

Branch Name:	Mechanical Engineering (Production Technology)
Program Code:	ET209
Course Name:	Mechanics of Metal Forming
Course Code:	2ET2090202T
Pre-requisite Course:	Zeal to learn the subject

Course Objectives:

1. To strengthen the knowledge in metal forming processes and analysis.
2. To comprehend metal forming theories and their relationships with material principles.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40	-	-	-	-	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Introduction: Advantages of metal forming, cold and hot forming, various metal forming processes.	02	05
2	Theory of Elasticity and Plasticity: Review of theory of elasticity, Stress tensor, stress transformations, principal stresses, differential equations of equilibrium, spherical and deviatoric stress tensors, octahedral stresses, infinitesimal and affine transformation for deformation, rotation and strain tensors, strain transformations, principal strains, spherical and deviator strain tensors, octahedral strains, finite deformations, Mohr's circles for state of stress and state of strain, generalized Hooke's law, Hooke's law for isotropic and homogeneous materials, plane stress and plane strain. Plasticity, stress space, yield criterion for metals, Von- Mises' yield criterion, Tresca's yield criterion, representation of the above in stress space, yield surface. Basic considerations of plasticity theory, simple models of material behavior, Levy-Mises (flow rule) and Prandtl-Reuss stress strain relations.	08	40
3	Slip Line Field Theory: Slip Line Field Theory, Incompressible two-dimensional flow, slip lines, equilibrium equations (referred to slip lines), Henkey's theorems, hodograph, simplest slip line fields, application in forming processes – extrusion and forging.	06	15

4	Metal Forming Processes: Rolling; Types of rolling, Determination of rolling pressure, Driving torque and power, Power loss in bearings, defects Wire-drawing; Determination of drawing force and power, Maximum allowable reduction, Defects Extrusion; Determination of work load, defects, Forging; Types of forging, Determination of maximum force required for forging a strip and a disc between two parallel dies (open die forging), defects Deep-drawing; Analysis to correlate the initial and final dimensions of the job, estimation of the drawing force, Defects, Bending; Determination of work load, Estimation of spring back, Punching and blanking; Mode of metal deformation and failure, deformation model and fracture analysis, Determination of working force, Friction and Lubrication in metal forming. High Energy Rate Forming (HERF) Processes; Explosive forming, Electro hydraulic forming, Electromagnetic forming.	08	40
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Review Presentation: The student is expected to spend minimum 2 hours per week (as mentioned in the teaching and evaluation scheme) to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. Student is supposed to explore various video lectures (e.g., NPTEL) available in the domain/subject. Student is required to make a review- presentation on the work carried out for the same. Recommended sites for journal papers are (1) asmedigitalcollection.asme.org (2) springer.com (3) sciencedirect.com (4) ieeexplore.ieee.org (5) scholar.google.co.in or others of similar repute.

List of Reference Books:

1. Stephan Timoshenko, and J. N. Goodier, Theory of Elasticity, McGraw Hill, 2010.
2. A. Ghosh and A. K. Mallik, Manufacturing Science, East west press, New Delhi, 2006.
3. Robert H. Wagoner and Jean-Loup Chenot, Fundamentals of Metal Forming, John Wiley and Sons, 1996.
4. G. K. Lal, P. M. Dixit and N. Venkata Reddy, Modelling Techniques for Metal Forming Processes, Narosa Publishing House, 2011.
5. William F. Hosford and R. M. Caddell, Metal Forming Mechanics and Metallurgy, Prentice Hall, 1993.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand and apply the mechanism of deformation for different metal forming processes and develop analytical relation between input and output parameters of process.	2 Understanding 3 Applying 6 Creating
CLO2	Understand and analyze the concept of yield criteria applicable to different material deformation processes.	3 Applying 4 Analyze
CLO3	Estimate the working loads for metal forming processes.	4 Analyze
CLO4	Apply theoretical and experimental techniques for measurement of important outcomes of metal forming processes.	3 Applying 6 Creating
CLO5	Understand the different lubrication mechanisms, lubricants and other valuable affecting the metal forming processes under different working conditions.	2 Understanding 3 Applying
CLO6	Understand the different types of defects, causes and apply their remedial measures in metal forming processes	4 Analyze 6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	M	H		H	H						L			
CLO2	M	H		H	M	L					L		M	
CLO3	L			M	M			L	M	L				M
CLO4	L			H	M	M		L	M	L				H
CLO5	H			L		M	H	M	M	L		L	M	
CLO6	H			M	M		H				M	L		H

H: High, M: Medium, L: Low