

1. *Course number and name*

ENGR 364: Materials and Manufacturing Processes

2. *Credits and contact hours*

3 credit hours: two 50-minute lecture sessions/week and one 2-hour-45-minute laboratory session/week

3. *Instructor's or course coordinator's name*

Instructor: Kwok Siong Teh, Associate Professor of Mechanical Engineering

Course coordinator: Kwok Siong Teh, Associate Professor of Mechanical Engineering

4. *Text book, title, author, and year*

Richard Budynas and Keith Nisbett, Shigley's Mechanical Engineering Design (9th Ed), McGraw-Hill, 2010.

a. *other supplemental materials*

M. P. Groover. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 4th ed., John Wiley & Sons, Inc., 2010.

5. *Specific course information*

a. *brief description of the content of the course (catalog description)*

Integration of stress analysis and failure theories with knowledge of materials and manufacturing processes in machine design.

b. *prerequisites or co-requisites*

ENGR 201: Dynamics; ENGR 309: Mechanics of Solids

c. *indicate whether a required, elective, or selected elective course in the program*

Required for Mechanical Engineering

6. *Specific goals for the course*

a. *specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.*

- Students will demonstrate they have a basic understanding of the mechanical behaviors, properties and uses of four different types of materials: metals, polymers, ceramics, and composites.
- Students will demonstrate the ability to quantify the mechanical behavior of materials under elastic, elastoplastic, and plastic deformation.
- Students will demonstrate the ability to predict materials failures under static and dynamic loading using appropriate choice of failure theories.

- Students will demonstrate they can perform stress analysis on simple mechanical components in order to obtain the correct geometry.
- Students will demonstrate they understand the history, philosophies, and methodologies of product design and the important role of material selection in product design.
- Students will demonstrate they understand modern product design methodologies, including design for manufacturability (DFM), design for assembly (DFA), quality function deployment (QFD), design to cost, quality management methods (Taguchi, SPC, and DOE), synchronous/lean manufacturing, and life cycle economics.
- Students will demonstrate an understanding of conventional metal-based manufacturing processes including materials removal processes, metal casting processes, metal forming and shaping processes, and metal joining processes.
- Students will demonstrate an ability to perform mechanistic or empirical modeling of manufacturing processes.
- Students will demonstrate an ability to perform manufacturing process selection.
- Students will demonstrate an understanding of designing with and processing of polymer, composites, and ceramics.
- Students will demonstrate understanding of special manufacturing processes, including rapid prototyping, IC manufacturing, top-down and bottom-up micro and nano manufacturing processes.
- Students will demonstrate the ability to perform in a team environment via engaging in team-based and scenario-based in-class design activities and mini design projects.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, b, c, d, e, g, h, i, j, k.

7. *Brief list of topics to be covered*

- Material properties and product attributes.
- Engineering materials: metals, polymer, ceramics, composites.
- Quantification of uni-, bi-, and multi-axial stresses in materials.
- Failure due to static loading; Failure theories
- Failure due to dynamic loading (fatigue)
- Product design: History, Philosophies, and Methodologies
- Design for manufacturability (DFM)
- Manufacturing: History and Modern Practices
- Manufacturing processes: solidification, forming, shaping, removal, and joining processes
- Special processes: Rapid prototyping, IC manufacturing, micro and nano fabrication