MLL 104 Characterization of Materials -I

First Interaction session 4th January 2022.

Introductory course on material characterization techniques. The course will introduce the concept of measurement, observations, qualification and characterization. We will start with fundamental principles behind various material characterization schemes such as X-ray crystallography, optical microscopy, electron microscopy, electrical measurements, optical measurements and thermal measurements. The measurement techniques will involve several fundamental physical properties which every engineer, particular a materials engineer should master. The course has **three hours of lecture and three hours** of lab session per week and has a massive **4.5** credits.

Course Content:

- Fundamental of measurement
- Optical microscopy
- X-ray diffraction and applications
- Scanning electron microscopy
- Optical Spectroscopy Techniques
- Thermal analysis
- Electrical characterization

People:

Instructor: **Prof. Krishna Balasubramanian**
Assistant Professor, Department of Material Science and Engineering
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Co-Instructor: Prof. Nirat Ray
Assistant Professor, Department of Material Science and Engineering
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Course Timing:

- Slot C, Tuesday, Wednesday, and Friday 8 AM – 9 AM

Prerequisites:

- Well-meaning intentions

Books and Reference:

Multiple references for each topic. Will be announced during the lecture time. General references are as follows:

- B. D. Cullity and S. R. Stock, Elements of X-ray Diffraction, Prentice Hall; 3 ed. 2001R
- R. F. Egerton, Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and
- AEM, Springer, 2005.
- R. Haynes, Optical Microscopy of Materials, Springer, 1984
- Michael E. Brown and Patrick K. Gallagher, Handbook of Thermal Analysis and Calorimetry, ,
- Elsevier, 2003.
- Peter J. Haines, Thermal methods of Analysis, Principles, Applications and Problems, Springer,
- 2012.
- David B. Williams, Barry Carter, Transmission Electron Microscopy: A Textbook for
- Materials Science, Springer, 2009
- 7. Y. Waseda, E. Matsubara, K. Shinoda, X-Ray Diffraction Crystallography, Springer, 2011

Evaluation:

- Relatively graded course with the following split up:
  Lecture part:
  35% minor, 40 % major, 10% homework/assignments and 15 % in-class interactions

  Practical part:
  70% - lab sheet evaluations, 15% inquisitiveness and 15% participation

  Final score: 60% Lectures and 40 % Practical

- **Audit Pass is 35%**

Course Organization:

- Course hosting:
  - All sessions on **MS Teams**, Exams on MOODLE.
  - Lecture notes and other information available on webpage: https://web.iitd.ac.in/~bkrishna/MLL104.html
- Homework to be submitted before the class sessions. Could involve simple coding exercising. Deadlines are razor sharp (its automated).
  - Submissions are binary: either you submit before time or leave without marks. Sorry, no concessions for any amount of delay!
- All evaluation will be off-line. Upload answer sheets and it will be evaluated by TA/myself.
- Dishonesty will be very seriously dealt with. We are a huge team of very experienced professionals. So, any malpractice will be identified, and the student will be given a ‘F’. Remember, this is much worse than just dropping the course!

Academic Honesty:

All students registering to this course voluntarily commit to the academic integrity, research and Ethics policy, IIT Delhi (https://academics.iitd.ac.in/sites/default/files/registration/forms/10_FORM%20H.pdf). This is an under-graduate level course in the country's most premier institute, and I expect the students to know their responsibility. If any document submitted to us is plagiarized (copied verbatim either from textbook/ online resources/ fellow students…), the student will be deregistered and promptly handed to institute authorities. Discussion is okay for homework, but the submission needs to reflect the student's work. No discussion/references are allowed in quizzes/ mid-semester/final exams.

Online Compliance:

If any student is having difficulty in accessing the online content/ submitting homework, please inform the instructor at the earliest.

Complete Schedule:

Topic	*Lectures*	*Week*	*Lab Experiment*	*Week Begining*
Introduction to measurement	1			
Introduction to properties of light, optical spectr	2	1	Warm up	03/01/22
Fundamentals of FT-IR	1			
Instrumentation of FT-IR, Fundamentals of UV	2	2	FTIR	10/01/22
UV-VIS instrumentation and analysis, XPS and oth	2			
Image formation in Light microscope	1	3	UV-VIS	17/01/22
Optical microscope instrumentation	1			
Image capture and analysis, Phase contrast, polar	2	4	Opt. Exp1	24/01/22
differential interference, fluerescence,	1			
X-ray diffraction,	2	5	Opt. Exp 2	31/01/22
instrumentation and analysis	1			
calculations for BCC,FCC..,	2	6	XRD 1	07/02/22
Minor Examinations		7	Mid Sem Evaluations	14/02/22
diffractometer, counter, camera	1			
introduction to SEM,	2	8	XRD 2	21/02/22
image formation, various SEM imaging technique	1			
EDS in SEM	2	9	SEM 1	28/02/22
AFM fundamentals	2			
AFM Instrumentationn	1	10	AFM	07/03/22
Fundamentas of DSC	1			
Instrumentation with DSC and DTA	2	11	DSC Exp, DTA	14/03/22
fundamentals of TGA	2			
Resistance, inductance and capacitance	1	12	TGA/Electrical	21/03/22
AC/DC measurements	2		Buffer for those who	
Summary and conclusions	1	13	wants to repeat	28/03/22
Total number of hours	**36**			