SECTION A

Answer any **THREE** *questions from this section.*

1. (a) (i) State Norton's theorem.

    (ii) Figure 1 shows a d.c. circuit. Using Norton's theorem, determine the current flowing in the 4Ω resistor. Assume the voltage source has negligible internal resistance.
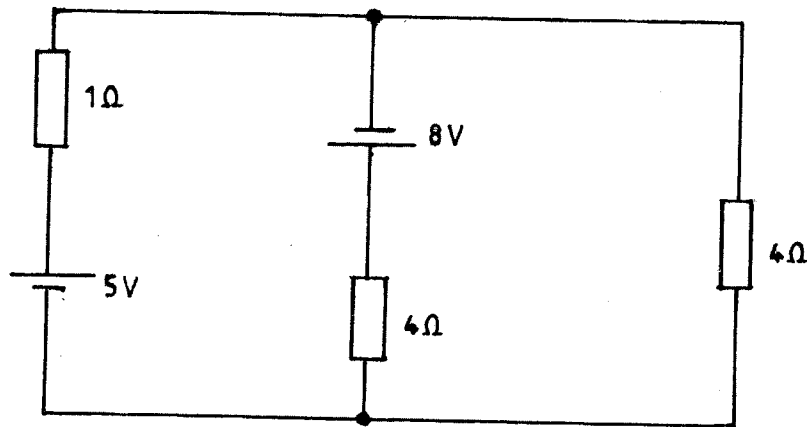
(10 marks)

Fig. 1

    (b) Sketch the growth and decay curves for d.c. R-L circuits.

(4 marks)

    (c) A d.c. circuit consists of a resistor connected in series with a $0.5\mu F$ capacitor and has a time constant of 15 ms. Determine the:

        (i) value of the resistor;

        (ii) capacitor voltage 5 ms after connecting the circuit to a 10 V supply.

(6 marks)

2. (a) State the functions of the following in a d.c. machine:

        (i) the yoke;

        (ii) pole shoes.

(4 marks)

   (b) (i) With the aid of sketches, distinguish between a lap winding and wave winding for d.c. machines.

(ii) An 8-pole, lap wound d.c. machine has 900 conductors and flux per pole of 0.02 wb. Determine the generated emf when running at a speed of 400 rev/min.

(7 marks)

(c) (i) State **three** applications of stepper motors.

(ii) With the aid of a labelled diagram, explain the operation of a split phase induction motor.

(9 marks)

3. (a) With the aid of diagrams, explain how torque is produced in a three phase induction motor.

(9 marks)

(b) (i) State **three** advantages of wound rotor induction motors as compared with the cage type.

(ii) A stator winding supplied from a three phase 60 Hz system is required to produce a magnetic flux rotating at 1800 rev/min. Determine its number of poles.

(7 marks)

(c) Explain why a **three** phase synchronous motor is not self starting. (4 marks)

4. (a) (i) With aid of a labelled diagram, explain how three phase E.m.fs are generated.

(ii) Sketch the waveforms for (a) (i).

(7 marks)

(b) Derive the expression for power in a three star connected balanced loads. (4 marks)

(c) (i) Draw a Delta-star transformer connected winding and show its terminal markings.

(4 marks)

(ii) A three phase transformer has 200 primary windings and 20 secondary windings. If the supply voltage is 2.2 kV. Determine the secondary line voltage on no-load when the windings are connected in:

(I) star-delta;
(II) delta-star.

(5 marks)

5. (a) (i) State the **two** components of a complex wave. (2 marks)

(ii) Differentiate between odd and even harmonics. (4 marks)

(iii) A complex voltage is given by

$$e = 140 \sin wt + 40 \sin 3wt$$

The corresponding current in the load is given by

$$i = 10 \sin (wt + 60°) + 8 \sin (3wt - 30°).$$

Determine the total power supplied.　　　　　　(4 marks)

(b) (i) State **two** most important properties of two port network.　　(2 marks)

(ii) Sketch the characteristic impendance/frequency characteristics of a T constant-K low pass filter.　　　　　　(2 marks)

(c) A constant K low pass filter using a π section has a design impendance of $0.4K\Omega$ and a cut-off frequency of 2 kHz. Determine the component values for the filter.

