ME 4215 Manufacturing Process Analysis (Elective)

Catalog Description: ME 4215 Manufacturing Process Analysis (3-0-3)

Prerequisites: COE 3001 Mechanics of Deformable Bodies and ME 3210 Design, Materials, and Manufacture

Corequisites: ME 3345 Heat Transfer

First principles based modeling and analysis of manufacturing processes. Process design and optimization.

Textbook: Serope Kalpakjian and Steven R. Schmid, *Manufacturing Processes for Engineering Materials*, 5th Edition, Prentice Hall, 2008.

Topics Covered:

1. Basics:
   - 1.1 Review of materials and mechanical properties
   - 1.2 Metrology and surface finish
   - 1.3 Taxonomy of manufacturing processes
2. Manufacturing process analysis:
   - 2.1 Solidification/molding processes: selected from
     - i) metal casting
     - ii) polymer and composites processing
   - 2.2 Mass conserving processes: selected from
     - i) bulk deformation: forging, rolling, extrusion, drawing
     - ii) sheet-metal forming: bending, stretching
   - 2.3 Subtractive processes: selected from
     - i) mechanical material removal: shaping, turning, milling
     - ii) non-mechanical material removal: EDM, ECM, Laser, EDM, WJM
   - 2.4 Additive processes: selected from
     - i) Joining methods: welding, adhesive bonding
     - ii) layer-by-layer manufacturing: stereolithography, direct laser melting/sintering
   - 2.5 Micro and nanomanufacturing methods: selected from photolithography, mechanical micromachining, self-assembly
3. Process design and optimization:
   - 3.1 Process design and optimization based on cost and time

Course Outcomes:

Outcome 1: To teach students to perform mathematical analyses of conventional and non-traditional manufacturing processes.

- 1.1 Students will demonstrate the ability to break down manufacturing processes for analysis.
- 1.2 Students will demonstrate the ability to identify known and unknown parameters including initial and boundary conditions for major manufacturing processes.
- 1.3 Students will demonstrate the ability to draw free body diagrams and control volumes of select manufacturing processes.
- 1.4 Students will demonstrate the ability to apply the fundamental principles from pre-requisite courses in mechanics, materials, and thermo-fluids to analyze manufacturing processes.

Outcome 2: To teach students to integrate core mechanical engineering principles to design manufacturing processes.

2.1 Students will demonstrate the ability to integrate the relevant core principles in mechanical engineering (mechanics, materials, and thermo-fluids) to solve problems in manufacturing.

2.2 Students will demonstrate the ability to carry out manufacturing process design based on first principles.

Outcome 3: Students will have a basic understanding of the economic considerations underlying manufacturing process optimization.

3.1 Students will demonstrate an understanding of the role of economics in manufacturing process selection.

3.2 Students will demonstrate the ability to perform simple cost and time based process optimization of select manufacturing processes.

Correlation between Course Outcomes and Student Outcomes:

ME 4215											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1					X						X
Course Outcome 1.2	X				X						X
Course Outcome 1.3	X				X						X
Course Outcome 1.4	X				X						X
Course Outcome 2.1	X				X						X
Course Outcome 2.2	X		X		X						X
Course Outcome 3.1			X						X		X
Course Outcome 3.2			X								X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Shreyes Melkote