New Jersey Institute of Technology
Department of Engineering Technology
MET 301 Analysis & Design Of Machine Elements-I

COURSE NUMBER	MET 301
COURSE NAME	Analysis & Design Of Machine Elements-I
COURSE STRUCTURE	(2-2-3) (lecture hr/wk - lab hr/wk – course credits)
COURSE COORDINATOR/ INSTRUCTOR	Dr. J. Sodhi/ Dr. S. Lieber
COURSE DESCRIPTION	The principles of strength of materials are applied to mechanical design. Topics include theory of failure, stress concentration factors and fatigue, the design and analysis of shafts subjected to static and dynamic loadings, and critical speed of a rotating shaft.
PREREQUISITE(S)	MATH 238 or MATH 112, MET 237 or MECH 237
COREQUISITE(S)	None
REQUIRED, ELECTIVE OR SELECTED ELECTIVE	Required
REQUIRED TEXTBOOK	Analysis of Machine Elements Using SOLIDWORKS Simulation 2025. SDC Publications. Print ISBN: 978-1-630577117. eBook ISBN: 9781630569549.
REFERENCE TEXTBOOKS	Shigley: Mechanical Engineering Design. McGraw Hill. (Open Access through NJIT Library) Jiang, Wei: Analysis and Design of Machine Elements. Wiley (Open Access through NJIT Library) How to Ace Mechanics of Materials with Jeff Hanson, 1st Edition. (Open Access through Access Engineering). Schaum's Outline of Strength of Materials, 7th Edition. (Open Access through Access Engineering). Spotts, Shoup & Hornberger: Design of Machine Elements, Prentice-Hall, 8th edition. ISBN 9780130489890 Beer, Johnston, DeWolf, and Mazurek Mechanics of Materials, Eighth Edition, McGraw-Hill, ISBN: 9781260113273
COURSE OUTCOMES (CLO)	By the end of the course students should be able to: 1. Analyze machine elements to calculate internal stress and strain resulting from externally applied loads.

2. Evaluate combined multi-axial normal and shear stresses to determine principal normal stresses, maximum shear stresses, and corresponding strains.
3. Identify and apply appropriate geometric and fatigue stress concentration factors and use relevant theories of failure to calculate the factor of safety for machine parts subjected to combined steady and cyclic loads.
4. Apply finite life design theories to analyze and predict fatigue failure in mechanical components.
5. Design rotating shafts, keys, and couplings to meet specified performance and safety criteria under applied loads.
6. Evaluate and analyze torsional and bending stresses and strains in a shaft.
7. Analyze the stress in a bolt subjected to an impact load.
8. Evaluate the specifications of a power screw to raise a specified load at a given speed within defined power consumption limits.
9. Evaluate the permissible load for a riveted joint by analyzing the resultant shearing stress on the most highly stressed rivet.
10. Determine the requirements for fillet welds under eccentric loading conditions (both steady and fluctuating).
11. Use computer-based Finite Element Analysis (FEA) tools to analyze stress and strain in machine elements, and validate FEA results with analytical solutions.
12. Apply written and graphical communication in engineering reports to accepted professional engineering standards.

CLASS TOPICS

Static equilibrium, Hook's Law, Normal stress-strain-deformation, Statically Indeterminate Problems in Axial Loading. Transverse loading, Shear force and Bending moment diagram, Bending stress, Moment of inertia, Transfer of axis, Transverse shear stress, Super-imposition of bending and axial stresses. Design of columns, Torsion of circular sections. Mohr Circle, 3D stress, Strain due to 3D stress, Failure theories, Stress concentration factors, Cyclic loading, Design for fatigue stress, Design for finite life, Combined static and cyclic load for finite life, Miner's equation. Design of shaft for fluctuating load, Shaft with bending loads in two planes, Design of keys and coupling. Deflection and slope of beam, Critical speed of a rotating shaft, Shaft on three supports, Deflection & slope of non uniform shaft – energy method, Shaft with non circular section, Shafting materials. Screws, Welded connections, Riveted connections. FEA analysis of machine elements.

STUDENT OUTCOMES

The Course Outcomes support the achievement of the following MET Student Outcomes:

Student outcome (1) - an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline
Related CO – 1 to 11

Student outcome (2) - an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
Related CO – 5, 8 - 10

Student outcome (3) - an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;
Related CO – 12

Student outcome (4) - an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes;
Related CO – 11

Student outcome (5) - an ability to function effectively as a member as well as a leader on technical teams.
Related CO – 12

GRADING POLICY

Homework/Quizzes	10 %
FEA Labs	20 %
Tests (3)	39 %
Final Exam	31 %

ACADEMIC INTEGRITY

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: NJIT Academic Integrity Code.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

GENERATIVE AI

Student use of artificial intelligence (AI) is permitted in this course for certain assignments and activities. It is not permitted to be used in the assignments noted by the instructor, as doing so would undermine student learning and achievement of course learning outcomes. Additionally, if and when students use AI in this course, the AI must be cited as is shown within the NJIT Library AI citation page for AI. If you have any questions or concerns about AI technology use in this class, please reach out to your instructor prior to submitting any assignments.

