ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Natural Sciences Business

COURSE: Tam 2001

Date: 8/28/2013

Credit Hours: 5.0

Prerequisite(s): PHY 1001 or equivalent or credit and registration) in MTH 2003

Delivery Method:

☒	**Lecture**	**5 Contact Hours (1 contact = 1 credit hour)**
☐	**Seminar**	**0 Contact Hours (1 contact = 1 credit hour)**
☐	**Lab**	**0 Contact Hours (2 contact = 1 credit hour)**
☐	**Clinical**	**0 Contact Hours (3 contact = 1 credit hour)**
☐	**Online**	
☐	**Blended**	

Offered: ☒ **Fall** ☐ **Spring** ☐ **Summer**

IAI Equivalent –***Only for Transfer Courses***-go to *http://www.itransfer.org*: EGR944

CATALOG DESCRIPTION:

This course employs a vector approach to statics and dynamics. The topics covered include resultants of force systems; algebraic and graphical methods of resolution; analysis of forces acting on members of trusses, frames, etc.; friction; centroids; kinematics of particles and rigid bodies; moments of inertia; kinetics of particles and rigid bodies; solution of kinetics problems by methods of work, energy, impulse and momentum; mechanical vibrations.

GENERAL EDUCATION GOALS ADDRESSED

Upon completion of the course, the student will be able:

☒ To apply analytical and problem solving skills to personal, social and professional issues and situations.
☐ To communicate orally and in writing, socially and interpersonally.
☐ To develop an awareness of the contributions made to civilization by the diverse cultures of the world.
☒ To understand and use contemporary technology effectively and to understand its impact on the individual and society.
☒ To work and study effectively both individually and in collaboration with others.
☐ To understand what it means to act ethically and responsibly as an individual in one's career and as a member of society.
☐ To develop and maintain a healthy lifestyle physically, mentally, and spiritually.
☐ To appreciate the ongoing values of learning, self-improvement, and career planning.

EXPECTED LEARNING OUTCOMES AND RELATED COMPETENCIES:

Upon completion of the course, the student will be able to:

This course stresses the use of mathematical methods to solve problems in statics and dynamics. Upon completion of this course, students should be able to use (vector) algebra, trigonometry, and differential and integral calculus (whichever methods are appropriate) to:

1. Demonstrate a superior command in unit analysis (both SI system and US customary units) in engineering.

2. Demonstrate an understanding of a variety of procedures used in analyzing/solving engineering problems, as well as a general guide in solving problems in statics and dynamics.

3. Add, subtract, and multiply vector quantities, e.g. vector forces and displacements.

4. Apply dot product and parallelogram law to analyze force vectors

5. Compute the resultant force, moment, and couple acting on a rigid body.

6. Determine whether a rigid body is in equilibrium under the action of a group of forces, moments, or couples.

7. Compute particle/rigid body equilibrium problems.

8. Determine/compute the forces and bending moments acting on or in trusses, frames or beams. This includes being able to draw shear and bending moment diagrams for these structures.

9. Determine/compute internal loading in structural members

10. Analyze and solve problems involving frictional forces (including wedges, screws, belts, bearings etc)

11. Determine the centers of gravity of two or three dimensional objects.

12. Determine and evaluate the centroids of lines, areas, or volumes.

13. Determine and evaluate the moments of inertia for areas, and mass moment of inertia

14. Solve problems involving equilibrium of particle and rigid body using virtual work.

15. Determine and compute the position, velocity, and acceleration of moving bodies as functions of time and position.

16. Apply Newton's second law, work and energy to solve problems involving particle kinetics.

17. Apply Impulse and momentum methods to solve problems involving particle kinetics.

18. Describe mathematically the translational and rotational motion of rigid bodies.

19. Apply Newton's law, work, and energy to solve problems involving the kinetics of rigid bodies.

20. Apply impulse and momentum methods to solve problems involving the kinetics of rigid bodies.
21. Solving problems involving three dimensional kinematics and kinetics of a rigid body

22. Solve problems involving mechanical vibrations.

COURSE TOPICS AND CONTENT REQUIREMENTS÷

1. General Principles.
1.1 Mechanics.
1.2 Fundamental Concepts.
1.3 Units of Measurement.
1.4 The International System of Units.
1.5 Numerical Calculations.

