Spring 1-1-2020

MET 301-102: Analysis and Design of Machine Elements I

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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. A. Sengupta/ A. Belal
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, MET 236, MET 237, CS106
COREQUISITE(S)	None
REQUIRED, ELECTIVE OR SELECTED ELECTIVE	Required
REQUIRED MATERIALS	1. Spotts, Shoup & Hornberger: Design of Machine Elements, Prentice-Hall, 8th edition. ISBN 9780130489890 2. Sengupta A. K., Analysis & Design Of Machine Elements – I, Summary Of Topics & Formulae
COMPUTER USAGE	MDSolids, Word, Excel
COURSE LEARNING OUTCOMES (CLO)	By the end of the course students should be able to: 1. Determine internal stress and strain developed given external loads on machine members. 2. Determine the principle normal and maximum shear stresses and strains from the interaction of bi-axial and tri-axial normal and shear stresses. 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. 4. Apply theories related to design for finite life. 5. Design rotating shafts, keys and couplings. 6. Theoretically and experimentally determine stress and strain of a shaft loaded in torsion and bending. 7. Write an effective laboratory report according to acceptable criteria.
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.

STUDENT OUTCOMES

The Course Learning Outcomes support the achievement of the following ECET Student Outcomes and TAC of ABET Criterion 9 requirements:

Student outcome a - an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities;
Related CLO – 1 to 5

Student outcome b - an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;
Related CLO – 1 to 5

Student outcome c - an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;
Related CLO – 6 & 7

Student outcome d - an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;
Related CLO – 5

Student outcome f - an ability to identify, analyze, and solve broadly-defined engineering technology problems;
Related CLO – 1 to 5

Student outcome g - an ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and an ability to identify and use appropriate technical literature;
Related CLO – 7

Student outcome m - technical expertise having added technical depth in mechanical design, solid mechanics, and electro-mechanical devices and controls;
Related CLO – 1 to 7

GRADING POLICY

Note: Grading Policy may be modified by Instructor for each Section in the Course)

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

ACADEMIC INTEGRITY

NJIT has a zero-tolerance policy regarding cheating of any kind and student behavior that is disruptive to a learning environment. Any incidents will be immediately reported to the Dean of Students. In the cases the Honor Code violations are detected, the punishments range from a minimum of failure in the course plus disciplinary probation up to expulsion from NJIT with notations on students' permanent record. Avoid situations where honorable behavior could be misinterpreted. For more information on the honor code, go to http://www.njit.edu/academics/honorcode.php

STUDENT BEHAVIOR

- No eating or drinking is allowed at the lectures, recitations, workshops, and laboratories.
- Cellular phones must be turned off during the 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 lecture, laptops should be closed during lecture.
- 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
Ahmed Belal

COURSE COORDINATED BY
Dr. A. Sengupta

CLASS HOURS

Monday	5:45 PM – 7:40 PM	ME 214
Monday	7:50 PM – 9:45 PM	ME 214

OFFICE HOURS

By appointment: asb62@njit.edu

HOMEWORK & PROJECT - IMPORTANT

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 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 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 production of 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

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

COURSE OUTLINE

Wk	Class	Topic	Textbook chapter	Homework
1	1/27	Static equilibrium, Engineering Materials, Tension and Compression in axial loading, Statically indeterminate problems.	1: 1-6	1: 5, 3, 7, 8, 11
2	2/3	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	2/10	Deflection of beam, transverse shearing stress in beams	1:13, 15, 16	1: 40, 41, 29, 31, 112
4	2/17	**Test 1** Shear and bending moment diagrams	1:17	1: 25, 61, 63
5	2/24	More on Shear and bending moment diagrams	1:18	1: 86, 121
6	3/2	Mohr Circle, 3D stress,	1:19-24	1: 88, 98, 102, 106, 108
7	3/9	Failure theories	2: 1-4	2: 3, 4, 23, 25, 27, 30
SPRING RECESS 3/15-3/22				
8	3/23	**Test 2** Stress concentration factors; Strain in 2-D stresses	2:5-6	2: 13, 18, 42, 51
9	3/30	Design for cyclic loading **Lab #1** Wheatstone bridge Cover page		2: 56, 61, 62
10	4/6	Design of shafts	3: 1-4	3: 1, 10, 11, 13, 18, 19
11	4/13	Design of keys and couplings, Shaft on three supports	3: 5-9	3: 26, 28, 29, 86, 84
12	4/20	Critical speed of a rotating shaft **Lab #2** Strain measurement	3:11	
13	4/27	**Test 3** Deflection & Slope of non uniform shaft, Energy Method.	3: 12,13	3: 41, 90, 45
14	5/4	Shaft with non circular section, Shafting Materials	3: 14-19	
15	TBD	FINAL EXAM		