COURSE OUTLINE
MECH 232 - MACHINE DESIGN

Prepared By: Daniel J. Miller
Updated By: Daniel J. Miller (April 2015)
A. **TITLE**: Machine Design

B. **COURSE NUMBER**: MECH 232

C. **CREDIT HOURS**: 3

D. **WRITING INTENSIVE COURSE**: No

E. **COURSE LENGTH**: (15 weeks)

F. **SEMESTER(S) OFFERED**: (Spring)

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY**:  
   - 2 lecture hours per week  
   - 2 recitation hours per week (problem solving, projects, exams)

H. **CATALOG DESCRIPTION**: Design of machine elements subjected to static, dynamic and fluctuating loads. Theory includes design of beams, shafts, mechanical power transmission devices. A design project is required for the course. The recitation session will be used for solving numerical problems and for consultation on the semester design project.

I. **PRE-REQUISITES/CO-REQUISITES**: CONS 272

J. **GOALS (STUDENT LEARNING OUTCOMES)**:  
   By the end of this course, the student will be able to:  

<table>
<thead>
<tr>
<th>Course Objective</th>
<th>Institutional SLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Methodically plan and design the solutions to fundamental machine element problems.</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>2. Solve problems that have compression, tensile, torsion, and/or eccentric loads.</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>3. Professional Competence</td>
<td></td>
</tr>
<tr>
<td>3. Apply Mohr’s Circle concept for combined stresses</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>4. Determine the allowable load that can be applied to long and short columns</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>5. Determine the endurance strength and design members subject to fluctuating loads.</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>3. Professional Competence</td>
<td></td>
</tr>
<tr>
<td>6. Design a load carrying shaft with keys or couplings.</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>3. Professional Competence</td>
<td></td>
</tr>
<tr>
<td>7. Design a mechanical drive system using belts, chains drives or gears.</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>8. Apply a variety of failure theories to a design analysis.</td>
<td>2. Critical Thinking</td>
</tr>
</tbody>
</table>

L. **REFERENCES:**
- Static and Dynamics by Hibbler, 9th edition, Prentice Hall

M. **EQUIPMENT:** The use of the Material Testing Lab (NS110) and Machine shop (NS106) are required

N. **GRADING METHOD:** (A-F)

O. **MEASUREMENT CRITERIA/METHODS:**
   - Unit Exams = 35%
   - Final Exam = 15%
   - Homework/Quizzes = 15%
   - Recitation Assignments/Design Projects = 35%

P. **DETAILED TOPICAL OUTLINE:**
   I. **Introduction**
      A. Design Process and Calculations
      B. Basic Sizes and Units
      C. Design Functions and Requirements
      D. Material (Ferrous, Non Ferrous, Composites) Properties
      E. Material Selection

   II. **Stress and Deformation Analysis**
      A. Direct Shear
      B. Torsional Shear
      C. Tensile and Compression
      D. Bending
      E. Beam Deflection
      F. Concentrated Bending Moments
      G. Stress Concentrations
      H. Combined Normal Stresses

   III. **Combined Stresses and Mohr’s circle**
      A. Application and use for Mohr’s Circle
      B. Principal Stress Element
      C. Drawing and Interpreting the Circle

   IV. **Design for Different Types of Loading**
      A. Identifying Loading Conditions and Stress Ratio
      B. Endurance Strength and Fatigue Failure
C. Estimated Endurance Strength
D. Design Factors
E. Prediction of Failure Analysis

V. Column Design
   A. Column Analysis
   B. Euler and Johnson Formula
   C. Spreadsheet Design and Analysis of Columns

VI. Belt and Chain Drives
   A. Type of Belt Drives
   B. Belt Drive Design
   C. Chain Drive Design

VII. Gears
     A. Type of Gears
     B. Gear Nomenclature
     C. Gear Train Ratios and Design
     D. Forces Developed in Gears

Q. RECITATION OUTLINE:
   I. The recitation time is setup to provide time for students to solve more complex
      and time consuming problems than is practical for homework. The assignments
      tie in with the unit topic for that week.
   II. Students work in teams to design a solution to a selected problem they choose.
       Examples include, but are not limited to (car jack, portable crane, transfer device,
       carton packer, oscillating spindle sander, robot gripper, chain conveyor)