Winter 2020

**Camosun College**

**Mechanical Engineering Technology**

***MENG 254 - Machine Design***

**Course Outline**

***Calendar Description:***

The students will apply failure theories for various types of materials exposed to static and repeated loading, so as to determine components lifetime. Design of machines using fasteners, shafts, bearings, belt-drives, spur gears, clutches, and brakes will be considered. Solving of design problems is assisted by computer methods. Specification and selection of standard components from appropriate industrial manufacturers is emphasized.

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| Offered: | Winter Semester |
| Credit: | 4 |
| In-Class Workload: | 4 hours Lecture, 1 hour Seminar |
| Out-of-Class Workload: | 5 hours |
| Prerequisites: | MENG 253 and MENG 273 |

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***Objectives:***

Upon successful completion of this course, the student should be able to:

1. Graphically and analytically determine the maximum shear and principal stresses in a plane from the given stresses.

2. Determine the probability of failure according to various failure theories.

3. Understand the principles behind fatigue and be able to estimate the lifetime of a part exposed to steady and alternating stresses.

4. Design shafts to handle the applied loads under a variety of applications.

5. Determine the correct screw thread to use for certain applications requiring pre-tensioning or transmission of power.

6. Determine the correct plain bearing and lubricant for a particular application based on the environment and loading of the bearing.

7. Specify the correct type and number of V-belts to satisfy a particular machine design and estimate the shaft centre distance and lifetime of the belts.

8. Determine the generated torque and required actuating force for a variety of different types of clutches and brakes.

9. Perform a force analysis on a spur gear, determine the bending stress, and the dynamic effects, and estimate the tooth and gear lifetime.

10. Design torsion, leaf, and helical springs; and determine the suitable wire material and size.

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***Outline:*** *Estimated Hours*

*1. Principal Stresses and Stress Transformation* *5*
- Mohr's Circle
- Stress Transformation
- Principal Stresses
- Maximum Shear Stress

*2. Static Failure Theories* *5*
- Types of Static Failures
- Static Failure Theories
- Geometric Stress-Concentration Factors

*3. Designing for Fatigue* *5*
- Endurance Limit of Material, S-N Curves
- Cumulative Fatigue

*4. Fatigue Diagrams* *5*
- Steady and Alternating Stresses
- Introduction to Fatigue Diagrams
- Stress-Concentration Factors
- Equivalent Static Stress

*5. Shafting* *5*
- Power Transmitted; Maximum Static Shearing Stress
- ASME Code for Shafting
- Transverse Shear Stress
- Fluctuating Loads on Shafts
- Mises-Hencky Theory for Failure
- Keys and Couplings

*Midterm #1 – Covers Sections 1, 2, 3 and 4* *2*

*6. Screwed Fasteners* *8*
- Standard Threads, Tolerancing
- Effect of Initial Tensioning and Fluctuating Loading
- Power Screw; Torque and Efficiency
- Stress Due to Impact Loading

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| *7.* | *Belt Drives*<br>Prime mover Size and Service Factor<br>Selection of Correct Size and Number of V-Belts<br>Selection of Appropriate Sheave Size<br>Belt Tension and Lifetime | *5* |
| *8.* | *Springs*<br>Spring Materials and Wire Sizes<br>Torsion Bar Design<br>Helical Compression and Tension Spring Design<br>Helical Torsion Springs | *5* |
| *Midterm #2 – Covers Sections 4, 5, 6 and 7* | | *2* |
| *9.* | *Plain Bearings*<br>Viscous Shearing Stresses; Petroff's Bearing Equation<br>Hydrodynamic Lubrication, Bearing Characteristic Curves<br>Temperature Rise in Plain Bearings<br>Zn/P curve; Bearing Materials<br>Construction of Bearing | *5* |
| *10.* | *Design of Gears*<br>Forces on Gear Teeth<br>Stresses in Gear Teeth<br>Gear Materials and Manufacture<br>Selection of Gear Material<br>Lifetime of a Gear Tooth, Gear, or Mating Pair of Gears | *5* |
| *11.* | *Clutches and Brakes*<br>Introduction to Common Types of Bakes and Clutches<br>Plate Clutches and Brakes<br>Disc Clutches<br>Cone Clutches and Brakes<br>Drum Clutches and Brakes<br>Band Clutches and Brakes<br>Energy Absorption and Heat Dissipation<br>Design Examples Involving Translation and Rotation | *8* |
| | Total Hours: | *65* |

***Distribution of Marks:***

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| Assignments | 20% |
| Laboratories | 10% |
| Midterm #1 | 20% |
| Midterm #2 | 20% |
| Final Exam | 30% |
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| | 100% |

All assignments must be submitted before sitting the final exam.

***Grading:***

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| A+ | 90 -> 100% | B- | 70 -> 72% |
| A | 85 -> 89% | C+ | 65 -> 69% |
| A- | 80 -> 84% | C | 60 -> 64% |
| B+ | 77 -> 79% | D | 50 -> 59% |
| B | 73 -> 76% | F | < 50% |

The weighted average of all exams must be over 50% or an I or F will be awarded.

***Required Text:***

Machine Elements in Mechanical Design
Mott, Vavrek and Wang, 6th Edition, Pearson Publishing

***Instructors:***

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Office: TEC111 Telephone: 250-370-4505
Email: wakefield@camosun.bc.ca

***Reference Website:***

*http://online.camosun.ca* This course is fully supported by Desire2Learn

***Assignments and Laboratories:***

No late assignments or labs will be accepted.

Assignments will be reviewed in class shortly after the due date. If identical assignments are handed in, the marks will be divided up equally between the students.