

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

<b>COURSE NUMBER</b>	MET 301
<b>COURSE NAME</b>	Analysis & Design Of Machine Elements-I
<b>COURSE STRUCTURE</b>	(2-2-3) (lecture hr/wk - lab hr/wk – course credits)
<b>COURSE COORDINATOR/ INSTRUCTOR</b>	Dr. J. Sodhi/ A. Belal
<b>COURSE DESCRIPTION</b>	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.
<b>PREREQUISITE(S)</b>	MATH 238 or MATH 112, MET 237 or MECH 237
<b>COREQUISITE(S)</b>	None
<b>REQUIRED, ELECTIVE OR SELECTED ELECTIVE</b>	Required
<b>REQUIRED MATERIALS</b>	1. Spotts, Shoup & Hornberger: Design of Machine Elements, Prentice-Hall, 8th edition. ISBN 9780130489890
<b>COURSE OUTCOMES (CLO)</b>	By the end of the course students should be able to: <ol style="list-style-type: none"><li>1. Determine internal stress and strain developed given external loads on machine members.</li><li>2. Determine the principle normal and maximum shear stresses and strains from the interaction of bi-axial and tri-axial normal and shear stresses.</li><li>3. Determine the geometric and fatigue stress concentration factors and select and apply theories of failure to determine the factor of safety of a machine parts under combined steady and cyclic load.</li><li>4. Apply theories related to design for finite life.</li><li>5. Design rotating shafts, keys and couplings.</li><li>6. Theoretically and experimentally determine stress and strain of a shaft loaded in torsion and bending.</li><li>7. Write an effective laboratory report according to acceptable criteria.</li></ol>
<b>CLASS TOPICS</b>	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.

## **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 5**

**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**

**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 – 7**

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

**Related CO – 6 & 7**

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

**Related CO – 6 & 7**

## **GRADING POLICY**

Homework	15 %
Laboratory	15 %
Tests	45 %
Final Exam	25 %

## **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](mailto: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**

Ahmed Belal/Dr. J. Sodhi  
Dr. J. Sodhi

#### **CLASS HOURS**

Wednesday 6:00 PM – 7:55 PM CKB 120

Wednesday 8:05 PM – 10:00 PM CKB120/ME 214

#### **OFFICE HOURS**

By appointment: [asb62@njit.edu](mailto:asb62@njit.edu)

## **HOMEWORK & PROJECT – IMPORTANT ANNOUNCEMENTS**

### **Home work:**

Homework sets are due on the following class. I will collect homework 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. I scrutinize your excuse before rescheduling.

### **Laboratory:**

1. Your safety and the safety of those around you are of prime importance. Efforts have been made to reduce the hazard in the lab as much as possible. If you see anything that you consider to be a safety hazard, report this condition to the lab instructor. Take your experiment seriously. Horseplay will not be tolerated and may constitute grounds for dismissal from the course.
2. All lab reports should be 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.
3. Due dates for laboratory reports will be announced in the class. 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**

<b>GRADE</b>	<b>NUMERIC RANGE</b>
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 chapter	Homework
1	1/22	Static equilibrium, Engineering Materials, Tension and Compression in axial loading, Statically indeterminate problems.	1: 1-6	1: 5, 3, 7, 8, 11
2	1/29	Bending stress, moment of inertia, transfer of axis, principle of superimposition of bending and axial stress	1: 7-11	1: 58, 24, 85, 49, 53, 55
3	2/5	Deflection of beam, transverse shearing stress in beams	1:13, 15, 16	1: 40, 41, 29, 31, 112
4	2/12	<b>Test 1</b> Shear and bending moment diagrams	1:17	1: 25, 61, 63
5	2/19	More on Shear and bending moment Diagrams, Columns	1:18	1: 86, 121
6	2/26	Mohr Circle, 3D stress, strain in 2D stress	1:19-24	1: 88, 98, 102, 106,
7	3/5	Failure theories, Stress concentration factors	2: 1-4	2: 3, 4, 23, 25, 27, 30
8	3/12	<b>Test 2</b> Design for cyclic loading	2:5-6	2: 13, 18, 42, 51
9	3/26	Design for finite life <b>Lab #1</b> Wheatstone bridge Cover page		2: 56, 61, 62
10	4/2	Design of shafts	3: 1-4	3: 1, 10, 11, 13, 18,
11	4/9	Design of keys and couplings, Shaft on three supports	3: 5-9	3: 26, 28, 29, 86, 84
12	4/16	Critical speed of a rotating shaft <b>Lab #2</b> Strain measurement	3:11	
13	4/23	<b>Test 3</b> Deflection & Slope of non uniform shaft, Energy Method.	3: 12,13	3: 41, 90, 45
14	4/30	Shaft with non circular section, Shafting Materials	3: 14-19	
15	TBD	FINAL EXAM		