

# MANUFACTURING AND PRODUCTION PROCESSES

ENME 202

**Lecture** : 3  
**Tutorial** : 1  
**Practical** : 3

**Year** : II  
**Part** : I

## **Course Objectives:**

The objective of this course is to impart knowledge and skills in the field of manufacturing and production processes. It deals with different metal forming and manufacturing processes along with advanced manufacturing techniques and automation processes that are used in modern industries.

### **1 Overview of Manufacturing**

**(6 hours)**

- 1.1 Introduction
- 1.2 Product cycle
- 1.3 Role of manufacturing in economic development
- 1.4 Role of engineers in manufacturing
- 1.5 Evolution of organization for manufacturing
- 1.6 Product design and concurrent engineering
- 1.7 Design for manufacture, assembly, disassembly and service
- 1.8 Green design and manufacturing
- 1.9 Selection of materials
- 1.10 Selection of manufacturing processes
- 1.11 Quality assurance and total quality management
- 1.12 Lean production and agile manufacturing
- 1.13 Manufacturing costs and global competition
- 1.14 Trends in manufacturing

### **2 Solidification Process and Powder Metallurgy**

**(5 hours)**

- 2.1 General characteristics of casting process and products
- 2.2 Solidification phenomena and associated problems
- 2.3 Sand casting process
- 2.4 Investment casting process
- 2.5 Permanent mould and pressure die casting
- 2.6 Continuous casting characteristics and capabilities
- 2.7 Powder metal processes and equipment
- 2.8 Manufacturing process for plastic and composite materials

### **3 Bulk Deformation Process**

**(5 hours)**

- 3.1 General characteristics of bulk deformation process and products

- 3.2 Force, energy and deformation: Sensitivity to frictions, geometry, temperature and deformation rate
- 3.3 Forging practice and technology; press and hammers, tooling design, manufacture wear
- 3.4 Design of forgings; characteristics and defects in forgings
- 3.5 Flat rolling; characteristics and defect in forgings
- 3.6 Shape rolling: Process and products
- 3.7 Extrusion
- 3.8 Wires, bar and tube drawing

**4 Sheet Metal Product Manufacturing Process (3 hours)**

- 4.1 Shearing and punching operations
- 4.2 Sheet metal and tube bending: Technology and practices
- 4.3 Deep drawing and hydro forming
- 4.4 Spinning operations and capabilities
- 4.5 Formability assessment

**5 Material Removal Processes: Chip-forming (6 hours)**

- 5.1 Modeling the cutting process
- 5.2 Force, power and productivity relationship
- 5.3 Cutting tools materials: Characteristics and economics
- 5.4 General purpose machine tool types
  - 5.4.1 Operation of lathes, milling, shapers and drilling machines
  - 5.4.2 Application of shaping, planning and slotting machines
- 5.5 Methods of mounting of jobs and cutting tools in machine tools
- 5.6 Uses of various attachments in machine tools
- 5.7 Control of machine tools and product properties
- 5.8 Cutting off process: Saws, flame cutting, arc cutting
- 5.9 Tribology in machining process

**6 Material Removal Processes: Abrasive and Advanced (6 hours)**

- 6.1 Abrasive based tooling
- 6.2 Grinding technology and practice
- 6.3 Advanced machining processes
- 6.4 Electrical discharge machining
- 6.5 Electrochemical machining
- 6.6 Laser-beam machining
- 6.7 Electron-beam machining
- 6.8 Water-jet and abrasive-jet machining processes
- 6.9 Hybrid machining
- 6.10 Economics of abrasive and advanced machining processes

- 7 Automation of Manufacturing Process (5 hours)**
- 7.1 Need for flexible automation and numerical controls
  - 7.2 CNC machine tool description; technology and practices
  - 7.3 Computer-integrated manufacturing
  - 7.4 Computer-aided design, engineering and process planning
  - 7.5 Industrial robots
  - 7.6 Group technology
  - 7.7 Economic consideration
- 8 Rapid Prototyping Process and Applications (4 hours)**
- 8.1 Need for rapid prototyping
  - 8.2 Subtractive and additive processes, virtual prototyping, self-replicating machines
  - 8.3 Direct manufacturing and rapid tooling
  - 8.4 Applications of rapid prototyping process
- 9 Material Joining Processes (5 hours)**
- 9.1 Principle of material joining process, types
  - 9.2 Fusion-welding processes
  - 9.3 Solid-state welding processes
  - 9.4 Brazing, soldering, adhesive-bonding processes
  - 9.5 Mechanical fastening processes
  - 9.6 Design considerations, defects analysis and testing of joints
  - 9.7 Economics of joining processes
- Tutorial (15 hours)**
- 1. Overview of manufacturing: Case study, econometric relationship exercises
  - 2. Solidification process and powder metallurgy: Numerical exercises on time, performance and efficiency
  - 3. Bulk deformation process: Numerical exercises on time, performance and efficiency
  - 4. Sheet metal product manufacturing process: Numerical exercises on time, performance and efficiency
  - 5. Material removal processes (Chip-forming): Numerical exercises MMR, performance and efficiency
  - 6. Material removal processes (Abrasive and advanced): Numerical exercises on MMR, performance and efficiency
  - 7. Automation of manufacturing process: Numerical exercises on time, cost, performance and efficiency
  - 8. Rapid prototyping process and applications: Numerical exercises on time, performance and efficiency
  - 9. Material joining processes: Numerical exercises on time, performance and efficiency

**Practical****(45 hours)**

1. Solidification and bulk deformation processes
2. Sheet metal working
3. Engine lathe operations
4. Shaper operations
5. Milling machine operations
6. Drilling machine operation
7. Grinding machine operation
8. Arc welding
9. Gas welding

**Final Exam**

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

<b>Chapters</b>	<b>Hours</b>	<b>Marks Distribution*</b>
1	6	8
2 and 3	10	14
5 and 6	12	14
4 and 7	8	12
8 and 9	9	12
<b>Total</b>	<b>45</b>	<b>60</b>

\* There may be minor deviation in marks distribution.

**References**

1. Kalpakjian, S., Schmid, R. and Vijay Sekar, K.S. (2021). Manufacturing Engineering and Technology (7<sup>th</sup> edition). Essex: Pearson Education Limited.
2. Kalpakjian, S., Schmid, R. and Vijay Sekar, K.S. (2023). Manufacturing Processes for Engineering Materials (6<sup>th</sup> edition). Essex: Pearson Education Limited.
3. Schey, J. A. (1999). Introduction to Manufacturing Processes. McGraw Hill.
4. Doyleetal, L. E. (1985). Manufacturing Processes and Materials for Engineers. Prentice Hall.
5. Shaw, M. C. (2005). Metal Cutting Principles. Oxford University Press.
6. Nagendra Parashar, B.S. and Mittal, R. K. (2011). Elements of Manufacturing Processes. P New Delhi: Prentice Hall of India Pvt Ltd.