Ex/Met/T/424A/2019

B. E. METALLURGICAL AND MATERIAL ENGINEERING EXAMINATION, 2019

(4th Year, 2nd Semester)

ADVANCED CHARACTERIZATION TECHNIQUES

Time : Three hours | Full Marks : 100

Use a separate Answer-Script for each Part

PART - I

(70 Marks)

(Answer question 1 and any three from the rest)

1.	Discuss the interaction of incident electrons as they transmit through thin solids.	10
2.	(a) Assuming the sinusoidal form of wave find the expression for scattered wave from a point scatterer.	10
	(b) Find the expression for the resultant of amplitude of scattering from a pair of point scatterers.	10
3.	(a) Using quantum mechanical concept find the ratio of amplitude of scattered X-ray by an electron to that of a point electron situated at the centre of the atom.	15
	(b) Find an expression of atomic scattering factor.	5
4	(a) Find an expression for the intensity of electron diffraction using the concept of kinematical theory for thin crystals. Plot the variation of intensity as a function of inverse of thickness of the crystal	12+2
	(b) Find an expression for structure factor	6
5	(a) Define reciprocal lattice. Discuss the graphical representation of diffraction condition. Show that the Bragg diffraction equation can be derived form Laue condition of diffraction.	3+3+10
	(b) Discuss the mechanism of image contrast in TEM	4
6	(a) Discuss the principle of AAS and UV-VIS spectroscopy.	5+5
	(b) Discuss the mechanism of interaction of IR active molecules with electromagnetic radiation.	5
	(c) Discuss briefly the principle of microwave spectroscopy.	5

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B.E. METALLURGICAL AND MATERIAL ENGINEERING
FOURTH YEAR SECOND SEMESTER EXAM – 2019

Subject: Advanced Characterisation Techniques

Part - II

(30 Marks)

(Answer Question No. 1 and any one from the rest)

1. Answer any six from the following:

(a) Why the resolution in scanning electron microscope his higher than optical microscope?
(b) How the magnification of in scanning electron microscope is decided?
(c) What is the advantage of AFM over electron microscope?
(d) Why does scanning electron microscopy require high vacuum of the specimen chamber?
(e) Can we directly use non-conducting specimen for scanning electron microscopy? If not, what do we need to carry out to study non-conducting specimen in scanning electron microscope?
(f) What is the need of high voltage in scanning electron microscope?
(g) What is the purpose of using filter in optical microscopy?
(h) What is the role of spot size in scanning electron microscopy? 6 x 2.5 = 15

2. (a) Briefly discuss the underlying principle for non-contact mode of atomic force microscopy. 5
(b) Briefly discuss the principle for microanalysis by EDS. Highlight the difference between EDS and WDS. 5 + 2 = 7
(c) What additional information are obtained in case of BSE imaging as compared to SE imaging in scanning electron Microscopy and why? 3

3. (a) Discuss the principle for differential thermal analysis (DTA) for phase transformation of materials? Why powdered sample is used for DTA instead of bulk specimen? 5 + 2 = 7

(b) What is the importance of dilatometry in studying phase transformation of steel? Design an experiment to study the austenite transformation kinetics in case of a plain carbon eutectoid steel by dilatometry. 2 + 6 = 8