

GUJARAT TECHNOLOGICAL UNIVERSITY

METALLURGY ENGINEERING (21)

METAL WORKING PROCESSES

SUBJECT CODE: 2172108

B.E. 7th SEMESTER

Type of course: core

Prerequisite: Knowledge of Elements of Metals, Plastic deformation of metals

Rationale: Metal forming in manufacturing and considers a metal-forming process as a system consisting of several interacting variables. These Includes an overall review and classification of all metal-forming processes. The fundamentals of plastic deformation - metal flow, flow stress of metals and yield criteria helps to understand the phenomena of metal working. This subject pursues more exposure on metallurgical metal forming processes like rolling, forging, extrusion, wire drawing and tube drawing, sheet metal working and other methods. The knowledge of above said processes helps in career opportunity in the field of manufacturing. Recent developments in metal-forming technology, including CAD/CAM for die design and manufacture also enhance the knowledge level of students to match industrial requirements.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Fundamental in Metal Working Fundamental in Metal working, temperature in metal working, Cold working and hot working of Metals, Stress-Strain diagram, Yield criteria, Workability, Recovery, recrystallization and grain growth.	4	5
2	Introduction to Metal Working Classification of metal forming processes, Mechanics of metal working, Flow curve for materials, effect of strain rate	6	10
3	Forging: Classification of forging processes, Forging equipment and operations, Open die forging, Closed die forging, Calculation of Forging loads in closed-die forging, Forging defects, Residual stresses in forging.	9	15
4	Rolling: Terminology of rolled products, types of rolling mills, Deformation zone in rolling, Neutral point, Angle of bite, Forward slip, Roll flattening,	12	20

	Rolling variables, Hot rolling, Cold rolling, Rolling of blooms billets, Elementary roll pass design, Forces and geometrical relationships in rolling, Defects in rolled products		
5	Extrusion: Classification of extrusion processes, Direct and indirect extrusion, Impact extrusion, Hydrostatic extrusion, Extrusion equipment, Hot Extrusion, Cold Extrusion, Extrusion ratio, Process variables, Lubrication & defects in extrusion, Derivation of extrusion pressure, Extrusion of tubing, Production of seamless pipe and tubing.	10	17
6	Drawing of rods, wires and tubes: Theory and practice of wire drawing, Wire drawing equipment, Variables in wire drawing, Defects in formed products	9	15
7	Sheet Metal Working: Shearing, Blanking, Bending, Stretch forming, Deep drawing, Embossing, Coining	6	10
8	Die Materials and Die Manufacturing: Die materials and die manufacture. Role of lubricants, Recent developments in metal forming technology and application of FEM to simulation of metal forming.	4	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	20	30	35	10	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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, McGraw-Hill.
2. Metal Forming: Fundamentals and Applications by Taylan Altan (ASM Series in Metal Processing)
3. Introduction to Industrial Mechanical Working Process by G. W. Rowe
4. Materials & Processes In Manufacturing By E.Paul De Garmo, J T Black & Ronald A Koshav
5. Modern Control Engineering by Ogata, PHI Publ. Prentice-Hall of India Pvt. Ltd.
6. Manufacturing Technology (Foundry, Forming and Welding) by P. N. Rao, TMH.

Course Outcome:

After learning the course the students should be able to:

1. Learn basic knowledge of Metal working processes.

2. Classify the metal working processes
3. Explain principle of forging, determination of forging load & its application.
4. Describe about the rolling operation and different aspect related to rolling.
5. Understand the manufacturing of tubes and pipe by extrusion method.
6. Describe the manufacturing of wire and rods and able to analyze the variable affecting it.
7. Acquainted with sheet metal working.
8. select the material for die manufacturing and software utilize for designing of it

List of Experiments:

1. To Study about Metal Forming processes.
2. To Study Metal Working Process: Rolling.
3. To Study Metal Working Process: Forging.
4. To Study Metal Working Process: Extrusion.
5. To Study Metal Working Process: Wire Drawing and Tube Drawing
6. To Study Sheet Metal Forming processes.
7. To study the process of designing of dies by CAD.
8. To study the role of lubrication method in metal forming
9. To study numerical on Rolling, forging and wire drawing.

List of Open Source Software/learning website:

<http://nptel.ac.in/>

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.