STUDENT BEHAVIOR	• No eating or drinking is allowed at the lectures, recitations, workshops, and laboratories. • Cellular phones must be turned off during class hours – if you are expecting an emergency call, leave it on vibrate. • No headphones can be worn in class unless allowed by the professor. • Unless the professor allows the use during lectures, laptops should be closed during lectures. • During laboratory, if you are finished earlier, you must show the professor your work before you leave class • Class time should be participative. You should try to be part of a discussion
MODIFICATION TO COURSE	The Course Outline may be modified at the discretion of the instructor or in the event of extenuating circumstances. Students will be notified in class of any changes to the Course outline.
PREPARED BY **COURSE COORDINATED BY**	Dr. S. Lieber/ Dr. J. Sodhi Dr. J. Sodhi

CLASS HOURS

Tuesday	1 – 3:05 PM	PC MALL 39
Thursday	1 – 3:05 PM	PC MALL 37

OFFICE HOURS BY APPOINTMENT

Email: samuel.lieber@njit.edu

HOMEWORK & PROJECT – IMPORTANT ANNOUCEMENTS

Home work:

Homework sets are due on the following class. Homework will be collected at the **beginning of the class.**

Attendance:

Please be on time for classes, late entry distracts the whole class. Good attendance may help in improving your grade. If you miss any laboratory, test or final exam without prior permission, you will receive zero credit for that item. In extraordinary circumstances, when such prior permission is impossible to obtain, I expect you to contact me at your earliest for rescheduling your laboratory, test or final exam.

Laboratory:

1. All lab reports should written using MSWord. Reports are graded on your presentation. Criteria: Is the material presented in a logical way? Can all the required results be found with ease? Are the results discussed intelligently in a good technical language? Your depth of understanding, discussion and conclusion will carry more weight than the production of the right numerical answer.
2. Due dates for laboratory reports will be announced in the class or on Canvas. Laboratory reports handed in after the due date will incur ten percent deduction in marks for lateness.

Laboratory reports late more than two weeks will not be accepted.

GRADING LEGEND

GRADE	NUMERIC RANGE
A	90 to 100
B+	85 to 89
B	80 to 84
C+	75 to 79
C	70 to 74
D	60 to 69
F	0 to 59

NJIT ONLINE INFORMATION

The instructor will discuss these requirements on the first day of the course and/or post on their Learning Management System (LMS). Please become familiar

- Canvas: https://canvas.njit.edu/
- Zoom: https://njit-edu.zoom.us/
- Online Proctoring: https://ist.njit.edu/online-course-exam-proctoring

COURSE OUTLINE

Wk	Class	Topic	Textbook & Assigments
1	9/2 9/4	Static equilibrium, Engineering Materials, Tension and Compression in axial loading, Statically indeterminate problems.	**Lecture**: • See Learning Management System
2	9/9 9/11	Bending stress, moment of inertia, transfer of axis, principle of superimposition of bending and axial stress. Deflection of beam, transverse shearing stress in beams	**Lecture**: • See Learning Management System
3	9/16 9/18	Shear and bending moment diagrams, Columns	**Lecture**: • See Learning Management System **Lab**: • Text Introduction (Outside Class)
4	9/23 9/25	Mohr Circle, 3D stress, strain in 2D stress	**Lecture**: • See Learning Management System **Lab**: • Ch. 1
NO CLASS 10/2 WELLNESS DAY			
5	9/30 10/7	**Test 1** Stress concentration factors	
6	10/9 10/14	Failure theories, Design for cyclic loading	**Lecture**: • See Learning Management System **Lab**: • Ch. 3
7	10/16 10/21	Design for finite life	**Lecture**: • See Learning Management System **Lab**: • Ch. 5
8	10/23 10/28	Design of shafts, Design of keys and couplings	**Lecture**: • See Learning Management System **Lab**: • Ch. 9

Wk	Class	Topic	Textbook & Assigments
9	10/30 11/4	**Test 2** Shaft on three supports, Critical speed of a rotating shaft	
10	11/6 11/11	Deflection & Slope of non uniform shaft, Shaft with non circular section, Shafting Materials	**Lecture**: • See Learning Management System **Lab**: • Ch. 10
11	11/13 11/18	Screws	**Lecture**: • See Learning Management System **Lab**: • Ch. 7
12	11/20 11/25	**Test 3** Welded Joints	
NO CLASS 11/27 THANKSGIVING			
13	12/2 12/4	Riveted Joints	**Lecture**: • See Learning Management System **Lab**: • Ch. 8
14	12/9 12/11	Review and Makeup Session	
15		**Final Exam**	