　　　　　　(6 marks)

SECTION B

*Answer any **TWO** questions from this section.*

6. Figure 2 shows three views of an object drawn in third angle projection. Copy the views using AutoCAD and insert **six** major dimensions. Draw the symbol of third angle projection. Print your work and attach it with your other completed drawings. (20 marks)
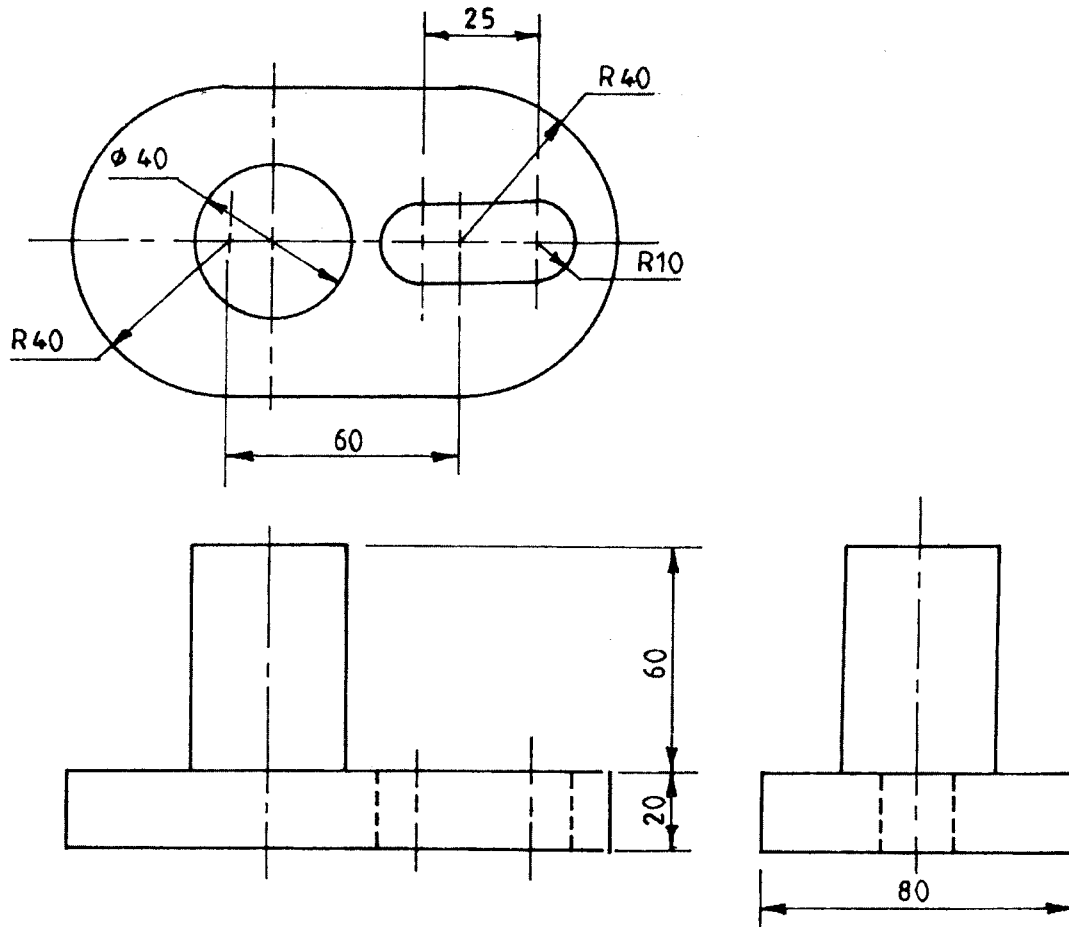
Fig. 2

7.   (a)   Sketch the following BS 3939 electrical and electronic symbols:

        (i)   Switched socket outlet;
        (ii)   One way switch;
        (iii)   Cooker unit;
        (iv)   Energy meter;
        (v)   Isolator;
        (vi)   Battery;
        (vii)   Inductor;
        (viii)   NOR gate;
        (ix)   Potentiometer;
        (x)   AND-gate.

(10 marks)

    (b)   Draw the transistor amplifier circuits connected in the following configurations:

        (i)   common-emitter;

        (ii)   common-collector.

(10 marks)

8.   Draw separately, the control and power circuit diagrams for automatic star-delta starting for a three phase induction motor with time delay.   (20 marks)

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