ETMC: Experimental Techniques for Materials Characterization

Programme: M.Sc. (Physics) Year: 2019-20 Semester: 4th Semester
Course : Program Elective: Materials Science) Credits : 3 Hours : 40

Course Context and Overview (100 words):
Materials characterization is the fundamental requirement to the development of new materials. Experimental techniques such as XRD, TEM, SEM, AFM, DTA, TGA, DSC, UV Vis, Raman, etc. are required to characterize broad range of materials. These techniques help to understanding the practical applications of the new materials. The aim of the course is to provide fundamental understanding of the different characterization techniques in terms of their working principle, instrumentation and analysis of the result.

Prerequisites Courses:

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: understand and describe the fundamental principles behind the various types of characterization techniques which are included in the syllabus.
C02: select appropriate experimental technique for characterization of different materials and nanomaterials.
C03: perform statistical analysis of the experimental data acquired.
C04: pursue the current research and further development within the domain of materials characterization

Course Topics:

Topics	**Lecture Hours**
Introduction	**1**
UNIT 1: X-ray based technique/s X-ray diffraction, Phase identification, indexing and lattice parameter determination; EXAFS, XPS, XRF	**9 (10)**
UNIT 2: Electron Beam based (Microscopy) techniques Introduction to Microscopes, Optical microscopy, TEM, SEM,	**6 (16)**
UNIT 3: Probe based techniques Atomic force Microscopy, Scanning Probe Microscopy	**4 (20)**
UNIT 4: Optical characterization techniques UV-Vis spectroscopy, Photoluminescence Spectroscopy, Fourier transform infrared spectroscopy, Raman Spectroscopy	**8 (28)**

UNIT 5: Thermal characterization techniques Differential Thermal analysis (DTA), Differential Scanning Calorimetry(DSC), Thermo-gravimetric analysis (TGA)	**2(30)**
UNIT 6: Electrical characterization techniques Electrical resistivity, Hall effect, I-V C-V, Magneto resistance,	**2 (32)**
UNIT 7: Magnetic characterization techniques VSM, SQUID, ESR, NMR, Mossbauer Spectroscopy	**4 (36)**
UNIT 8: Other Techniques Mass Spectroscopy and Others	**4 (40)**

References:

1. Materials Characterization Techniques; Sam Zhang, Lin Li, Ashok Kumar;CRC press, (2008)
2. Transmission Electron Microscopy; D.B. Williams and C.B. Carter, Plenum Press (2004)
3. Modern ESCA The Principles and Practice of X-Ray Photoelectron Spectroscopy, Terry L.Barr, CRC press, (1994)
4. Materials Characterization Techniques, S Zhang, L. Li and Ashok Kumar, CRC Press (2008).
5. Physical methods for Materials Characterization, P. E. J. Flewitt and R K Wild, IOP Publishing (2003).
6. Characterization of Nanophase materials, Ed. Z L Wang, Willet-VCH (2000).
7. Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series) A. K. Tyagi,
Mainak Roy, S. K. Kulshreshtha and S. Banerjee;, Volumes 49 – 51 (2009)
8. Encyclopedia of Materials Characterisation Editors: c.r. Brundle, C.A. Evens, Jr, S. Wilson, Butterworth-Heinmann, Boston (1992)
9. Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.) : will be provided as and when required

Evaluation Methods:

Item	Weightage
Quizzes/Assignments/project	25
Midterm	25
Final Examination	50

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