

Exam.Code:0475

Sub. Code: 3728

2071

M.Sc. (Physics) Fourth Semester  
PHY-7057: Analytical Techniques for Materials

Time allowed: 3 Hours

Max. Marks: 60

**NOTE:** Attempt five questions in all, including Question No. IX (Unit-V) which is compulsory and selecting one question each from Unit I -IV.

x-x-x

**UNIT – I**

- I. a) Discuss Stark effect and show that the first order Stark effect for the ground state of hydrogen is zero.
- b) If the  $K_{\alpha}$  radiation of Mo ( $Z=42$ ) has a wavelength of  $0.71 \text{ \AA}$ , calculate the wavelength the corresponding radiation of Cu ( $Z=29$ ). (8,4)
- II. Describe in detail the elemental analysis using WDXRF technique. Discuss working principle, experimental detail involved in this technique. What are its advantages and limitations? (12)

**UNIT - II**

- III. a) Give an account of the salient features observed in the electronic spectrum of a diatomic molecule. Discuss the conditions under which band-heads are degraded towards violet or red in the electronic spectrum. Why no such heads are generally observed in the infrared spectrum of a diatomic molecule?
- b) State optical pumping and population inversion. (8,4)
- IV. a) Discuss the instrumentation and working of FTIR spectrometer. What are its advantages over dispersive IR spectrometer?
- b) Give a brief account of Born-Oppenheimer approximation. (2x6)

**UNIT - III**

- V. a) Explain the principle, construction and working of Rotary pump?
- b) What is a lock-in-detector? Discuss experimental set up in detail. How does it help in improving signal to noise ratio? (2x6)

P.T.O.

(2)

- VI. a) What is Linear Variable Differential Transformer (LVDT)? Explain its principle and working. What are its applications?
- b) What is Penning gauge? Discuss its working, advantages and limitations. (2x6)

#### UNIT - IV

- VII. Describe the principle, instrumentation and working of Electron Beam Evaporation technique for preparation of thin films. What are the advantages and limitations of this technique? Mention some of the important applications of this method for the deposition of thin films. (12)
- VIII. Explain principle/construction and working of Transmission electron Microscopy (TEM) technique for thin film characterization. How its operating principle differs from Scanning Electron Microscope (SEM)? Mention few applications of this technique. (12)

#### UNIT - V

- IX. Attempt any six of the following:-
- a) Explain thermoelectric transducer.
  - b) What is isotopic shift?
  - c) What is an optical resonator?
  - d) What is Strain gauge?
  - e) What is the principle of box-car integrator?
  - f) Consider a p-electron in one electron atom. Calculate the value of L, S and J.
  - g) What is Auger effect? (6x2)

x-x-x