

# **Gautam Buddha University; Greater Noida**

## **School of Engineering (Mechanical Engineering)**

<b>Degree</b>	<b>Course Name</b>	<b>Course Code</b>	<b>Marks:100</b>
M. Tech.	Modeling of Metal Forming Processes	MEM 518	SM+MT+ET 25+25+50
<b>Semester</b>	<b>Credits</b>	<b>L-T-P</b>	<b>Exam.</b>
I	3	3-0-0	3 Hours

### **Unit - I**

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

**Plasticity Fundamentals:** Introduction; Von Mises 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.
4. Handbook of Metal Forming; Kurt Lange; Society of Manufacturing Engineers. Michigan; USA; 1988.
5. An Introduction to the Principles of Metal Working; Rowe; Arnold.
6. Metal Forming - Processes and Analysis; Avitzur; Tata McGraw-Hill Co.; New Delhi; 1977.
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.