

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Mechanical Engineering

SUBJECT NAME: Metal Forming Analysis

SUBJECT CODE: 2171913

B.E. 7th SEMESTER

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale:

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to hot forming, cold forming, warm forming its advantages and disadvantages Typical stress strain diagram for ductile materials Forming properties of metals and alloys (yield strength/flow stress, ductility, strain hardening, strain rate sensitivity, effect of temperature and hydrostatic pressure on yield strength) Classification of forming processes and advantages of metal forming	02	5
2	Stress of stress at a point, stresses on an inclined plane, Principal stress, Two dimensional Mohr's circle for stress analysis, Deformation and strain, Stress of strain at a point	03	10
3	Yield conditions, Von Mises' hypothesis of yielding, Tresca's hypothesis of yielding, graphical representation of yield criteria, Elastic stress strain relations for isotropic elastic materials, Idealized stress strain relations in plastic deformations, Isotropic and kinematic work hardening	05	10
4	Introduction to; (i). Theory of slip lines, (ii). upper bound theorem and (iii). lower bound theorem	03	10
5	FORGING processes: Introduction, classification of forging, forging machines, metal flow in forging, Analysis of plane strain compression, analysis of compression of circular disc with slab method	06	15
6	EXTRUSION Processes: Introduction, calculation of extrusion load using slab method, slip line method & upper bound method. Defects in extrusion. Direct & indirect extrusion. WIRE DRAWING Processes: Introduction, defects, maximum possible reduction. Wire drawing load calculation using slab method.	08	15
7	ROLLING Processes: Classification, types of mill, Analysis of longitudinal strip or sheet rolling process (calculation of roll separating force, torque & power, angle of bite, maximum reduction in rolling), rolling defects, roll flattening, roll camber	06	15

8	SHEET METAL FORMING Processes: various sheet metal operations, Blanking and punching operations, compound and progressive dies, nesting, clearance, forces in blanking, Bending of plates, bendability, spring back, bending force, bending moment for real material, stress and strain in bending, stress in deep drawing, drawability. drawing load, Anisotropy in sheetmetal	10	15
9	Introduction to forming limit diagram, Friction and lubrication in forming processes	03	5

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	10	10	10	10	10

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. Ghosh A. and Mallik A. K., "Manufacturing Science", East -West Press, New Delhi, 1998.
2. Juneja B. L., "Fundamentals of Metal Forming Processes", New Age International Publishers, 2010.
3. Hosford William F. and Caddell R. M., "Metal Forming Mechanics and Metallurgy", Prentice Hall, 1993.
4. Mielnik Edward M., "Metal Working Science and Engineering", McGraw Hill, 1991.
5. Dieter G. E., "Mechanical Metallurgy", McGraw Hill, 1988.
6. Rao P.N., "Manufacturing Technology", Tata McGraw Hill, 1990.
7. Wangoner Robert H. and Jean-Loup Chenot, "Fundamentals of Metal Forming", John Wiley & Sons, 1997.
8. Beddoes J. and Bibby M. J., "Principles of Metal Manufacturing Processes", Viva Books, 2000.
9. Sharma P. C., "Production Engineering", S. Chand & Co ., New Delhi, 2003.

Course Outcome:

After learning the course the students should be able to:

- Identify various forming process
- Identify and determine various methods rolling processes
- Identify and determine various methods to forging processes
- Identify and determine various methods to extraction processes
- Identify and determine various methods to Drawing processes
- Identify and determine various methods to Sheet metal forming processes

List of Experiments:

1. To construct a slip-line net for upsetting a work piece.
2. Experimental determination of stress strain behavior for ductile material and to evaluate the various elastic and plastic constants.
4. To analyze flow stress of the given material and to plot a graph of forging ratio vs. flow stress. Plot the bulge profile of the forged pieces, to find the radius of curvature of bulging of the forged pieces and to plot a graph of forging ratio vs. H_f / R_c .
5. To analyze the bending force vs. bending angle for 'V' bending of strip and to plot the strain distribution.

6. To measure the force required in extrusion of model material by using a die having different diameter and to draw the graphs between extrusion force vs. extrusion ratio.
7. To study the rolling process and plot the graph for percentage reduction in area vs. power in rolling.
8. Industrial visits for exposure to various metal forming processes and report preparation based on observations and learning.

Design based Problems (DP)/Open Ended Problem:

1. Review of various methods for experimental measurements of friction in metal forming processes.
2. To plot the forming limit diagram and to study the effect of various strain paths on formability
3. To review research paper on experimental strain measurement in sheet metal forming processes

Major Equipment:

Various test setups can be developed over the period of time as UG project work or post graduate dissertations for performing experiments on related topics

List of Open Source Software/learning website:

1. Code_Aster
2. AutoForm
3. CalculiX
4. www.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.