



**Department of Metallurgical and Materials Engineering**

**Course Plan [ EVEN semester- Jan 2025 - May 2025]**

<b>Course Title: X-Ray Diffraction and Electron Microscopy</b>	<b>Code: MT 254</b>
<b>Credits: (3-1-0) 4</b>	<b>Pre-requisite: Nil</b>
<b>Instructor: Prof. Jagannatha Nayak</b>	<b>Mobile: 9900711945</b> <b>E-mail : jagan@nitk.edu.in</b>
<b>Objectives:</b> The Main objectives of the course are to: <ul style="list-style-type: none"> <li>• Study the various aspects of X-ray Diffraction</li> <li>• Introduce to various methods of X-ray Diffraction</li> <li>• Study the use of X-RD techniques in metallurgy</li> <li>• Study the concepts of Electron microscopy (SEM and TEM) and other Tools</li> </ul>	
<b>Expected Learning Outcomes:</b> Upon completing the course, student is expected: <ul style="list-style-type: none"> <li>• To be able to appreciate the importance of X-RD and Electron microscopy in materials Characterization.</li> <li>• To be able to identify and use proper technique for a given requirement.</li> </ul>	
<b>Course Coverage including tutorials:</b>	<b>Hours</b>
Introduction	1 hr
Basics of Crystallography	2 hrs
X-rays: Generation, Properties, Absorption and Filtering + Tutorials	5 hrs
Diffraction of X-rays, Diffraction under non-ideal conditions, Methods of diffraction	6 hrs
Intensity of diffracted beams + Tutorials	6 hrs
Powder method: Specimen preparation, Selection of radiation, Background radiation	2 hrs
Determination of Crystal structure, Solvus line + Tutorials	6 hrs
Order-disorder transformation, Chemical analysis, Particle size analysis	4 hrs
Stereographic projections; Determination of texture + Tutorials	6 hrs
Electron microscopy: General principles, Electron – specimen interaction, Electron optics	2 hrs
TEM: Image formation scheme, Reciprocal lattice, Electron diffraction, specimen preparation	4 hrs
SEM: Signal generation, modes of operation, specimen preparation, EDAX	4 hrs
EPMA, FIM, STM	2 hrs
<b>Total:</b>	<b>50 Hrs</b>

**Evaluation Scheme:**

- Continuous Evaluation: 30% {Tutorials + Quizzes}
- Examination: 70 % (Mid-Semester 20%; End-Semester 50%)

**Minimum marks to be scored to avoid FF grade is 30 out of 100**

**References:**

1. B D Cullity, "*Elements of X-ray Diffraction*", Addison-Wisely Publishing Company, Inc, 1978.
2. K Ramakanth Hebbar, "*Basics of X-ray Diffraction and its applications*", I K International Publishing House Pvt. Ltd., New Delhi, 2007
3. R E Smallman and K M B Ashbee, "*Modern Metallography*"
4. B Chalmers, "*Physical Methods of Materials Characterization*"
5. P. E. J. Flewitt & R. K. Wild, "*Physical Methods of Materials Characterization*", IOP Publishing Ltd, 1994
6. ASM Handbook

**Important Note:**

- Students are advised not to miss any quizzes as they will not be repeated. No improvement quiz will be conducted.
- Students are advised to go through the regulations
- Reg:G7. ATTENDANCE REQUIREMENTS:
- 7.1 All students must attend every lecture, tutorial and practical classes.
- 7.2 To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted. A maximum of seven days attendance in a semester may be granted to those students who have been absent for participating in curricular and extracurricular activities after due approval from the Institute.
- 7.3 A student with less than 75% attendance in a course during a semester, in lectures, tutorials and practicals taken together as applicable, will not be permitted to appear in the End Semester Examinations of the course in which the shortfall exists, irrespective of his/her academic performance, and irrespective of nature of his/her absence . He/She shall be awarded '**FA**' **grade** in that course.

Sd/  
(Course Instructor)