King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 307: Machine Design I

Catalogue Description: (3-0-3)
Design process, review of stress, strain and deformation analysis as applied to mechanical design; properties of materials; review of static failure theories; designing against fatigue failures; element design; shafts, keys, couplings, power screws; bolted, riveted and welded joints.

Status in Curriculum (Required or Elective): Required (offered Fall & Spring)

Prerequisites:CE 203, ME 218

Co-requisites:ME 322, ME 323

Prerequisites by Topic:
- Structural Mechanics (CE 203)
- Introduction to Mechanical Engineering Design (ME 218)

Co-requisites by Topic:
- Manufacturing Processes (ME 322, ME 323)

Textbook:

Shigley's Mechanical Engineering Design, Budinas, R. G. and Nisbett, J. K., McGraw Hill, 10th Edition, 2014.

References:
1) **Mark's Standard Handbook for Mechanical Engineers**, Avallone, E. A., Maumeister III, T. and Sadegh, A. M., McGraw Hill, 11th Edition, 2007.
2) **Machine Elements in Mechanical Design**, Mott, R. L., Prentice Hall, 5th Edition, 2013.
3) **Fundamentals of Machine Elements**, Schmid, S. R. and Hamrock, B. J., CRC Press, 3rd Edition, 2013.
4) **Design of Machine Elements**, Spotts, M.F. and Shoup, T.E., Prentice Hall, 8th Edition, 2003.
5) **Machine Design: An Integrated Approach**, Norton, R.L., Prentice Hall, 5th Edition, 2013.
6) **Fundamentals of Machine Component Design**, Juvinall, R. C. and Marshek, K. M., Wiley, 5th Edition, 2011.

Coordinator:Dr. Mehmet Sunar, AssociateProfessor of Mechanical Engineering

Goals:(General Objectives)
This course is intended to incorporate knowledge learned in mechanics, structures, materials and manufacturing processes into mechanical design. Competence in multi-axis stress analysis and Mohr's circle is reinforced. Uses of failure theories under steady and variable loadings are emphasized. Design of certain mechanical elements including shafts, power and fastening screws, and detachable, permanent and welded connections is also carried out.

Course Outline (Lecture Topics):
1. Introduction to Design: *general Description of Design Process* (1 hour)
2. Load and Stress Analysis: *Mohr's Circle, Normal and Shear Stresses, Stress Concentration, Pressurized Vessels, Press and Shrink Fits* (9 hours)
3. Deflection Analysis: *Deflection by Integration, Superposition and Castigliano's Theorem, Statically Indeterminate Structures, Buckling* (4 hours)
4. Failures Resulting from Static Loading: *Failure Theories for Ductile and Brittle Materials* (4 hours)
5. Fatigue Failure Resulting from Variable Loading: *Stress-Life Method, Endurance Limit, Stress Concentration and Notch Sensitivity, Fatigue Analysis* (10 hours)
6. Shafts and Shaft Components: *Shaft Design via Stress and Deflection Considerations, Shaft Components* (3 hours)
7. Screws, Fasteners, and Design of Nonpermanent Joints: *Thread Standards and Definitions,Power and Fastening Screws, Tension and Shear Joints* (10 hours)
8. Welding, Bonding and Design of Permanent Joints:*Symbols and Types of Welding, Stresses in Weld Joints, Static and Fatigue Loading* (4 hours)

Design Activities/Projects:
A design project is assigned to assess design process on shafts and various components.

Computer Usage:

Students are encouraged to solve some assigned homework problems and the design project using software, such as MS Excel, MATLAB and available design packages.

Laboratory:

None

Assessment Tools:

i- Mid-term Examinations
ii- Homework Assignments
iii- Quizzes
iv- Final Exam
v- Design Project

Course Learning Outcomes:

I- Students shall demonstrate ability to use free-body diagrams, equilibrium equations, force, moment and torque diagrams, and calculate resulting stresses.
II- Students shall demonstrate how to find relevant properties of materials from various sources.
III- Students shall demonstrate ability to compute principal stresses in different machine members subjected to combined loadings.
IV- Students shall demonstrate ability to calculate principal stresses and extreme deflections for various cases of loading, and check criteria for failure due to yield or due to unacceptable deflections.
V- Students shall demonstrate ability to analyze thin- and thick-walled cylinders, shrink fitted assemblies, and to design shafts.
VI- Students shall demonstrate ability to apply stress and deflection analyses, failure criteria under steady and variable loadings, in applications involving the design of simple machine elements, such as shafts, power and fastening screws, welding joints and various other connections.

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
Course-to-Student outcome mapping	I, II, III, IV, V, VI		V		I, II, III, IV, V, VI	V	V	V, VI			V
Emphasis*	**S**		**M**		**M**	**L**	**M**	**L**			**M**

* **L**:: Little/None **M**: Moderate **S**: Strong

Status of Continuous Improvement review of this Course:

Date Reviewed: March 2015
Prepared by: Dr. Mehmet Sunar
Reviewed by: Design & Dynamics Group
Date Prepared: March 11th, 2015