

Branch Name:	Mechanical Engineering (Production Technology)
Semester/Year:	Semester II / Second Year
Subject Title:	Mechanics of Metal Forming
Subject Code:	1ET2090202
Pre-requisite:	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 Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
02	00	00	02	30	20	00	00	50

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 behaviour, 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	08	40

	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.		
		24	100

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 (5) ieeexplore.ieee.org (6) scholar.google.co.in or others of similar repute.

Course Outcomes:

The student will be able to

1. Solve the numerical problems to calculate stresses on inclined planes.
2. Apply theory of failure for the given process.
3. Estimate the working loads for Metal forming processes.

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.