Diploma in Electrical and Mechanical Engineering

Term-End Examination

June, 2007

BEE-031 : ELECTRICAL TECHNOLOGY

Time : 2 hours   *Maximum Marks : 70*

Note :   Answer **five** questions in all. Question number 1 is **compulsory**. Attempt any **four** from the remaining questions. Use of calculator is allowed.

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1. (a) State true or false for the following statements :   *7×1=7*

    (i)   The energy sources (voltage or current) which do not change their direction with time are called direct current or DC sources.

    (ii)   Inductors store energy in an electrical field.

    (iii)   Current flowing through an inductor leads the voltage applied by 90°.

    (iv)   Power factor (cos α) is the ratio of active power to apparent power.

    (v)   A synchronous motor can run at variable speed.

    (vi)   Iron losses of a transformer can be determined by performing the short circuit test.

    (vii)   DC shunt motors are constant speed motors.

    (b)   Fill in the blanks with the correct answer from the given choices :   *7×1=7*

(i)   Capacitors store energy in _____ .

   (a)   magnetic field

   (b)   variable field

   (c)   electric field

   (d)   none of the above

(ii)   In an AC circuit, average value of current (i_{av}) is given by i_{av} = _____ .

   (a) $\dfrac{2}{\pi} I_m$

   (b) $\dfrac{1}{\pi} I_m$

   (c) $\dfrac{3}{\pi} I_m$

   (d) $2\pi I_m$

(iii)   Current flowing through a capacitor leads the voltage applied by _____ .

   (a)   0°

   (b)   45°

   (c)   90°

   (d)   15°

(iv) Unit of active power is _____ .

(a) watt

(b) volt-ampere

(c) volt-ampere reactive

(d) none of the above

(v) The direction of induced emf can be determined by _____ .

(a) Fleming's Right Hand Rule

(b) Fleming's Left Hand Rule

(c) Kirchhoff's Current Law

(d) Thevenin's theorem

(vi) For a DC shunt motor, if ϕ is constant then torque 'T' developed is _____ .

(a) $T \propto I_a$

(b) $T \propto \dfrac{1}{I_a}$

(c) $T \propto \dfrac{I_a}{2}$

(d) $T \propto I_a^2$

(vii) In a basic transformer, the ratio of induced voltages in primary and secondary windings is proportional to the ratio of turns in primary and secondary windings and is given by
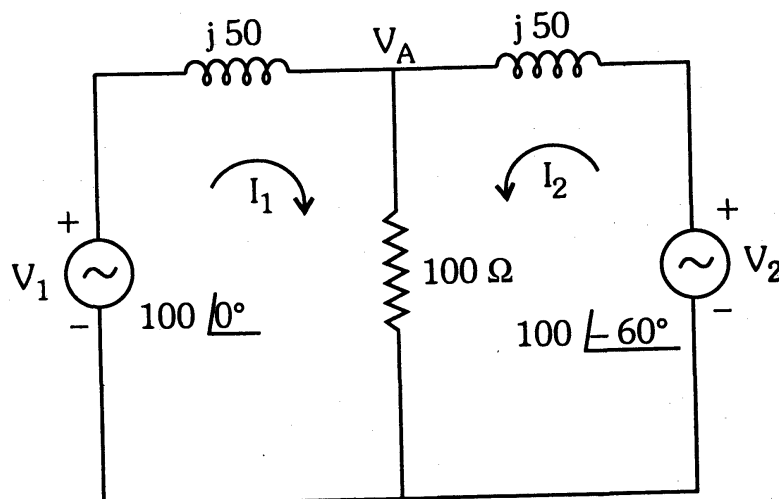
(a) $\dfrac{E_2}{E_1} = \dfrac{N_1}{N_2}$

(b) $\dfrac{E_1}{E_2} = \dfrac{N_1}{N_2}$

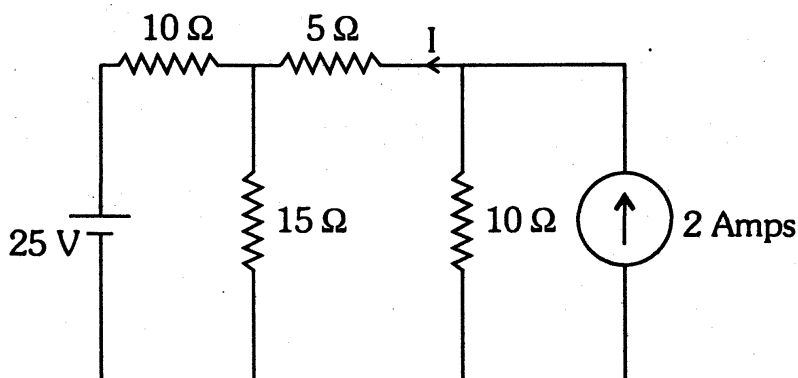(c) $\dfrac{E_1}{E_2} = \left(\dfrac{N_1}{N_2}\right)^2$

(d) $\dfrac{E_1}{E_2} = N_1 N_2$

2. (a) Explain Kirchhoff's Voltage Law with the help of a simple circuit diagram.   7

(b) From the circuit given below, calculate I_1 and I_2 using Kirchhoff's Laws :   7

3. (a) State and explain Thevenin's theorem. 7

(b) Using the superposition theorem, find the current through the 5 Ω resistor. 7

4. (a) Briefly give the constructional details of a DC machine. 4

(b) The emf induced in the armature of a 500 kW, 240 volts, shunt generator is 260 volts, when the field current is 18 Amps. The generator is supplying power to a given load at its rated terminal voltage. The armature circuit resistance is 0·008 ohms and brush contact voltage drop is 2 volts. Determine the following :

(i) Load current

(ii) Power generated

(iii) Power output

(iv) Electrical efficiency 10

5. (a) What are the copper losses and iron losses in a transformer and how are these losses reduced ?   7

   (b) A single phase transformer has 400 primary and 900 secondary turns. The net cross-sectional area of core is 50 cm^2. The primary winding is connected to 50 Hz supply at 440 volts. Calculate

   (i) Peak value of flux density in the core

   (ii) Voltage induced in the secondary winding

   (iii) Turns ratio   7

6. (a) Draw the cross-section of a 3-phase induction motor and briefly explain the various parts.   7

   (b) A 3-phase induction motor, 500 volts, 6-pole, 50 Hz, develops 50 bhp at 900 rpm at a p.f. of 0·80 lagging. Calculate

   (i) rotor copper loss

   (ii) total power developed

   (iii) number of cycles per minute of the rotor emf

   The stator losses are 2000 watts. All other losses are negligible.   7

7. (a) Briefly explain the working principle of a 2-pole alternator with the help of a diagram.   7

   (b) How does an induction motor differ from a synchronous motor ?   7

8. Explain any *two* of the following : 2×7=14

(a) What is the principle on which a synchronous motor works ? What is 'pull-out' torque ?

(b) What is meant by the term 'synchronizing of alternators' ? How is synchronization of alternators achieved ?

(c) What are instrument transformers ? Draw the circuits of potential transformer and current transformer.