GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Part Time)

Subject Code: 2961910

Metal forming analysis

6th SEMESTER

Type of course: Departmental elective

Prerequisite: Basic Knowledge of METAL FORMING

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction to hot forming, cold forming, warm forming its advantages and disadvantages and its effect on mechanical properties. Description of Material properties of metals and alloys (yield strength/flow stress, ductility, strain hardening, strain rate sensitivity, effect of temperature, friction, lubrication and hydrostatic pressure on yield strength). Tensile test, effect of properties on forming. Classification of forming processes and advantages of metal forming.	**4**
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.	**3**
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	**3**
4	Introduction to; (i). Theory of slip lines, (ii). upper bound theorem and (iii). lower bound theorem.	**3**
5	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 sheet metal. Sheet formability: Forming limit curve – concept and evaluation, formability tests, theoretical prediction, factors affecting FLC.	**12**
6	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	**5**
7	EXTRUSION Processes: Introduction, calculation of extrusion load using slab method, slip line method & upper bound method. Defects in extrusion. Direct & indirect extrusion.	**6**

	WIRE DRAWING Processes: Introduction, defects, maximum possible reduction. Wire drawing load calculation using slab method	
8	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	**6**

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.
4. Z. Marciniak, J. L. Duncan, S. J. Hu, Mechanics of sheet metal forming, Elsevier, Butterworth-Heinemann, 2002
5. Dieter G. E., "Mechanical Metallurgy", McGraw Hill, 1988.
6. Wangoner Robert H. and Jean-Loup Chenot, "Fundamentals of Metal Forming", John Wiley & Sons, 1997.
7. Beddoes J. and Bibby M. J., "Principles of Metal Manufac turing Processes", Viva Books, 2000.
8. Sharma P. C., "Production Engineering", S. Chand & Co ., New Delhi,
9. Rao P.N., "Manufacturing Technology", Tata McGraw Hill, 1990.

Distribution of marks weightage for cognitive level

Bloom’s Taxonomy for Cognitive Domain	Marks % weightage
Recall	10
Comprehension	10
Application	20
Analysis	30
Evaluate	20
Create	10

Course Outcome:

After learning the course the students will able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Understandthe concept of different metal forming process.	15
CO-2	Application of various metal forming processes.	15
CO-3	Analyze metal forming processes both analytically and numerically	30
CO-4	Predict and evaluate the behaviour of material during the Forming processes.	30
CO-5	Design and formulate forming process for new product.	10

List of Experiments:

1.To construct a slip-line net for upsetting a work piece.

2. To conduct Tensile test on ductile sheet material and to study stress –strain behavior of it.

3. 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. Hf / Rc.

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. To study the forming limit diagram of ductile material and to study the effect of various strain paths on formability

9. Industrial visits for exposer to various metal forming process and report preparation based on observations and learning.

Major Equipment:

1.Hydraulic press

2. Universal testing machine

3. 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. www.nptel.ac.in