

GUJARAT TECHNOLOGICAL UNIVERSITY

MANUFACTURING ENGINEERING ENGINEERING MATERIALS AND METALLURGY SUBJECT CODE: 2133403 B.E. 3RD SEMESTER

Type of course: Theoretical + Practical (Regular)

Prerequisite: Basic knowledge of materials and their mechanical properties

Rationale: Correlate the material behavior and properties based on their structure

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

Contents:

Sr. No.	Subject Content	Hours	Module Weightage
1.	Constitution Of Alloys And Phase Diagrams Constitution of alloys – Solid solutions, substitutional and interstitials – Phase diagrams and microstructure development: Isomorphous, eutectic, peritectic, Eutectoid and peritectoid alloy systems. Iron-Iron carbide equilibrium diagram, Development of microstructures in Iron- carbon alloys	8	20
2.	Heat Treatment Full annealing-stress relief, Recrystallisation- Spheroidizing, Normalising, Hardening and tempering of steel. Isothermal transformation diagrams- TTT– CCT cooling curves - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburizing, nitriding, cyaniding, carbonitriding – flame and induction hardening – vacuum and plasma hardening – current trends-thermo-mechanical treatments- elementary ideas on sintering	16	20
3.	Ferrous And Non Ferrous Metals Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W)- classification of steels (tool steel, stainless)– cast irons – alloy cast irons- Copper and Copper alloys –Aluminum and its alloys- Magnesium and its alloys– Titanium and its alloys- Nickel and Cobalt alloys, properties and applications of these materials.	12	20
4.	Non-Metallic Materials Types, properties and applications: Polymers – Commodity Plastics, Engineering Plastics, Specialty Plastics – Thermosetting Plastics – Bio-Degradable Plastics, Ceramics and Composites– Super conductors- nanomaterials and their properties.	12	20
5	Mechanical Properties And Testing Crystal imperfections- Dislocations- Strengthening mechanisms- Elastic, anelastic and viscoelastic behaviour – modulus of elasticity- plastic deformation- Mechanical tests- tension, compression, impact, hardness- effect of temperature,	12	20

	grain size , solutes and precipitates on dislocation dynamics – Mechanism of Fracture - mechanism of creep-creep resistant materials- creep tests- fracture toughness ductile- brittle transition –deformation mechanism maps- fatigue fracture-fatigue test.		
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Reference Books:

1. George E. Dieter, Mechanical Metallurgy, McGraw Hill, 2007.
2. Sydney H Avner, “Introduction to Physical Metallurgy”, 2/E Tata McGraw Hill Book Company, 2007.
3. Kenneth G. Budinski and Michael K. Budinski “Engineering Materials”, PHI / Pearson Education
4. G.S. Upadhyay and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt. Ltd, 2006.

Course Outcome:

After learning the course the students should be able to :

Students will be able to correlate the behavior of materials and their properties which can be altered to make the material useful in high end applications. This course will give an insight of the various heat treatment processes being carried out in the industry for day to day usage. Students will also get to know in detail about the various materials being used for different engineering applications.

List of Experiments:

1. Preparation And Study Of Microstructures Of Pure Metals Like Iron, Copper & Aluminium
2. Preparation And Study Of Microstructures Of Low Carbon Steels, Medium Carbon Steels & High Carbon Steels
3. Study Of Microstructures Of Cast Iron
4. Study Of Microstructures Of Non Ferrous Alloys
5. Study Of Microstructures Of Heat Treated Steels
6. Jominy End Quench Test
7. To Measure The Hardness Of Various Heat Treated & Untreated Steels
8. Study Of Plastics And Composites Materials
9. Study Of Bio – Degradable Plastics
10. Study Of Crystal Imperfections & Dislocations

Design based Problems (DP)/Open Ended Problem:

1. Preparing models of F.C.C, B.C.C, H.C.P, Crystal Imperfections by students
2. Seminar on the recent advancements in the heat treatment practices by the students

Major Equipments:

- Metallurgical Microscope
- Jominy End Quench Test Apparatus
- Brinnell / Rockwell Hardness Testing Machine
- Electric furnace

List of Open Source Software/learning website:

- <http://freevideolectures.com/Course/3104/Principles-of-Physical-Metallurgy/31> (NPTEL video series)
- <http://www.virginia.edu/bohr/mse209/chapter4.htm>

- ASTM Handbooks (Volume 2 to Volume 13)

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.