GUJARAT TECHNOLOGICAL UNIVERSITY

METALLURGY ENGINEERING (21)

PLASTIC DEFORMATION OF METALS

SUBJECT CODE: 2142106

B.E. 4th SEMESTER

Type of course: Engineering Science

Prerequisite: None

Rationale: Plastic Deformation of Metals program is to prepare students for careers in Engineering where Principles of Mechanical Metallurgy of metals can be applied to the Industries dealing with Metal forming operations. This education at the undergraduate level will enable students to seek employment in Metal Industries upon graduation while, at the same time, provide a firm foundation for the pursuit of graduate studies in Metallurgy Engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Elastic and Plastic Deformation Elastic and plastic deformation of metallic materials. Stress-strain, yield phenomena for ductile. Ductile vs brittle behaviour. Mohr's circle, Yielding criterion, Von-Mises and Maximum-shear-stress/Tresca yielding criterion, Failure criteria under combined stresses,	09	20
2	Plastic deformation of single crystals: Lattice defects, Crystal Imperfection: Point defect, line defect & surface defects. Slip phenomena, slip systems, Slip by dislocation movement, concept of critical resolved shear stress, Twinning as mode of deformation, Stacking faults, Strain hardening of single crystal.	08	18
3	Plastic deformation of poly crystalline material. Grain boundaries & deformation, strengthening from grain boundaries, strain hardening of poly crystalline materials. Strengthening Mechanism of metals.	08	18
4	Dislocation theory: Burger vector and dislocation loop. Dislocation in FCC (Including formation of Stacking faults) BCC & HCP, stress field of dislocations, forces on dislocation, forces between dislocation motions of dislocations, dislocation climb. Jogs in dislocations. Sources, Multiplication of dislocations-Frank Reed source. Techniques of observation of dislocation.	10	22
5	Annealing of cold worked metals, Recovery, Recrystallization and grain growth.	03	06
6	Fracture behaviour of metals: Types of fracture in metals, theoretical cohesive strength of metals, Griffith theory of brittle fracture. Theory of ductile brittle transition temperature. Concept of Fracture Mechanics	07	16

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
20%	30%	35%	10%	5%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Reference Books:

1. Mechanical Metallurgy by -G. E. Dieter, Publisher: Mc Graw Hill Co,
2. Mechanical Behaviour and testing of Materials by A.K.Bhargava & C.P.Sharma, Publisher: PHI
3. Dislocations and Mechanical Behaviour of Metals by M.N.Shetty, Publisher: PHI
4. Deformation and Fracture Mechanics of Engineering Materials by R. W. Hertzberb, Publisher: John Wiley & Sons.
5. Physical Metallurgy Principles-Robert E. Reed Hill, Publisher: Cengage Learning

Course Outcomes:
After successful completion of the course students should be able to:

1) Know about Elastic and plastic deformation of metallic materials
2) Understand effect of deformation behaviour of ductile & brittle material.
3) Able to understand various strengthening methods of metals & alloys.
4) Recognise the microstructural and property changes during stages of Annealing.

List of Open Source Software/learning website:

I. http://nptel.iitm.ac.in/
II. www.ocw.mit.edu

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.