Machine Design I

Course Code: ENME435
Credit Hours: 3
Contact hours: 3
Department: Mechanical Engineering
Prerequisite: ENME 223: Mechanical Drawing, ENCE233: Mechanics of Material
Offered Semester: second 2021-2022
Instructor: Dr. Allan Tubaileh **Office**: dean office

Text Book: Mechanical Engineering Design Ninth Edition *Metric*
Joseph E. Shigley and Charles R. Mischke 10th edition.

Course Objective

At the end of this course the student must be able to: to formulate and analyze Stress and strain in machine elements, find the principals axial, bending, torsion and shear stresses, design columns to prevent Buckling, find deflection of elements by energy method, apply theories of failure for static loading, fatigue failure, Design of machine elements: shafts, screws, springs, welded joints and coupling. Design and analysis of friction brakes and clutches.

Learning Outcomes

1. Ability to find the critical stressed section of a machine element. 2. Ability to analyze 2D and 3D stress state. 3. Ability to analyze strains and deflections.4.Knowledge of various static failure criteria for different materials. 5. Ability to apply static failure criteria in the design and analysis of machine components. 6. Ability to analyze and design components with non-uniform cross sections and combined loadings. 7. Knowledge of fatigue failure and load-life relation. 8. Knowledge of various fatigue failure criteria. 9. Ability to apply fatigue failure criteria in the design and analysis of machine components under various loading conditions. 10. Ability to design and analyze permanent joints (riveted, welded, etc.) under concentric and eccentric loading conditions. 11. Ability to design and analyze reused joints (bolts, keys, pins, etc.) under various loading conditions. 12. Ability to design and analyze power screws. 13. Ability to design and analyze shafts with different geometrical features under various loading conditions. 14. Understand spring terminology and different types of springs. 15. Ability to design and analyze coil springs (compression, tension, torsion) under various loads. 16. Knowledge of standards for machine elements. 17. Understanding of safety and reliability concepts in the design of machine elements. 18. Ability to minimize the characteristic dimension of a machine element. 26. Understanding of the influence of manufacturing process in design of machine elements. 19. Ability to justify a design project in a formal report. 28. Ability to analysis and design friction brakes and clutches. 29. Ability to present the outcomes of the design in the form of engineering drawings.

This course serves to cover the following ABET outcomes:

(c) Ability to design a system, component, or process to meet desired needs.
(e) Ability to identify, formulate and solve engineering problems.
(k) Ability to use techniques, skills and modern engineering tools necessary for engineering practice.

Course Content:

One Week:
1- Introduction and revision of Mechanics of materials

Two Weeks:
2- Stress analysis: Stress strain relations; Axial ,bending and shear stresses; Strain energy;

Two Week:
3- Deflection by energy method, Buckling of columns, Bending stresses in curved beams.

Two Weeks:
4- Design for static loading: Theories of failure.

Three Week:
5- Design for fatigue loading: Fatigue failure concept, Design Theories, Case studies.
Midterm Exam

Two Week:
6- Design for fasteners and connections: Design and analysis of power screws, Permanent and reused connections. Design of screws under shear and axial loads.

7- Welded Brazed and Bonded Joints: welded joint under shear, axial and bending loads.

One Week
8- Springs: Springs definitions, design of different types of springs: extension, compression and torsional.

One Week

9- Clutches, breaks, couplings.

Grading

MidtermExam	30%
Final Exam	40%
Quizzes and home works	10%
Projects	10%
	100%

References:
1- Juvinall and Marshek: Fundamental of Machine component design, 3rd edition, Wiley.
2- Norton: Machine Design an integrated approach, Prentice Hall.