

**20P309**

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Name.....

Reg. No.....

**THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2021**

(CBCSS-PG)

(Regular/Supplementary/Improvement)

**CC19P PHY3 E05 - EXPERIMENTAL TECHNIQUES**

(Physics)

(2019 Admission onwards)

Time: Three Hours

Maximum: 30 Weightage

**Section A**

Answer *all* questions. Each question carries 1 weightage.

1. Give the properties and functions of the oil in oil sealed rotary vacuum pump.
2. Explain why vacuum is required for thin film preparation by the thermal evaporation technique?
3. Explain how a typical magnetic valve operates.
4. Explain the two important principles used in a Van de Graaff accelerator.
5. Explain the basic principle of the linear electrostatic accelerator.
6. Why do crystals diffract X-rays? List the advantages of XRD.
7. What is meant by depth profiling? Explain how a resonance nuclear reaction is useful for depth profiling.
8. How do we calculate grain size from XRD?

**(8 × 1 = 8 Weightage)**

**Section B**

Answer any *two* questions. Each question carries 5 weightage.

9. Discuss the glow discharge phenomenon, with particular reference to its use in thin film preparation. Give a diagram of the experimental setup used and explain the details and working.
10. With the help of a diagram, explain the various parts and working of a Turbo molecular Pump. What are its advantages?
11. Explain how the high voltage limitation of an electrostatic accelerator is overcome in a linac / cyclotron. Describe the principle and working of a linear accelerator (Cyclotron). Derive the fundamental equations.
12. Describe the principle of the PIXE technique. What are its distinctive features? Give the details of the experimental setup for elemental analysis using this technique. What are the applications of this method? How does it compare with NAA / RBS / NRA?

**(2 × 5 = 10 Weightage)**

### Section C

Answer any *four* questions. Each question carries 3 weightage.

13. The pumping speed of a certain pump is found to be a constant = 100 Torr litres s<sup>-1</sup> in the pressure range of 10<sup>-2</sup> to 3 x 10<sup>-3</sup> Torr and to vary exponentially with pressure below this range. At a pressure of 10<sup>-5</sup> Torr its value is 20 Torr litres s<sup>-1</sup>. The pump is used to pump down a chamber of volume 200 cm<sup>3</sup>. The initial pressure is 10<sup>-2</sup> Torr and the final pressure is 10<sup>-5</sup> Torr. Calculate the time taken and the amount of gas pumped out during this time.
14. A quartz crystal monitor indicates a change in frequency of 1600Hz when an aluminium film of density 2.7gm/cm<sup>3</sup> is deposited on its face. Determine the film thickness if the quartz crystal is 0.2mm is thick and the density of quartz is 2.3gm/cm<sup>3</sup>. Estimate the starting frequency of the crystal
15. A cyclotron, operating at 5 kV and a magnetic flux density of 0.8 Weber/m<sup>2</sup> accelerates alpha particles to 2 MeV. How long does it take accelerate the particles from rest to this energy?
16. As a result of the elastic scattering of a proton with kinetic energy 13 keV by the Coulomb field of a stationary <sup>4</sup>He nucleus the latter recoils at an angle 60<sup>0</sup> to the direction of the incoming proton. Calculate the impact parameter.
17. What is XRD pattern? How does XRD determine crystal structure?
18. A beam of X-rays of wavelength 0.071 nm is diffracted by (110) plane of rock salt with lattice constant of 0.28 nm. Find the glancing angle for the second-order diffraction.
19. Alpha particles with kinetic energy 1.7 MeV are scattered by the Coulomb field of a stationary Pb nucleus. Calculate the differential cross section for the scattering through an angle 60<sup>0</sup>.

**(4 × 3 = 12 Weightage)**

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