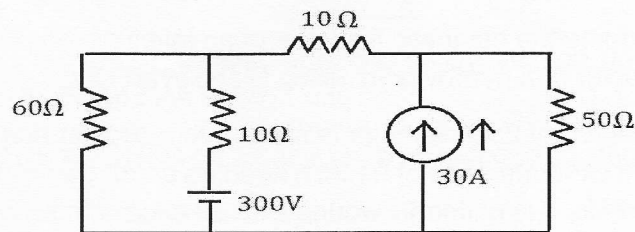
                                                        5+(2+5)=12

3 a) Derive the torque equation of dc motor.

   b) A shunt generator delivers 50kW at 250V when running at 400r.p.m.
       The armature and field resistance are 0.02Ω and 50Ω respectively.
       Calculate the speed of the machine when running as shunt motor
       and taking 50kW input at 250V. Allow 1V per brush for contact drop.

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c) Draw the speed-torque and speed-armature current characteristics of a D.C. series motor.

$3+7+2=12$

GROUP - C

4   a) A positive charge Q is uniformly distributed over an imaginary thin spherical shell of radius 'a' in air. Using Gauss Law, calculate the field intensity at any point inside and outside the shell.

b) Derive the expression for potential at a point within an electric field. Also write the expression for potential at a point due to 'n' number of charges.

c) A voltage of 110V DC is applied across two capacitors in series having capacitances of 50×10^{-6} F and 30×10^{-6} F. Find the voltage drop across each capacitor. What is the charge in each capacitor?

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

5   a) Mention two similarities and two dissimilarities between magnetic and electric circuit.

b) Determine the magnetic field due to an infinitely long current carrying conductor at a nearby point using Biot-Savart Law.

c) A steel rod of 2cm diameter is made into a circular ring having a mean circumference of 94.3cm keeping an air gap of 1mm between two ends. It is uniformly wound with an exciting coil consisting of 600 turns and excited with a current of 2.5A. Neglecting magnetic leakage, calculate i) MMF ii) Magnetic Flux iii) Reluctance iv) Flux Density v) Relative Permeability of steel (assume that steel part takes about 40% of total ampere turns. $2+5+5=12$

GROUP - D

6   a) Obtain the expression for the peak factor and form factor for a square wave.

      b) Define active and reactive power.

      c) Two coils are connected in parallel across 200V and 50Hz mains. One coil takes 0.8KW and 1.5KVA . The other coil takes 1 KW and 0.6KVA. Calculate the resistance and reactance of each coil.

<div align="right">4+3+5=12</div>

7   a) Explain how we can measure the 3φ power by two wattmeter method with the help of phasor diagram. Also derive the formula of the power factor angle.

      b) Three equal impedances of (8+j12)Ω are connected in star across 415V, 3 phase, 50Hz supply. Calculate i) line current ii) power factor iii) active and reactive power drawn by the load

<div align="right">7+5=12</div>

GROUP - E

8   a) Why is open circuit test performed on low voltage side and short circuit test on high voltage side?

      b) Derive the condition for maximum efficiency in a single phase transformer.

      c) Determine the full-load efficiency at unity power factor for the 50KVA, 2400/120V, 50Hz single phase transformer of which the following are test figures:

      O.C. Test: 120V, 9.65A, 396W
      S.C. Test: 92V, 20.8A, 810W

<div align="right">4+4+4=12</div>

9.   a) Explain how the rotating magnetic field is produced in 3φ induction motor.

b) A 500V, 3φ, 50Hz induction motor develops an output of 15 KW at 950 R.P.M. If the input p.f. is 0.86 lagging, Mechanical losses are 730W and stator losses 150W, find the :

   i) slip   ii) rotor Cu loss   iii) motor input   iv) line current

c) Derive the condition for maximum torque in 3φ induction motor.

5+5+2=12