Course alpha, number, title: ME 371 Mechanical Design I

Required or elective: Required

Course (catalog) description: Kinematic analysis of linkage mechanisms, spur gears and cam-follower systems.

Prerequisite(s): (ME 361 or concurrently)

Textbook(s) and/or other required material: R.L. Norton, Design of Machinery, McGraw-Hill

Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered:
1. Fundamentals
   • Reference frames, coordinate transformations, rigid body kinematics, position and displacement, velocity, acceleration
2. Applications
   • Linkage mechanisms, cam/follower systems, gears
3. Manufacturing Processes
   • Primary and secondary manufacturing processes for metals: forging, extrusion, rolling, bending, stamping, casting. Process design issues associated with these processes.
   • Manufacturing of composite and polymeric materials: injection molding, blow molding, extrusion, lay-up technique, RTM, RIM, compression molding, filament winding, pultrusion. Process design issues associated with these processes.
   • Properties of metals and plastics typically used for engineering applications.
5. Design thinking in the context of engineering/industrial practice

Course learning objectives:
Upon successful completion of this course, students can:

For linkage mechanisms,
• Construct the loop closure equation and then perform position, velocity and acceleration analysis.
  [L: Comprehension, Analysis] [M: Question in Exams]
• Calculate the number of degrees of freedom (DOF) for a mechanism.
  [L: Knowledge, Analysis] [M: Question in Exams]
• Synthesize a four-bar mechanism. That is, given the desired motion of the mechanism, determine its link lengths.
  [L: Synthesis] [M: Question in Exams, Project]

For cam/follower,
• Identify types of follower, follower motion, joint closure and cams, cam motion constraints, etc.
  [L: Knowledge] [M: Question in Exams]
• Setup SV AJ diagrams for a desired cam/follower motion.
  [L: Comprehension, Analysis] [M: Question in Exams]
• Using Polynomials, design a cam/follower arrangement with a desired motion.
  [L: Synthesis] [M: Question in Exams, Project]

For gears,
• Calculate velocity and torque ratios.
- Identify the involute tooth form and its properties.
- Recognize the gear nomenclature as defined by AGMA.

Recommend an appropriate manufacturing process for a given design and material
[L: Application, Evaluation] [M: Question in Exams]

Recommend an appropriate material for a given design
[L: Application, Evaluation] [M: Question in Exams]

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<tr>
<th>Relationship of course to ME program outcomes</th>
<th>The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:</th>
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<tr>
<td>2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.</td>
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<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering—2</td>
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<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0</td>
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<td>(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—2</td>
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<td>(d) an ability to function on multidisciplinary teams—2</td>
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<td>(e) an ability to identify, formulate, and solve engineering problems—2</td>
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<td>(f) an understanding of professional and ethical responsibility—0</td>
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<td>(g) an ability to communicate effectively—1</td>
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<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1</td>
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<td>(i) a recognition of the need for and the ability to engage in life-long learning—0</td>
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<td>(j) a knowledge of contemporary issues—0</td>
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<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1</td>
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| Contribution to professional component: | 50% Engineering Science 50% Engineering Design |

| Person(s) who prepared this description | Brian Thompson and Farhang Pourboghrat (original, 2009) Diaz (2015) |

| Date of Preparation | 2015 |