(This Question paper contains 2 printed page) Roll No. _____

Your Roll No. _____

Sr. No. of questions Paper : **7446**

Unique Paper Code: 2223010044

Name of the Paper: Sensors and Detectors

Name of the Course: B.Sc. (Hons.) Physics - NEP UGCF-2022

Semester: VIII- Semester (DSE Paper)

Duration: 3 Hours Maximum Marks: 90

Instructions for Candidates

1. *Write your Roll No. on the top immediately on receipt of this question paper.*
2. *Question No. 1 is compulsory.*
3. *Attempt any four from the remaining five questions.*
4. *All questions carry equal marks.*
5. *Use of non-programmable calculators is allowed.*
6. *Answers should be concise, relevant, and suitably illustrated wherever required.*

1. Attempt any six of the following: (6 × 3 = 18)
   (a) What is a transfer function?
   (b) Define static calibration and component error.
   (c) What is the role of a movable ferromagnetic core in a plunger-type variable inductance sensor?
   (d) Why is phase-sensitive demodulation used in an LVDT output circuit?
   (e) Define Hall voltage and state two factors on which it depends.
   (f) What is meant by the temperature coefficient of resistance of an RTD?
   (g) Define spectral threshold in a photodetector.

2. (a) Classify transducers on the basis of (i) energy source and (ii) output form. Give two examples for each case.
   (b) With neat diagrams, explain the construction and working of an LVDT. Obtain the qualitative form of its output characteristic about the null position.
   (c) A parallel-plate capacitive sensor has plate area A= 4.0×10^{-4} m^2, air dielectric, and plate spacing d= 0.50 mm. Calculate its capacitance. If the spacing decreases by 0.05 mm, find the new capacitance and the percentage change. (6 + 8 + 4 = 18)

3. (a) Explain the construction, working, and performance characteristics of a Hall-effect sensor.
   (b) Describe the construction and working of Photoconductive cell (LDR) with two applications.
   (c) A Cu–Constantan thermocouple may be taken to have Seebeck coefficient S = 41 $\mu V\ K^{-1}$

over a limited range. Estimate the thermo-emf for a hot-junction temperature of 180°C and a cold-junction temperature of 30°C. (8 + 6 + 4 = 18)

4. (a) Distinguish between direct and indirect pressure measurement. Discuss the working range and operating principle of a McLeod gauge.

   (b) Explain the working of a Pirani gauge. State its advantages and limitations.

   (c) A U-tube manometer containing mercury ($\rho = 13.6 \times 10^3$ kg m^{-3}) shows a level difference of 18 cm. Calculate the corresponding pressure difference. Take $g = 9.8$ m s^{-2}. (8 + 6 + 4 = 18)

5. (a) Define work function, quantum yield, time lag, and linearity for radiation sensors.

   (b) Describe the construction and working of a Geiger–Muller counter. What is the purpose of quenching?

   (c) Explain the working of a scintillation detector and the role of the photomultiplier tube in it. (6 + 6 + 6 = 18)

6. (a) Explain the basic principle of remote sensing and distinguish between active and passive sensing.

   (b) What is LiDAR? Describe its principle, major components, and any two applications.

   (c) Explain the significance of the fill factor (FF) and how it is calculated. (6 + 6 + 6 = 18)