Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B. Tech (Old)/SEM-1/EE-101/2011-12

2011
BASIC ELECTRICAL ENGINEERING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Read the following units :

I) $\sec^{-1}$

II) $\text{radian}^2/\sec^2$

III) sec

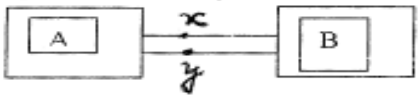
IV) ohm

The units of R/L, 1/LC, RC and $\sqrt{\left(\frac{L}{C}\right)}$ respectively are

a) I, II, IV and III b) III, II, I and IV

c) II, IV, I and III d) I, II, III and IV.

ii) If a network *A* has a voltage source that is controlled by the network *B*, then is it possible to find Thevenin equivalent at *x*, *y* terminal ?



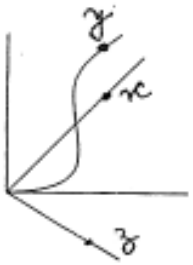
a) Yes

b) No

c) Depends upon initial condition

d) Sometimes but not always.

iii) Which is the BH curve of a ferromagnetic material ?



a) x b) y

c) z d) none of these.

iv) Superposition theorem is not valid for

a) voltage responses b) current responses

c) power responses d) linear networks.

v) Total instantaneous power supplied by a 3-phase *ac* supply to a balanced R-L load is

a) zero

b) constant

c) pulsating with zero average

d) pulsating with non-zero average.

vi) The Thevenin equivalent resistance R_{th} for the given network is

a) 1 ohm b) 2 ohm

c) 4 ohm d) infinity.

vii) In an RL series circuit V_L ..... V_R, by .....degrees.

a) lags, 45 b) lags, 90

c) leads, 90 d) leads, 45.

viii) The rms value of a sinusoidal *ac* current is equal to its value at

a) 60 degree b) 45 degree

c) 30 degree d) 90 degree.

ix) According to Gauss theorem, the surface integral of the normal component of the electric flux density D over a closed surface containing charge Q is

a) Q b) $Q/\varepsilon_{\circ}$

c) $Q\varepsilon_{\circ}$ d) $Q^2/\varepsilon_{\circ}$

x) In a 6-pole wave wound armature of a DC motor, the number of parallel paths is equal to

a) 2 b) 4

c) 6 d) 8.

xi) An ideal current source has

a) no resistance

b) very high resistance in series

c) infinite resistance in parallel

d) low resistance in parallel.

xii) The excitation current of a transformer is of the order of

a) 2% of full load current

b) 10% of full load current

c) 50% of full load current

d) 75% of full load current.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. State and explain Faraday's laws of electromagnetic induction.

3. A mild steel ring having a cross-sectional area of $10\,cm^2$ and mean circumference of 60 cm has a coil of 300 turns wound around it. Determine

   a) reluctance of the steel ring

   b) current required to produce a flux of 1mWb in the ring. Relative permeability of the given steel is 400 at the flux density developed in the core.

   c) if a slit of 1 mm is cut in the ring, what will be the new value of the current ?

   Assume no fringing effect.

4. Write short notes on any *two* of the following : $2 \times 2\frac{1}{2}$

   a) Power factor

   b) Real and apparent power

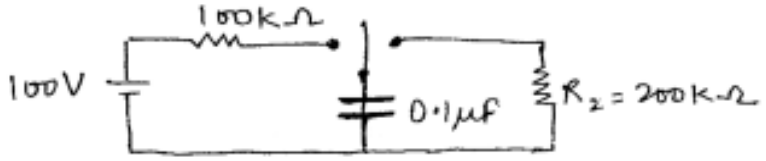
   c) Form factor of a sinusoidal wave.

5. a) Derive expression for quality factor for a series resonance circuit. 2

   b) A circuit having a resistance of 4 ohm, inductance of 0·5H and a variable capacitance in series is connected across a 100V, 50Hz supply. Calculate the capacitance to give resonance and the Q-factor of the circuit. 3

6. a) State Gauss theorem. 2

b) Determine mathematical expression for variation of voltage across the capacitor and the current through the capacitor following the closure of the switch at $t = 0$ sec on position 1. 3



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Prove that the efficiency of a transformer is maximum when iron loss is equal to copper loss.

b) Following test data were obtained on a 20kVA, 50Hz, 1 ph, 2000/200V transformer.

No load test : 200V, 1A, 120W

Short circuit test : 60V, 10A, 300W

Find the

i) efficiency of the transformer at half of the full load and 0·8 pf lag.

ii) maximum efficiency and the load at which it occurs. 5 + 10

8. a) Deduce the *emf* equation of a DC machine.

   b) A 4-pole, 500V shunt motor has 720 wave connected conductors on its armature. The full load armature current is 60A and the flux per pole is 0·3Wb. Armature resistance is 0·2 ohm. Calculate the full load speed of the motor to maintain rated terminal voltage at full load.

   c) What do you mean by back *emf* of a DC machine ?

   5 + 7 + 3

9. a) Explain how a rotating field is produced in a three phase induction motor.

   b) Why does Induction motor never attain synchronous speed ?

   c) A three phase 6-pole, 50Hz induction motor has slip of 1% at no load and 3% at full load. Calculate

      i) synchronous speed
      ii) no load speed
      iii) full load speed
      iv) frequency of rotor current at standstill
      v) frequency of rotor current at full load. 5 + 3 + 7

10. a) Prove that the power factor of a balanced three phase load can be calculated from the readings of two wattmeters used to measure three phase power.

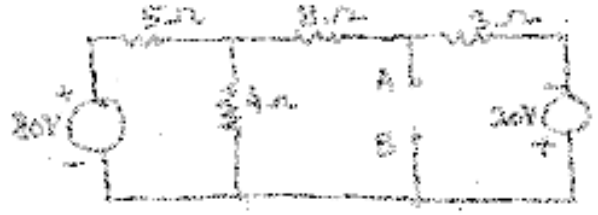
    b) A balanced three phase load consists of three coils each of resistance 4 ohm and inductance 0·2H. Determine total power when the coils are

       i) star connected
       ii) delta connected

       to a 440V, 3-phase, 50Hz supply. $7\frac{1}{2} + 7\frac{1}{2}$

11. a) Apply the principle of superposition to the network shown to find out the current in the 3 ohm resistance, connected between C & D.

b) Obtain Thevenin and Norton equivalent circuits at AB as shown in the Fig.



c) Calculate the value of R that will absorb maximum power from the source. Also compute the value of maximum power.

5 + 5 + 5