

# ME 35400 MACHINE DESIGN

## Course Outcomes [Related ME Program Outcomes in brackets]

1. Apply Statics, Dynamics, and Strength of Materials to the realization of machine components. [1, 2]
2. Understand fatigue failure mechanisms [1]
3. Apply fatigue failure theories to create reliable mechanical components. [1, 2]
4. Select standard machine components and materials. [2]
5. Enhance problem-solving and communication skills through design projects. [3]

### Static & Fatigue Failure Theories (5 wks)

1. Shape synthesis
2. Stress Analysis Procedure
3. State of Stress
4. Static Failure Theories
5. S-N Diagrams
6. High Cycle Fatigue
7. Stress Concentration
8. Fully Reversed Loading
9. Non-Zero Mean Stress
10. Combined Loading
11. Application of Fatigue to shafts, beams, keys
12. Materials for Shafts

### Bearings (2 weeks)

1. Rolling Element Bearings
  - Types; Load/Life
  - Effects of axial loads
  - Cumulative Damage
2. Journal Bearings
  - Types/Materials
  - Petroff's Model
  - Reynolds Equation
  - Short/Long Brng. Solutions

### Bolts (2 weeks)

1. Geometry
2. Bolt Stiffness
3. Member Stiffness
4. Load Factor
5. Bolt yielding
6. Joint separation
7. Bolt fatigue

### Spur Gears (2 weeks)

1. Geometry
2. Loads
3. Stresses
  - surface
  - bending
4. Strength
5. Safety factors
  - surface
  - bending

### Helical Springs (2 weeks)

1. Materials
2. Geometry
3. Stresses
4. Spring Rate
5. Static Failure
6. Fatigue Failure
7. Buckling
8. Surge

### Design of Machine Components and Systems (Typical Course Projects)

- Design of a 2-speed transmission
- Valve spring and head bolt design for an engine
- Bicycle crank arm
- Wind turbine blade
- Engine crankshaft
- Tractor spindle

### Brakes/Clutches (2 weeks)

1. Self-Energizing concept
2. Self-Locking concept
3. Materials
4. Short Shoe Brake
5. Long Shoe Brake
6. Disk Clutch/Brake
7. Band Brake

<b>COURSE NUMBER:</b> ME 35400		<b>COURSE TITLE:</b> Machine Design (3 credits)	
<b>REQUIRED COURSE OR ELECTIVE COURSE:</b> Required		<b>TERMS OFFERED:</b> Fall and Spring	
<b>TEXTBOOK/REQUIRED MATERIAL:</b> R.G. Budynas and J. Keith Nisbett, <i>Shigley's Mechanical Engineering Design</i> , 10 <sup>th</sup> ed, McGraw-Hill, 2015.		<b>PRE-REQUISITIES:</b> ME 263 Introduction to Mechanical Engineering Design, Innovation, and Entrepreneurship ME 274 Basic Mechanics II ME 323 Mechanics of Materials	
<b>COORDINATING FACULTY:</b> TBD			
<b>COURSE DESCRIPTION:</b> Design, analysis, and selection of machine components for fluctuating loading. Application of design fundamentals to mechanical components and integration of components to form systems. Open-ended design projects reinforce the design process.		<b>COURSE OUTCOMES</b> [Related ME Program Outcomes in brackets]: 1. Apply Statics, Dynamics, and Strength of Materials to the realization of machine components. [1, 2] 2. Understand fatigue failure mechanisms. [1] 3. Apply fatigue failure theories to create reliable mechanical components. [1, 2] 4. Select standard machine components and materials. [2] 5. Enhance problem-solving and communication skills through design projects. [3]	
<b>ASSESSMENTS TOOLS:</b> 1. Weekly homework. 2. Design project reports. 3. Exams and Class Tests.			
<b>NATURE OF DESIGN CONTENT:</b> Design of machine components such as shafts, keys, gears, journal bearings, springs, brakes, and clutches, and selection of components such as roller element bearings to meet machine performance requirements.		<b>RELATED ME PROGRAM OUTCOMES:</b> 1. Engineering fundamentals 2. Engineering design 3. Communication skills 4. Ethical/Prof. responsibilities 5. Teamwork skills 6. Experimental skills 7. Knowledge acquisition	
<b>PROFESSIONAL COMPONENT:</b> 1. Engineering Topics: Engineering Science – 50% Engineering Design – 50%			
<b>COMPUTER USAGE:</b> The design projects require students to write computer programs to conduct analysis studies.			
<b>COURSE STRUCTURE/SCHEDULE:</b> Lecture - 3 days per week at 50 minutes			
<b>PREPARED BY:</b> Jitesh Panchal		<b>REVISION DATE:</b> December 18, 2019	