

Department of Mechanical Engineering Technology

*Course number/name:*

MECH 3540: Manufacturing Systems

*Credits/contact hours:*

3 credits/2 class hours, and 2 lab hours.

*Instructor/coordinator:*

Angran Xiao, Associate Professor of Mechanical Engineering Technology

*Text book/title/author/year*

Manufacturing Processes for Engineering Materials, S. Kalpakjian, S. Schmid, Prentice Hall ISBN 0131489658

*Specific course information*

*Catalog description:*

This course will introduce students to the basic manufacturing processes presently utilized in the industry. This course describes the behavior and manufacturing properties and fundamentals of materials and introduces the students to different materials used in the field of industrial design.

*Pre/Corequisites:*

MECH 1201, IND 2304

*Required/elective/selected elective:*

Elective for Mechanical Engineering Technology

*Course learning objectives:*

1. Demonstrate the ability to state materials properties and apply these properties to manufacturing processes and design.
2. Demonstrate the ability to compare and distinct the advantages of traditional mechanical manufacturing processes in design process.
3. Demonstrate the ability to interpret product requirements, manufacturing process data and apply them to select and/or synthesize suitable manufacturing process(es).
4. Demonstrate the ability to differentiate advanced and non-traditional manufacturing processes.
5. Demonstrate the basis process optimization techniques by understanding the role of economic consideration, materials properties and design constraints in manufacturing processes selection.

*Course addresses ABET student outcomes:* SO1, SO3 and SO4.

*Brief list of topics to be covered:*

- Manufacturing systems. Definition of manufacturing. Product design process and concurrent engineering. Design for manufacture. Selection of materials. Selection of manufacturing processes. Quality assurance and total quality management. Global competitiveness and manufacturing cost.
- Crystal structure of metals, Deformation and strength of single crystals. Mechanical behavior of materials. Arrangement of atoms in a metal structure. Grains and grain boundaries. Mechanisms of strain hardening. Elastic and plastic features of stress-strain

curves. Hardness, fatigue, creep, impact, and residual stresses in material processing. Physical properties of materials. Metal alloys strengthening of metal alloys by heat treatment.

- Ferrous metals and alloys, nonferrous metals. Polymers, Ceramics, Graphite and Diamonds. Production of iron and steel. Continuous casting. Carbon and alloy steels. Stainless steels. Tool and die steels. Structure of polymers. Thermoplastics. Thermosetting plastics. General properties of and applications of thermoplastics and thermosetting plastics. Elastomers, rubbers. Structure of Ceramics. Types of ceramics. Glasses. Glass ceramics. Graphite and diamond.
- Lecture: Composite materials. Reinforced plastics and applications. Mold casting processes. Structure of reinforced plastics. Types of reinforcing fibers. Role of fibers in overall properties. Selection and applications of reinforced plastics and composites. Metal casting. Permanent mold casting. Inspection techniques for casting. Foundries and foundry automation. Investment casting. Design considerations in casting. Casting alloys. Economics of casting.
- Forming and shaping processes and equipment. Rolling of metals. Forging of metals. Extrusion and drawing of metals. Sheet metal forming processes. The flat rolling processes. Rolling mills. Calculation of roll forces. Open and closed die forging. Forgeability of metals. Die design, die materials and lubrication. Die manufacturing methods. Forging machines and economics of forging. The extrusion and drawing process of metals. Extrusion defects. Extrusion and drawing equipment. Sheet metal forming processes. Formability tests for sheet metals. Deep drawing. Rubber forming and spinning. Design considerations in sheet metal forming.
- Processing of metal powders. Processing of ceramics, glass, Production of metal powders, Methods of producing metal powders. Compaction of metal powders. Sintering. Secondary and finishing operations. Design considerations. Economics of powder Metallurgy. Processing of ceramics. Shaping ceramics. Forming and shaping of glass. Design considerations for ceramics and glasses.
- Forming and shaping plastics and composite materials. Extrusion, injection molding, blow molding. Thermoforming compression molding. Transfer molding. Casting. Foam molding. Processing of Elastomers.