

**ACADEMIC AFFAIRS OFFICE
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE**

No. Acd./ 3102 /IAPC-76

Dated: February 03, 2020

Head, Department of Physics

(through e-mail)

The IAPC in its 76th meeting held on 07.11.2019 vide **Item No. 76.2.3** considered and approved the proposed revised syllabus of PHN-704 Advance Characterization Techniques (PCC) of Department of Physics to run in the Spring Semester 2020 onwards for M.Tech. (SSEM) program.

The approved syllabus is attached as **Appendix-A**.

Keeti

Assistant Registrar (Curriculum)

Copy to (through e mail):-

1. All faculty
2. All Heads of Departments/ Centres
3. Dean, Academic Affairs
4. Associate Dean of Academic Affairs(Curriculum)
5. Channel // Academic webpage of iitr.ac.in

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT. /CENTRE: **DEPARTMENT OF PHYSICS**

1. Subject Code: **PHN-704** Course Title: **Advanced Characterization Techniques**

2. Contact Hours: **L: 3 T: 0 P: 3**

3. Examination Duration (Hrs.): **Theory 3 Practical 0**

4. Relative Weightage: **CWS: 10-25 PRS: 25 MTE: 15-25 ETE: 30-40 PRE: 0**

5. Credits: **4** 6. Semester: **Spring** 7. Subject Area: **PCC**

8. Pre-requisite: **Nil**

9. Objective: To introduce various methods of characterization of materials for their structural, electrical, magnetic and optical properties.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Crystal Structure Determination: Brief description of crystal lattices; X-ray diffractometer; Determination of crystal structure using X-ray diffraction	12
2.	Electron Microscopes: Brief description of different microscopes like TEM, SEM, AFM; Modes of operation of microscopes, sample preparation, Interpretation of electron diffraction and determination of crystal structure; morphology of the crystals.	11
3.	Thermal Analysis: Thermogravimetric analysis, Differential thermal analysis and Differential scanning calorimetry and methodology; Determination of phase transitions using these methods.	5
4.	Electrical and Magnetic Property: Measurement of electrical conductivity in different materials- insulators, metals and semiconductors using four probe and Hall effect method. Vibrating Sample Magnetometer (VSM), Superconducting Quantum interference Devices (SQUID)	8
5.	Optical Characterization: Optical characterization of materials using photoluminescence and UV-visible spectroscopy.	3
6.	Chemical Analysis: Brief description to X-ray fluorescence, atomic absorption and electronic spin resonance spectroscopy.	3
	Total	42

11. Suggested Books.

S. No.	Name of Authors/Book/Publisher	Year of Publication/Reprint
1.	Culity, B. D., "Elements of X-ray Diffraction", Addison-Wesley.	2001
2.	Grundy, P. J. and Jones, G. A., "Electron Microscopy in the Study of Materials", Edward Arnold.	1976
3.	Egerton, R. F., "Physical Principles of Electron Microscopy", Springer.	2008
4.	Willard, H. H., Merritt, L. L. and Dean, J. A., "Instrumental Methods of Analysis", CBS publications.	1991
5.	Fultz, B. and Howe, J. M., "Transmission Electron Microscopy and Diffractometry of Materials", Springer.	2007
6.	Melissinos, A.C. and Napolitano, J., "Experiments in Modern Physics", Academic Press.	2003
7.	Sze, S.M., "Semiconductor Devices Physics and Technology", John Wiley and Sons.	2002
8.	Nakra, B.C. and Chaudhary, K.K., "Instrumentation Measurements and Analysis", Tata McGraw Hill.	2002
9.	Sayer, M. and Mansingh, A., "Measurement, Instrumentation and Experiment Design in Physics and Engineering", Prentice Hall.	2000
10.	Runyan, W.R., "Semiconductor Measurements and Instrumentation", McGraw Hill	2002

Experiments

S. No.	Contents	Contact Hours
1.	Analysis of X-Ray Diffraction pattern and evaluation of lattice parameters, unit cells, density, strain/strain of powder samples based on cubic structured materials.	42
2.	Studies on surface morphology of graphite sheet using STM and investigating the I-V characteristics.	
3.	Determination of phase transition using thermal analyzers (TGA/DTA/DSC).	
4.	AC susceptibility measurements of bulk samples.	
5.	Ultraviolet- visible spectroscopy of metal/metal oxides and composite materials	
6.	Structural phase transition study using LCR bridge	
7.	To determine transition temperature of given superconducting material and study Meissner effect.	
	Total	42