SECTION A

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

1. (a) State any **two** disadvantages of c.g.s system of units. (2 marks)

(b) Explain the following errors in measurements stating how each can be minimized;

(i) gross;
(ii) systematic. (6 marks)

(c) The expression of eddy current loss in Watts per unit length of wire of a circular cross section is given by:

$$W = f^x B^y_{max} d^z \rho^k$$

Where;
f = frequency of supply in hertz
B_{max} = maximum value of flux density
d = diameter of the wire
ρ = resistivity of the wire material

Using MKSA System of units, determine the value of constants x, y, z and k. (12 marks)

2. (a) State **three** factors that affect the performance of rectifier - type instruments. (3 marks

(b) With the aid of a circuit diagram of a Q-meter show that the self capacitance (Cd) determined by frequency doubling method is given by:

$$Cd = \frac{C_1 - 4C_2}{3}$$ (6 marks)

(c) (i) With the aid of a labelled diagram describe the measurement of flux density in a ring specimen.
(ii) Derive the expression for the flux density measured in c(i). (8 marks)

(d) In measurement of resistance by substitution method, a standard 0.5MΩ resistor was connected to a galvanometer of 20 kΩ. The galvanometer deflection gave 51 divisions with the standard resistor and 81 divisions with the unknown resistance. Determine the value of the unknown resistor. (3 marks)

3. (a) Describe the following sources of errors in ac bridges stating the precautions taken to reduce them.
(i) eddy current errors;
(ii) stray conductance effects. (6 marks)

(b) Figure 1 shows a Hay's bridge.

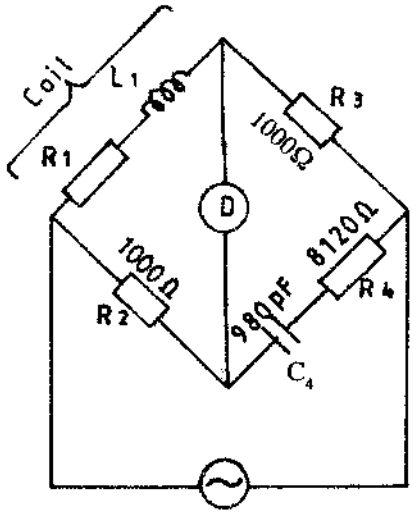

Fig. 1

(i) Derive the expression for balance condition.

(ii) Calculate the resistance R_1 and inductance L_1 of the coil at a frequency of 4 kHz. (9 marks)

(c) Two wattmeters are connected to measure the input power to a 3 phase load operating at a power factor of 0.4 lagging. If the total power recorded is 30 kw, determine the reading of each wattmeter. (5 marks)

4. (a) Differentiate between the following failures:

(i) degradation and catastrophic;

(ii) complete and partial. (4 marks)

(b) With the aid of curve(s) explain the relationship between reliability and cost. (9 marks)

(c) An electronic equipment used in an office comprises of:

10 transistors with a failure rate of 0.01% per 1000 hours each.
40 resistors with a failure rate of 0.04% per 1000 hours each.
20 capacitors with a failure rate of 0.03% per 1000 hours each.
50 soldered connections with a failure rate of 0.01% per 1000 hours each.

Determine the reliability of this equipment;

(i) for an operating period of 1000 hours;

(ii) with a mean time between failure of 100,000 hours during the same period of operation as in c(i). (7 marks)

e the soldering methods used in electrical works.

ine the procedure of removing unwanted solder on a joint by use of ldering pump. (6 marks)

e any **three** types of sweeps used in a CRO in modulation measurement. cribe frequency measurement using Lissajous pattern method in CRO. (6 marks)

oil instrument has an internal resistance of 15Ω and gives a full scale ith a current of 40 mA.

h the connection diagram that can be used to extend the range of the ammeter, rmine the value of the resistance required for the ammeter to measure a ent of 50A. (4 marks)

ors have the following ratings $R_1 = 40 \pm 5\%\Omega$, $R_2 = 80 \pm 5\%\Omega$, and Ω. If the resistors are connected in series, determine the percentage r due to the connection. (4 marks)

SECTION B

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

following terms in relation to semiconductor theory:

sion;
nbination. (6 marks)

the aid of a diagram the operation of an NPN transistor. (6 marks)

on current of a PN junction diode is 250 mA at a temperature of 300 k. e voltage that would have to be supplied across the junction to cause a ent of 10^5 A to flow (Take Boltzman's constant $K = 1.38 \times 10^{-23}$, electron $.6 \times 10^{-19}$) (4 marks)

led voltage - current (V-I) characteristic curve of a PN junction (4 marks)

7. (a) State **three**;

(i) differences between Bipolar and Unipolar junction transistors.
(ii) precautions that should be observed while handling MOSFETS. (6 marks)

(b) (i) Draw labelled schematic symbols of;

I P channel DEMOSFET;
II E - only N-channel MOSFET. (8 marks)

(c) Figure 2 shows a transistor amplifier circuit.
Determine:

(i) base current;
(ii) collector current;
(iii) collector to emitter voltage.

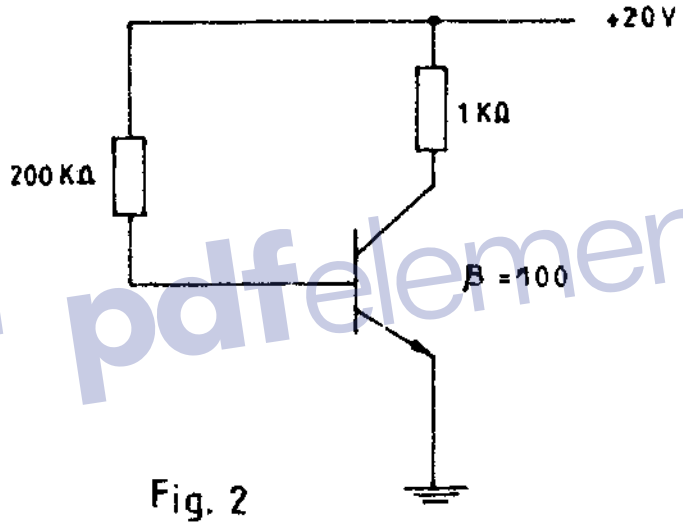

Fig. 2

(6 marks)

8. (a) State **three** properties of a cathode used in thermionic valves. (3 marks)

(b) With the aid of a labelled block diagram explain the operation of a cathode ray oscilloscope (CRO). (7 marks)

(c) Draw PNP transistor current regulator and explain its operation. (7 marks)

(d) For a Bipolar junction transistor show that

$$\beta = \frac{-\alpha}{1-\alpha}$$

Where β = common emitter gain
α = common base gain (3 marks)