B.E/B. Tech (Full Time) DEGREE END SEMESTER EXAMINATION NOV/DEC 2012

MATERIALS SCIENCE AND ENGINEERING

FIFTH SEMESTER – R 2008

ML 9303 – CHARACTERISATION OF MATERIALS

Time: 3 hr Max. Marks: 100

PART – A (2 X 10 =20)

Match the following:

1. (a) Reflective Objective — (i) Differential Interference Contrast Microscopy
   (b) Phase Retardation Plate — (ii) Colour Metallography
   (c) Polarization — (iii) Hot Stage Microscopy
   (d) Optical sectioning — (iv) Phase contrast Microscopy
2. (a) Shortest wavelength — (i) doesn't change with voltage
   (b) Compton Scattering — (ii) True absorption
   (c) X- ray fluorescence — (iii) decrease with increase in voltage
   (d) Characteristic radiation — (iv) high for low atomic number
3. (a) Warrens Method — (i) UV radiation
   (b) Balanced Filter — (ii) Photomultiplier
   (c) Scintillation Counter — (iii) Monochromatic radiation
   (d) Geiger Counter — (iv) Particle size
4. (a) Spot pattern — (i) STM
   (b) Vibrating cantilever — (ii) High Resolution TEM
   (c) Phase Contrast — (iii) Monocrystalline
   (d) Conducting sample — (iv) Non contact AFM
5. (a) Differential Scanning Calorimetry — (i) Mass Difference
   (b) X- ray Photoelectron Spectroscopy — (ii) Temperature Difference
   (c) Thermogravimetry — (iii) Enthalpy
   (d) Differential Thermal Analysis — (iv) Chemical Shift

Write the significance of the following equations:

6. $\varepsilon = n^2$ where ε- dielectric constant and n- refractive index

7. $1/\lambda_{K\alpha 1} = 1/\lambda_K - 1/\lambda_{L_{III}}$ where K and L_{III} refer to absorption edges and Kα1 refer emission line

8. $\lambda_{K\alpha} \operatorname{Sin} \Theta_\beta = \lambda_{K\beta} \operatorname{Sin} \Theta_\alpha$ where Θ_α and Θ_β are bragg's angle of diffraction for K_α and K_β radiation.

9. $\lambda L = rd$ where L – camera length, r – distance of diffracted spot and d – interplanar spacing

10. $E_{K\,L1\,L2,3} \approx E_{BK} - E_{BL1} - E_{BL2,3}$ where E_{BX} correspond to binding energy of shell X

PART – B (5 X 16 =80)

11. (a) (i) Brief on the various signals that emanate from electron material interaction in SEM. (10)

(ii) List the appropriate method of sample preparation for metals, ceramics, polymers and biological sample for TEM analysis. (4)

(iii) What is the method of sample preparation for biological samples for SEM analysis? (2)

12. (a) (i) Why spherical aberration, chromatic aberration, field of curvature, astigmatism and distortion arises with use of lens in optical microscopy? (10)

(ii) List the corrections achieved with use of following: Apochromats, Achromats and Flourite. (6)

(OR)

(b) (i) Brief on the working principle of Differential Interference Contrast Microscopy. (10)

(ii) Differentiate the application of positive and negative phase contrast plate with suitable diagram. (6)

13. (a) (i) Derive Scherrer's formula for the determination of average grain size. (6)

(ii) Derive the Lorentz-Polarization factor. (10)

(OR)

(b) (i) What are the methods of generating monochromatic X-ray radiation? (4)

(ii) Identify the crystal system, calculate the lattice parameters and theoretical intensity of x-ray diffraction peaks 2Θ (^{o}) using that occur at 38.52, 44.76, 65.14, 78.26, 82.47, 99.11, 112.03, 116.60 and 137.47 and their corresponding multiplicity factor are 8,6,12,24,8,6,24,24 and 24. The x-ray wavelength is 1.54Å. The atomic scattering factor for $Sin\Theta/\lambda$ values 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0 and 1.1 are 11, 8.95, 7.75, 6.6, 5.5, 4.5, 3.7, 3.1, 2.65, 2.3 and 2.0. (12)

14. (a) (i) Compare and contrast the proportional, scintillation, Geiger and Semiconductor counters. (10)

(ii) Compare Disappearance – Phase method and Parametric method of determining solvus curves of phase diagrams. (6)

(OR)

(b)(i) Show how diffraction taken at two inclinations can help in determination of residual stress of biaxial stressed component and also elaborate on diffractometer method of determination of residual stress.

15. (a) (i) Differentiate between the two types of X-ray Spectroscopy. (6)

(ii) Brief on the principle of Auger Spectrometer and application of AES. (10)

(OR)

(b) (i) Compare and contrast the Differential Thermal Analysis and Differential Scanning Calorimetry.
