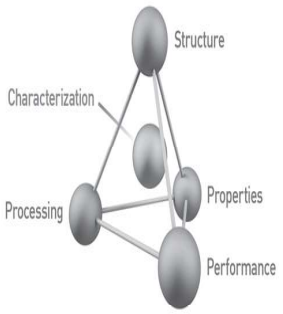
19ME312 ADVANCED MATERIALS AND CHARACTERIZATION



https://www.google.com/search?q=Advanced+material+and+characterization

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
20	30	-	-	5	5

PRE-REQUISITE COURSE: Materials Science and Metallurgy

COURSE DESCRIPTION AND OBJECTIVES:

This course offers understanding of the basic principles of materials used in "High-Tec" applications, usually designed for maximum performance and various characterization tools for material analysis. The objective of this course is to gain knowledge on Properties, importance, applications and characterization of different Advanced Materials.

COURSE OUTCOMES:

Upon completion of the course the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand capabilities of advanced materials and characterization techniques.	1
2	Suggest suitable material to work under challenging environments.	1
3	Select the appropriate tool to characterize the material by knowing its merits and demerits.	2,5
4	Analyze material properties with respect to its microstructural aspects.	2
5	Evaluate the material for defects and stresses using appropriate qualitative and quantitative techniques.	4

SKILLS:

- ✓ *Understand the range of advanced materials and constraints associated with their use.*
- ✓ *Perform various structural and microstructural characterization techniques on materials.*
- ✓ *Determine crystal structure, lattice parameter, phase identification, solvus line estimation and residual stress analysis using XRD.*

UNIT- I **L-9**

SPECIAL STEELS: Metallurgical aspects, Composition, properties and applications of different types of Dual phase steels, TRIP steels, Maraging steels, Hadfield steels, Free cutting steels, Ausformed steels, Heat resistant steels, Creep steels, HSLA steels.

UNIT- II **L-9**

SUPER ALLOYS: Composition, properties and applications of Iron base, Nickel base and cobalt base super alloys.

CARBONACEOUS MATERIALS: Carbonaceous including Nano tubes, Fullerenes and their applications.

UNIT- III **L-9**

SMART MATERIALS: Shape memory alloys, Piezo electric materials, Electro-rheological fluid, Magneto, Rheological fluids and their applications.

BIOMATERIALS: Property requirement, Biocompatibility and bio functionality, Important bio metallic alloys, Ni-Ti alloy, Fe-Ni-Co alloys (ODS), Hydroxyapatite and Co-Cr-Mo alloys.

UNIT- IV **L-9**

MATERIAL CHARACTERIZATION TECHNIQUES: Importance of Material characterization, Classification of techniques for characterization**,** Metallurgical microscope, Scanning electron microscopy (SEM) - construction of Scanning electron microscope, modes of operation; Working principle of TEM, Working principle of Atomic force microscope (AFM).

UNIT- V **L-9**

X-RAY DIFFRACTION: Continuous and characteristic X-radiation, Bragg's law and X-ray diffraction, Determination of lattice parameter, Crystal size measurement, Phase identification/quantification, Solvus line determination, Retained austenite and residual stress measurement.

THERMAL ANALYSIS: Working principle and applications of DTA, DSC, FLIR.

TEXT BOOKS:

1. R.E Smallman, A.H.W Ngan, "Physical Metallurgy and Advanced Materials", 7th edition, Butterwoth-Heinemann, 2010.
2. K.M. Gupta, "Engineering Materials, Research, Applications and Advances", 1st edition, CRC Press, 2015.

REFERENCE BOOKS :

1. P.K. Mitra, "Characterization of Materials", 1st edition, PHI, 2014.
2. P.S. Gill, "Materials Science & Engineering", 1st edition, Katson Books, 2015.