D 150371 **(Pages : 2)** **Name.....**

Reg. No.....

THIRD SEMESTER M.Sc. (CBCSS) REGULAR/SUPPLEMENTARY DEGREE EXAMINATION, NOVEMBER 2026

Physics

PHY 3E 05—EXPERIMENTAL TECHNIQUES

(2019 Admission onwards)

Time : Three Hours Maximum Weightage : 30

Section A

8 Short questions, each answerable within 7.5 minutes.
Answer **all** *questions.*
Each question carries 1 weightage.

1. What is meant by pumping speed of a vacuum pump ?
2. What is the function of a liquid nitrogen trap in a vacuum system ?
3. What is the principle of laser evaporation for thin-film preparation ?
4. What is a quartz crystal monitor and what quantity does it measure ?
5. What is the basic principle of PIXE ?
6. What is meant by energy straggling in RBS ?
7. What is the difference between Single-crystal and Powder diffraction ?
8. What is meant by the PDF database in X-ray diffraction ?

(8 × 1 = 8 weightage)

Section B

4 Essay questions, each answerable within 30 minutes.
Answer any **two** *questions.*
Each question carries 5 weightage.

9. Explain the Pirani gauge and thermocouple gauge. Discuss their principles of operation, construction and limitations.
10. Explain sputter depositin with suitable description of the glow-discharge process. Discuss the important factors affecting sputtering.
11. Describe the construction and working of a linear accelerator (LINAC). Explain the function of drift tubes and the RF accelerating field.
12. Explain the principle, experimental arrangement and applications of Proton Indduced X-ray Emission (PIXE). Mention the important limitations of PIXE.

(2 × 5 = 10 weightage)

Turn over

Section C

7 Problems questions, each answerable within 15 minutes.
Answer any **four** *questions.*
Each question carries 3 weightage.

13. A vacuum chamber of volume 100 litres is evacuated using a pump having an effective pumping speed of 50 litres/s. If the initial pressure is 10^{-21} mbar, calculate the time required to reach 10^{-5} mbar, assuming no leakage or outgassing.

14. A quartz crystal monitor has a sensitivity of 60 Hz per μg cm.$^{-2}$ During thin-film deposition the crystal frequency changes by 360 Hz. Calculate the deposited mass per unit area.

15. An ion source produces singly charged ions which are accelerated through a potential difference of 50 kV. Calculate the energy acquired by each ion in keV.

16. A 1.5 MeV helium ion is back scattered elastically from a heavy target. If the detected energy is 1.20 MeV, calculate the energy loss of the ion in the target.

17. In an XRD experiment using Cu-Kα radiation of wavelength 0.154 nm, a first-order reflection from a crystal occurs at a glancing angle of 30°. Find the interplanar spacing.

18. A powder sample gives a first-order diffraction peak at $2\theta = 60°$ using X-rays of wavelength 0.154 nm. Calculate the corresponding d-spacing.

19. A cyclotron has a magnetic field of 1.0 T and accelerate protons. Calculate the cyclotron frequency. Take $e = 1.6 \times 10^{-19}$ C, $m_p = 1.67 \times 10^{-27}$ kg.

(4 × 3 = 12 weightage)