Answer script upload link: https://forms.gle/qbdHGx3Rnih2qfXo6

ASUTOSH COLLEGE

(Affiliated to University of Calcutta)

Semester 5- Examination

Physics-Hons

Paper- CC12

Practical Examination

Full Marks-30

Time- 2Hrs

Answer any one question

1. Determine the band gap energy of the given semiconductor sample using four-probe method:

(a) Write down the working formula for resistivity measurement on a large sample in four probe method explaining all relevant symbols and draw the respective four-probe contact diagram. [4+4]

(b) Complete the following table for the study of the variation of voltage with temperature (T ^{0}K) at a constant current (I)= 2 mA.

Data Supplied:

Distance between the probes (s): 0.2 cm

Thickness of crystal (w): 0.050 cm

Correction Factor $G_7(\frac{w}{s})$ = 5.545

Serial No.	Temperature in ^{0}C	Voltage (V) mV	Temperature in ^{0}K	$\rho = \frac{\rho_0}{G_7(\frac{W}{S})}$ (ohm cm)	T^{-1} in K^{-1}	$log_{10}\rho$
1	27	153				
2	32	154				
3	37	150				
4	42	144				
5	47	133				
6	52	122				
7	57	110				
8	62	97				
9	67	85				
10	72	73				
11	77	64				

12	82	55				
13	87	47				
14	92	40				
15	97	35				
16	102	31				
17	107	27				
18	112	24				

[6]

(c) Draw $log_{10}\rho$ versus $\frac{1}{T}$ graph [6]

(d) Determine the value of energy band gap (E_g) of the given sample [4]

(e) (i) What are the advantages of four probe resistivity measurement method over two probe resistivity measurement method?

(ii) Discuss the relevance of drawing of $log_{10}\rho$ vs $\frac{1}{T}$ curve. [3+3]

2 (a) Draw the circuit diagram of a temperature controller using OPAMP, thermistor, transistor, relay and suitable resistances. [8]

(b) Design the following circuit with the following data and find out the values of required components. [8]

(i) D.C. Power Supply=±12V
(ii) Variation of thermistor voltage for a given series resistance with the variation temperature is given in the following table.
(iii) Resistance of the thermistor =170Ω and voltage across thermistor=205mV
(iv) (at Room Temperature 25^0 C)
(v) β of transistor=165
(vi) Collector current, I_C =80mA

Data Table for calibration of a thermistor:

No of Obs.	Temperature (^{0} C)	Thermistor Voltage (mV)
1	25	205.0
2	30	186.5
3	35	160.0
4	40	140.2
5	45	121.1
6	50	105.3
7	55	91.7
8	60	80.9
9	65	70.8
10	70	62.0
11	75	56.5
12	80	50.5

(c) (i) Draw calibration curve using above data in a mm graph paper.

(ii) To maintain the water bath at 50^0 C, calculate the reference voltage of the comparator of the above circuit. [6+2]

(d) (i) What is thermistor? Name one element, which can be used as a thermistor? ii) What is a relay? What do you mean by 12V ,150Ω relay? [3+3]

3. (a) Draw the necessary circuit diagram for drawing B − H loop of a specimen given in the form of an anchor ring. For calibration of the galvanometer use standard solenoid. [5]

Given:

No. of turns per unit length of the primary of the anchor ring	n_1	$440m^{-1}$
No. of turns in the secondary of the anchor ring	n_2	54
No. of turns per unit length of the primary of the solenoid	n_3	$620m^{-1}$
No. of turns in the secondary of the anchor ring	n_4	6000
Mean diameter of the core of the anchor ring	D_1	0.015m
Mean diameter of the primary of the solenoid	D_2	0.0265m
Mean value of $\frac{I}{d}$ (When current in the primary of the solenoid changes from +I to −I, d is the deflection on the galvanometer scale)	$\frac{I}{d}$	25.4 A/m

(b) Let the values of the magnetic field within the specimen are B_1 and B_2 when magnetizing current (through the primary of the anchor ring) values are I_1 and I_2 respectively. When current changes from I_1 to I_2, galvanometer shows a deflection d_1. Express $(B_1 - B_2)$ in terms of d_1, $\frac{I}{d}$ and the constants, mentioned in the above table.

(c) Given: $I_1 = 3.5A$

$I_2(A)$	$d_1(cm)$
-3.5	20.6
3.0	0.4
2.5	0.6
2.0	1.0
1.5	1.6
1.0	2.0
0.5	3.0
0.25	4.1

0.0	4.7
-0.25	7.0
-0.5	11.5

Find B_1, H_1. For all I_2 (given), find B_2, H_2. (2 + 2) + (4 + 4)

(d) Draw the part of B − H loop with the data you have (use only B_2 and H_2 values that you have calculated). 6

(e) (i.) At which step/steps of the experiment you need to demagnetize the specimen?
(ii.) Can you perform the experiment of drawing B − H loop without using the solenoid? Justify your answer briefly.

(3+4)