Code No: RR411812 **Set No.1**

IV B.Tech. I Semester Regular Examinations, November -2005
X-RAY METALLOGRAPHY
(Metallurgy & Material Technology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. What are the basic designs for X-ray sets? Explain with sketches. [16]
2. (a) Write a note on Diffraction Directions.
   (b) Derive an expression for the absorption factor of a diffractiometer specimen in the form of a flat plate of finite thickness 't'. (Note that the absorption factor now depends on θ). [8+8]
3. (a) How does Laue diffraction pattern look? Explain. [6]
   (b) Where is Laue method useful? [5]
   (c) What are the factors that affect the relative intensity of diafraction line? Explain. [5]
4. Define a powder photograph? How are powder photographs classified? Explain in detail. [16]
5. What is X-ray spectrometer? Where does it find use? Draw a neat sketch of X-ray diffractometer and indicate the parts. [16]
6. Write notes on the following (With neat sketches)
   (a) Guinier-Tennevin method.
   (b) X- ray topographic method. [8+8]
7. Consider the diffraction geometry for $\alpha = 0$ in the transmission method for determining preferred orientation and for $\alpha = 90^0$ in the reflection method. Let tinf be the infinite thickness required in the reflection method, and assume tinf is that thickness which would diffract 99 percent of the intensity diffracted by the specimen of truly infinite thickness. Let $2t_{opt}$ be the optimum thickness for the transmission method. How much is the diffracted intensity decreased. [16]
8. Compare and Contrast Coherent and Incoherent radiation. [16]

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Code No: RR411812 **Set No.2**

IV B.Tech. I Semester Regular Examinations, November -2005
X-RAY METALLOGRAPHY
(Metallurgy & Material Technology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is the frequency (per second) and energy per quantum (in joules) of x-ray beams of wavelength $0.71A^0$ (Mo Kα) and $1.54A^0$ (Cu Kα)? [7]
   (b) Calculate the velocity and kinetic energy with which the electrons strike the target of an X-ray tube operating at a voltage 'V'. Determine the short-wavelength limit of the continuous spectrum emitted and the maximum energy per quantum of radiation? [9]

2. A crystal shows the diffraction maxima at the angles $2\theta = 38.184^0$, 44.392^0 , 64.576^0 and 72.547^0 . if the wavelength of X-rays used is $1.541A^o$. Find out whether the crystal used is BCC or FCC. What is 'a' of the crystal? (a = lattice Parameter). - [16]

3. Write short notes on the following:
   (a) Multiplicity factor
   (b) Lorentz factor. [8+8]

4. A Debye-Scherrer pattern is made of Silicon, which has the same structure as diamond, with Cu Kα radiation. What are the indices of the first two lines on the pattern, and what is the ratio of the integrated intensity of first to that of the second. (Assume necessary data suitably). [16]

5. (a) What are back reflection Focussing Cameras? What is the principle involved in it? Draw a neat sketch.
   (b) Explain the reasons for Background radiation in Powder Camera method. [8+8]

6. What are various X-ray methods of assessing crystal quality. Explain with neat sketches. [16]

7. On a stereographic projection parallel to the surface of a rolled sheet, show
   (a) the positions of the (110) poles, represented by small ellipses, for the ideal orientation $\{111\} < 110 >$, including the positions due to reflection symmetry, and
   (b) the lines showing the positions of the (110) poles for a $< 111 >$ fiber texture, with the fiber axis normal to the plane of sheet. [8+8]

8. Write notes on the following:

(a) Focussing Cameras

(b) Techniques used in stress measurements. [8+8]

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Code No: RR411812 **Set No.3**

IV B.Tech. I Semester Regular Examinations, November -2005
X-RAY METALLOGRAPHY
(Metallurgy & Material Technology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is the frequency (per second) and energy per quantum (in joules) of x-ray beams of wavelength $0.71A^0$ (Mo Kα) and $1.54A^0$ (Cu Kα)? [7]
   (b) Calculate the velocity and kinetic energy with which the electrons strike the target of an X-ray tube operating at a voltage 'V'. Determine the short-wavelength limit of the continuous spectrum emitted and the maximum energy per quantum of radiation? [9]

2. (a) With sketches, explain the atomic scattering factor.
   (b) With a neat sketch, explain the effects produced by the passage of x-rays through matter. [8+8]

3. Write short notes on the following:
   (a) Multiplicity factor
   (b) Lorentz factor. [8+8]

4. (a) How does Debye-Scherrer diffraction pattern look? [4]
   (b) Where is Debye-Scherrer method useful? [6]
   (c) Explain how a powder camera is superior to a Diffractometer with examples. [6]

5. What voltage must be applied to a Molybdinum target tube in order that the emitted X-rays excite K Flouroscent radiation from a piece of Copper placed in the X-ray beam? What is the wavelength of the fluorescent radiation? [16]

6. What is the principle involved in Diffractometre method (The texture of Sheet). With neat sketch explain the working of Diffractometre method. [16]

7. Consider the diffraction geometry for $\alpha = 0$ in the transmission method for determining preferred orientation and for $\alpha = 90^0$ in the reflection method. Let tinf be the infinite thickness required in the reflection method, and assume tinf is that thickness which would diffract 99 percent of the intensity diffracted by the specimen of truly infinite thickness. Let $2t_{opt}$ be the optimum thickness for the transmission method. How much is the diffracted intensity decreased. [16]

8. Write short notes on the following:
   (a) Measurement of line position

(b) Subsurface measurements. [8+8]

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Code No: RR411812 **Set No.4**

IV B.Tech. I Semester Regular Examinations, November -2005
X-RAY METALLOGRAPHY
(Metallurgy & Material Technology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. What are the methods of X-ray diffraction? Explain with neat sketches. [16]

2. (a) For BCC Iron, compute (i) the interplanar spacing (ii) the diffracting angle for the (220) set of planes. The lattice parameter of Iron is 0.2889 nm. Assume that a monochromatic radiation having a wavelength of 0.1541 nm is used and the order of reflection is done.

   (b) (i) Calculate the interplanar spacing for (110) and (221) sets of planes in Aluminum (ii) When a monochromatic X-ray beam of X-rays of wavelength 0.1542 nm is used, the first order reflection from (113) set of planes occurs at θ . What is the value of θ ? [8+8]

3. (a) Explain in detail the scattering of X-rays by an atom. [7]

   (b) What is structure factor? Derive an expression for the structure factor. Calculate the structure factor for NaCl. [9]

4. Define a powder photograph? How are powder photographs classified? Explain in detail. [16]

5. What is the principle involved in Seemann-Bohlin Camera? With a neat sketch explain the construction and working of Seemann-Bohlin Camera. [16]

6. Write notes on the following:

   (a) Crystal quality [6]

   (b) Particle size [5]

   (c) Grain size. [5]

7. (a) Explain in detail Order-Disorder transformation. [7]

   (b) The following data were obtained from a Debye Scherrer pattern of a simple cubic substance, made with Copper radiation. The given $Sin^2\theta$ values are for the Kα, lines only [9]

$h^2 + k^2 + l^2$	$Sin^2\theta$
38	0.9114
40	0.9563
41	0.9761
42	0.9980

Determine the lattice parameter a_0 , accurate to four significant figures, by graphical extrapolation of 'a' against $Cos^2\theta$.

8. A Debye Scherrer pattern is made with CuKα radiation of Au Cu_3 quenched from a temperature T_1 . The ratio of the integrated intensity of the (420) line to that of (421) line is found to be 4.38. Calculate the value of the long range order parameter S at temperature T1. (Take the lattice parameter of Au Cu_3 as 3.75 A^0). [16]

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