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| PROFESSOR'S NAME | Dr. S. Sankaran |
| DEPARTMENT | Department of Metallurgy and Material Science |
| INSTITUTE | Indian Institute of Technology Madras |
| COURSE OUTLINE | It is the first course at the under graduate level on microstructural characterization of materials. This course will cover the basic principles and techniques of X-ray diffraction, optical, scanning electron and transmission electron microscopy along with demonstrations of the instrument details and imaging experiments through videos. This course also deals with the sample preparation techniques for the microstructural analysis with practical examples through videos. |
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COURSE DETAILS

| S. No | Module ID/ Lecture ID | Lecture Title/Topic |
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| 1. | M1_L1 | Properties of Light, Image Formation |
| 2. | M1_L2 | Magnification and Resolution |
| 3. | M1_L3 | Depth of Field, Focus and Field of View |
| 4. | M1_L4 | Lens Defects, Filters and Light Microscopy Introduction |
| 5. | M1_L5 | Optical Microscope Demo., Bright Field Imaging, Opaque Specimen Illumination |
| 6. | M2_L6 | Opaque Stop Microscopy, Phase Contrast Microscopy |
| 7. | M2_L7 | Dark Field Microscopy, Polarization Microscopy |
| 8. | M2_L8 | Differential Interference Contrast and Fluorescence Microscopy |
| 9. | M2_L9 | Sample Preparation Techniques for Optical Microscopy |

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| 10. | M2_L10 | Tutorial Problems - I |
| 11. | M2_L11 | Tutorial Problems - II |
| 12. | M3_L12 | Introduction to Scanning Electron Microscopy |
| 13. | M3_L13 | Lens Aberrations, Object Resolution, Image Quality |
| 14. | M3_L14 | Interaction Between Electrons and Sample, Imaging Capabilities, Structural Analysis, Elemental Analysis |
| 15. | M3_L15 | SEM and its Mode of Operation, Effect of Aperture Size, Working Distance, Condenser Lens Strength |
| 16. | M3_L16 | SEM and its Mode of Operation- Continuation, Relation Between Probe Current and Probe Diameter, Summary |
| 17. | M3_L17 | Factors Affecting Interaction Volume, Demonstration of SEM |
| 18. | M3_L18 | Image Formation and Interpretation |
| 19. | M3_L19 | Image Formation and Interpretation Continued, EDS, WDS |
| 20. | M3_L20 | Special Contrast Mechanisms, Monte Carlo Simulations of Interaction Volume |
| 21. | M3_L21 | Electron Channeling Contrast Imaging (ECCI), Electron Back Scattered Diffraction(EBSD)- Theory & Instrument Demonstration |
| 22. | M3_L22 | Tutorial Problems on SEM |
| 23. | M4_L23 | Basics of X-Ray Emission from Source, Electron Excitation and X-Ray Interaction with Materials in General |
| 24. | M4_L24 | Properties of X-Rays |
| 25. | M4_L25 | Bragg's Law Derivation |
| 26. | M4_L26 | Diffraction Relationship with Reciprocal Space |
| 27. | M4_L27 | X-ray Scattering |
| 28. | M4_L28 | Factors Affecting Intensities of X-Ray Peaks - I |
| 29. | M4_L29 | Factors Affecting Intensities of X-Ray peaks - II |
| 30. | M4_L30 | Effect of Crystallite Size and Strain on Intensity of X-Rays |

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| 31. | M4_L31 | Profile Fit, Factors Affecting Peak Brodening |
| 32. | M4_L32 | Indexing of Diffraction Pattern, Quantitative Analysis |
| 33. | M4_L33 | Indexing, Quantitative Analysis-Continuation, Residual Stress Measurements |
| 34. | M4_L34 | XRD and Residual Stress Measurement- Lab Demonstration |
| 35. | M5_L35 | Introduction to Transmission Electron Microscopy (TEM) |
| 36. | M5_L36 | Fundamentals of Transmission Electron Microscopy (TEM) |
| 37. | M5_L37 | Basics of Diffraction - I |
| 38. | M5_L38 | Basics of Diffraction - II |
| 39. | M5_L39 | TEM Imaging - I |
| 40. | M5_L40 | TEM Imaging - II |
| 41. | M5_L41 | TEM Instrument Demonstration |
| 42. | M5_L42 | TEM Sample Preparation-1TEM Sample Preparation - I |
| 43. | M5_L43 | TEM Sample Preparation - II |
| 44. | M3_L44 | XRD Tutorial - I |
| 45. | M3_L45 | XRD Tutorial -II |
| 46. | M4_L46 | TEM Tutorial - I |
| 47. | M4_L47 | TEM Tutorial - II |
| 48. | M6_L48 | Quantitative Metallography – Tutorial - I |
| 49. | M6_L49 | Quantitative Metallography – Tutorial - II |
| 50. | M6_L50 | Quantitative Metallography – Tutorial - III |
| 51. | M6_L51 | Quantitative metallography – Tutorial - IV |
| 52. | M6_L52 | Quantitative Metallography – Tutorial - V |
| 53. | M6_L53 | Quantitative Metallography – Tutorial - VI |
| 54. | M6_L54 | Quantitative Metallography – Tutorial - VII |

List of reference material/ books:

Name and contact details of two referees for the course: