ENGINEERING MECHANICS
ME 231

Math &Physical. Science : 30% Engineering Science: 40% Engineering Design: 30% Humanities and Social Science: ---	**Course Title**: Engineering Mechanics **Course Code**: ME 231 **Credit Hours**: (4,1) 4 **Year and Semester**: 2006, Spring **Date Prepared**: 21/2/2006 **Prepared by**: Asst. Prof. Dr. Saad Yasin **Office: ME** 106 E **Phone:** 630-1087 **Email** : saad.yasin@emu.edu.tr

I. Catalog Description:
The first part of the course will cover Introduction to vector algebra, Principle of mechanics, Static equilibrium of particles and rigid bodies. Distributed force system. Shear and moment diagrams. Structural analysis using methods of joint, section and the zero force member. Elements of structures: beams, trusses, cables. Friction such as surface and belt friction. Center of gravity and centroid. Moments of inertia and principle of virtual work for systems of connected rigid bodies. In second part of the course covers kinematics and kinetics of particles in rectilinear and curvilinear motions using various coordinate systems. Work and energy, impulse and momentum principles. Planar kinematics using analytical and graphical methods, and kinetics of rigid bodies using force and acceleration, work and energy, and impulse and momentum principles, and vibration of single and two-degree of freedom systems.

II. Perquisites: Phys 101/102, Math 150, 152, and 201

Prerequisite by Topic:
Basic knowledge of Physics I and II and Calculus I, II, and III

III. Textbook: "Engineering Mechanics-Statics and Dynamics", 10th Edition, R. C. Hibbeler , Prentice Hall, 2004

Recommended References:

1. "*Engineering Mechanic -Statics and Dynamics"*, SI Edition, Bedford and Fowler, Prentice Hall, 2005

2. "Engineering Mechanics –Statics and Dynamics", 2nd Edition, Pytel and Kiusalaas, Brooks/Cole Publishing, 1999

3. "Vector Mechanics for Engineers—Statics and Dynamics", 7th Edition, Beer, P. F. and Johnston, E. R., McGraw-Hill, New York, 2004

4. "Engineering Mechanics- Static and Dynamics", 5th Edition, Meriam, J. L. and Kraige, L. G. John Wiley & Sons, New York, 2002

IV. Course Objectives

A student completing this course should be able to do the following:

1. To learn how to determine the external forces acting on particles in static equilibrium.
2. To learn how to determine the external forces and moments acting on rigid bodies in static equilibrium.
3. To learn how to determine the internal forces in stationary structures such as trusses, frames, and machines.
4. To develop methods of calculating properties such as centers of gravity and area moments of inertia.
5. Understand the principles of Newton's laws and their application to the real life physical problems that require knowledge of the relationship between force and motion.
6. Develop the analytical skills needed to systematically formulate, solve, and analyze a wide range of dynamics problems.
7. Model dynamical problems consisting of mechanical systems composed of rigid components.
8. Develop equations of motions for simple systems of particles and rigid bodies, including simple 1-DOF vibratory motion.
9. Continue to higher-level courses and apply the concepts learned to engineering design problems.

V. Topics Covered

Week 1& 2	Introduction, Scalars and vectors, Vector addition, Cartesian vector notation, Addition of Cartesian vectors, position vectors, force directed along a line, dot product, particle equilibrium, free body diagrams, co-planar and three dimensional force systems, vector cross product, moment of a force, moment of a couple reduction of force and couple systems, reduction of a simple distributed loading , Equilibrium in two dimensions, Vector Operations, derivatives of Vector functions, rectilinear motion of particles, Curvilinear motion of Particles, Position, velocity, and acceleration in vector forms, Cartesian and Normal and tangential components of velocity and acceleration
Weeks 3&4	plane trusses, method of joints, method of sections, frames and machines internal forces in members, shear force and bending moment equations and diagrams, relationship between distributed load, shear force and bending moment, dry friction, wedges, center of gravity, centroid, locating centroids by integration, composite bodies, moments of inertia for areas, parallel axis theorem, moments of inertia by integration , moments of inertia of composite areas, product of inertia, change of axes, Mohr's circle for moments of inertia
Week 5	Derivatives of Vector functions, rectilinear motion of particles, Curvilinear motion of Particles, Position, velocity, and acceleration in vector forms, Cartesian and Normal and tangential components of velocity and acceleration. Cylindrical coordinates Motion of particles relative to translating reference frames, dependent motion of two particles, relative motions of two particles using translating axes
Week 6&7	**Particles Dynamics:** Newton's 2nd law, work-energy principle and conservation of energy, linear impulse-momentum principle and conservation of momentum, and direct central impact
Week 8	**Planar Kinematics of rigid bodies:** Pure translational motion, fixed axis rotation, general planar motion, instantaneous center of zero-velocity

Week 9	**Continuation of Planar Kinematics of rigid bodies:** Pure translational motion, fixed axis rotation, general planar motion, instantaneous center of zero-velocity
	MIDTERM WEEK
Weeks 10&11	**Planar Kinetics of rigid body:** Kinetic energy, work due to force and couples, principle of work and energy, conservation of energy
Weeks 12& 13	**Planar kinetics of rigid body:** Impulse and momentum, principle of Impulse Momentum, conservation of Momentum, and eccentric impact
Week 14	Introduction to 3-D kinematics of rigid body and 1-DOF, free and forced , damped and undamped, vibration analysis
	Final Exam

VI. Class Schedule

Four 50 minutes lectures per week, 50 minutes tutorial per week

VII. Homework/Projects

Homework Problems will be assigned and only few selected problems will be collected for grading. An announced Quiz will be given weekly. A minimum of three lab reports will be required.

VIII. Computer Usage

Computer programming languages such as C and FORTRAN are very helpful. Use of Software such as MATLAB is very important and should be utilized in the homework assignments. Also, students are encouraged to use the Internet to search for various topics, including contents of similar courses offered elsewhere. Students can reach teaching material, solved problems, data sheets etc. on certain Web sites. Check out these websites (www.freestudy.co.uk, cwx.prenhall.com/bookbind/pubbooks/bedford2/).

IX. Contribution of Course to Professional Component

This course equips students to analyze a wide range of static engineering problems as well as simple mechanisms. After successful completion of this course, students will be able to develop static equilibrium equations and dynamic equations of motion for simple systems of particles and rigid bodies, including simple vibratory motion. At the end, students will learn how to model a system composed of rigid bodies; understand how to pose and analyze statically and dynamical problems involving rigid bodies by applying Newton's laws; demonstrate their ability to model a mechanical system and solve its governing equations; and show their competence in interpreting their mathematical solution to an engineering problem.

X. Relationship of Course to Program Objectives

Course Objective	Program Objectives						
	Math & Physical Sciences	Mater. Eng. Principles	Define & Solve Eng. Problems	Mater. - Process Selection& Design	Exper. Data Analysis & Interpret.	Commun. & Team Work	Soc. Issues & Ethics
1		X	X				
2	X		X	X			
3						X	
4				X	X		
5		X	X		X		
6		X	X				
7		X	X				
8		X	X				

XI. Evaluation of Outcomes

Selected Homework problems, Labs, and design project	15%
Quizzes	15%
Midterm (Regular Program)	30%
Final Examination	40%
Total	**100%**

Attendance, Behavior, and Participation: Important factor to improve critical letter grades.

Homework problems assignments: Solve but do not hand-in for grading
Only Selected Homework problems will be randomly assigned for grading

CHAPTER	PROBLEMS
1	5, 11, 19
2	1, 8, 13, 24, 28, 33, 56, 61, 62, 79, 89, 93, 97, 105, 131
3	3, 7, 8, 13, 17, 40, 45, 58, 73
4	5, 10, 20, 31, 50, 61, 65, 81, 87, 113, 134, 139, 145, 150, 160
5	3, 7, 21, 35, 56, 62, 84, 97
6	6, 14, 23, 26, 33, 48, 57, 66 c, 73, 86, 100, 120
7	5, 11, 29, 34, 44, 53, 58, 71, 86, 101
8	5, 10, 38, 62, 69, 79, 87, 105
9	1, 8, 15, 34, 41, 57, 60
10	2, 4, 18, 34, 50, 80, 106, 112
11	1, 10, 14, 23, 30, 49
12	11,17,23,26, 67, 91, 118, 122, 145, 153, 188, 195, 196
13	6, 21, 60, 67, 99
14	11, 14, 21, 77, 88
15	2, 14, 34, 50, 57, 63, 79, 96, 102
16	5, 12, 37, 57, 68, 91, 116,123
17	32, 41, 54, 89
18	2, 47, 50

Note: Some of the questions on the exams and quizzes might be picked from the assigned problems

Academic Dishonesty:

All forms of student dishonesty are considered unacceptable. If students have clearly used plagiarism or copied from other students a grade of **zero** will be given for the assignment or exam; in instances of copying on assignments and reports, **all** students involved will be assigned a zero. Cheating on final exams will generally result in a grade of **F** being assigned for the course.