### School of Engineering (Mechanical Engineering)

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<tr>
<th>Degree</th>
<th>Course Name</th>
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<tr>
<th>Semester</th>
<th>Credits</th>
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<td>I</td>
<td>3</td>
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#### Unit - I

**Introduction and Process Modeling:** Introduction; Uniform energy method; Slab method; Slip line field method; Upper bound method; Visioplasticity method; Finite Element method.

**Plasticity Fundamentals:** Introduction; Von Misses criterion; Tresca criterion; Experimental verification of yield criterion; Plastic anisotropic; Anisotropic yield criterion; Plastic instability; Generalized necking failure conditions.

(07 Hours)

#### Unit - II

**Uniform Energy and Slab Methods:** Introduction; Uniform energy method; Application - Comparison of flat plate between two parallel platten; Rolling of flats; Direct extrusion; Wire drawing; Tube drawing.

**Slab Method:** Introduction; The slab method; Open die forging – Low and high slipping friction conditions; Mixed friction conditions; Load calculations; Strip drawing; Wire and rod drawing; Tube drawing; Extrusion; Strip rolling.

(09 Hours)

#### Unit - III

**Slip Line Field Technique:** Introduction; Plane strain; Alpha and beta lines; Stress equation; Velocity equation; Hencky’s first theorem; Hencky’s second theorem; Velocity discontinuities; Stress discontinuities; Stress boundary conditions; Construction of slip line fields; Construction of Hodographs; Application of field line technique for rolling extrusion etc.

(08 Hours)
Unit - IV

Upper Bound Technique: Introduction; Principle of virtual work; Principle of maximum work; Upper bound theorem; Application of upper bound technique for frictionless square die; extrusion through a smooth circular die; rolling of sheets; Axisymmetric extrusion; Axisymmetric deep drawing. (07 Hours)

Unit - V

Visioplasticity Technique: Introduction; Visioplasticity analysis – stress distribution under plane strain and in axial symmetry; Application. (06 Hours)

Unit - VI

Finite Element Method: Introduction; Finite element method; Eulerian rigid plastic FEM formulation for plane strain rolling – governing equation; domain and boundary conditions; integral form; finite element approximation; finite element equation; solution procedure. (08 Hours)

Recommended Books:

1. Modeling Techniques for Metal Forming Processes; G K Lal; P M Dixit; N Venkata Reddy; Narosa Publisher
2. Manufacturing Science; Ghosh & Mallik; Affiliated East-West Press.
3. Technology of Metal Forming Processes; S. Kumar; Prentice Hall of India.
5. An Introduction to the Principles of Metal Working; Rowe; Arnold.
7. ASM Metals Handbook. Vol.14; Forming and Forging; Metals Park; Ohio; USA; 1990.
8. Metal Forming: Fundamentals and Applications; Taylor Altan; Soo I.K. Oh; Harold. L. Gegel; ASM; Metals Park; Ohio; USA; 1983.