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2

National Institute of Technology Hamirpur (H.P.)

Examination: B.Tech. (Engineering Physics) Course Name: Instrumentation & Measurements Maximum Marks: 50

End Semester-2023 Course Code: PH 324 Time allowed: 3 hours

## Notes: All questions are compulsory.

Mention the question number on your answer sheet before attempt.

- 1. i) The auto-brightness feature automatically adjusts the brightness of the display of your smartphone, how?
  - ii) Explain the working principle of Mcleod gauge.
  - iii) Differentiate between critical point and triple point of the substance.
  - iv) Index the peak A for given XRD pattern of a polycrystal and predict the crystal structure.



v) Define thermistor and differentiate between NTCs and PTCs on the basis of resistance variation with temperature.

(5x2 = 10)

- 2. What is working principle of Wheatstone bridge and how it is used with the proximity sensor to read out the presence of an object. Illustrate with an example. 5
- **3.** How is the water level sensed in washing machine? Sketch the sensor used and explain its operation. Also describe your strategy and considerations in terms of design. 5
- 4. In a turbomolecular pump, the pressure in a tube of 400mm dia and 1m length is  $5\times10^{-7}$  mbar is achieved after 3 hours of pumping. The pressure is reduced to  $4\times10^{-7}$  in 40s with a pumping speed 10 lit./s of pump including reduction by the conductance it to the chamber. Compute the rate of change of pressure and also evaluate the total outgassing rate (in absence of leaks) of vacuum chamber at this moment.
- 5. How does the moment transfer pump work? Discuss the working principle of oil diffusion pump and explain its functioning? 5
- 6. Enlist the appropriate points that have to be taken care to design the Cryostat for low temperature measurements. Explain the working of liquid He cryostat with neat sketch.
- 7. With neat block diagram, illustrate the construction and working of Scanning Electron Microscope (SEM). Is it necessary to have the sample conductive, if so why? 5

- 196
- 8. The peak broadening as well as the decrease in peak height was observed, during a diffraction experiment by Cu-K<sub>a</sub> (0.154 nm) radiation on ball-milled Al NPs. The results of FWHM ( $\beta$ ) values for peaks corresponding to the (111), (200), (220), and (311) planes at angles are summarized in Table 1. Determine the crystal structure, the average crystallite size and strain in the given sample.

S. No.	hkl	2θ (deg)	FWHM (β) (deg)
1	111	38.47	0.102
2	200	44.70	0.065
3	220	65.10	0.089
4	311	78.26	0.091

Table 1: XRD data for given sample.

9. What is the essential condition for Raman shift in scattering of em radiation? Discuss the classical theory to explain the Raman effect.

5

 $\sim$  All the best  $\sim$