2. Force Vectors.
2.1 Scalars and Vectors.
2.2 Vector Operations.
2.3 Vector Addition of Forces.
2.4 Addition of a System of Coplanar Forces.
2.5 Cartesian Vectors.
2.6 Addition and Subtraction of Cartesian Vectors.
2.7 Position Vectors.
2.8 Force Vector Directed Along a Line.
2.9 Dot Product.

3. **Equilibrium of a Particle.**
3.1 Condition for the Equilibrium of a Particle.
3.2 The Free-Body Diagram.
3.3 Coplanar Force Systems.
3.4 Three-Dimensional Force Systems.

4. Force System Resultants.
4.1 Moment of a Force–Scalar Formation.
4.2 Cross Product. Moment of a Force–Vector Formulation.
4.3 Principle of Moments.
4.4 Moment of a Force About a Specified Axis.
4.5 Moment of a Couple.
4.6 Equivalent System.
4.7 Resultants of a Force and Couple System.
4.8 Further Reduction of a Force and Couple System.
4.9 Reduction of a Simple Distributed Loading.

5. Equilibrium of a Rigid Body.
5.1 Conditions for Rigid-Body Equilibrium.
5.2 Free-Body Diagrams.
5.3 Equilibrium in Two Dimensions.
5.4 Equations of Equilibrium.
5.5 Two- and Three-Force Members.
5.6 Equations of Equilibrium.
5.7 Constraints and Statistical determinacy

6. Structural Analysis
6.1 Simple Trusses.
6.2 The Method of Joints.
6.3 Zero-Force Members.
6.4 The Method of Sections.
6.5 Frames and Machines.

7. Internal Forces.
7.1 Internal Forces Developed in Structural Members.
7.2 Shear and Moment Equations and Diagrams.
7.3 Relations between Distributed Load, Shear, and Moment.
7.4 Cables.

8. Friction.
8.1 Characteristics of Dry Friction.
8.2 Problems Involving Dry Friction.
8.3 Wedges.
8.4 Frictional Forces on Screws.
8.5 Frictional Forces on Flat Belts.
8.6 Frictional Forces on Collar Bearings, Pivot Bearings, and Disks.
8.7 Frictional Forces on Journal Bearings.
8.8 Rolling Resistance.

9. Center of Gravity and Centroid.
9.1 Center of Gravity, Center of Mass, and Centroid for a Body.
9.2 Composite Bodies.
9.3 Theorems of Pappus and Guldinus.
9.4 Resultant of a General Distributed Force System.
9.5 Fluid Pressure.

10. Moments of Inertia.
10.1 Definitions of Moments of Inertia for Areas.
10.2 Parallel-Axis Theorem for an Area.
10.3 Radius of Gyration of an Area.
10.4 Moments of Inertia for Composite Areas.
10.5 Product of Inertia for an Area.
10.6 Moments of Inertia for an Area About Inclined Axes.
10.7 Mohr's Circle for Moments of Inertia.
10.8 Mass Moment of Inertia.

11. Virtual Work.
11.1 Definition of Work and Virtual Work.
11.2 Principle of Virtual Work for a Particle and a Rigid Body.
11.3 Principle of Virtual Work for a System of Connected Rigid Bodies.
11.4 Conservative Forces.
11.5 Potential Energy.
11.6 Potential Energy Criterion for Equilibrium.
11.7 Stability of Equilibrium.

12. Kinematics of a Particle.
12.1 Introduction.
12.2 Rectilinear Kinematics: Continuous Motion.
12.3 Rectilinear Kinematics: Erratic Motion.
12.4 General Curvilinear Motion.
12.5 Curvilinear Motion: Rectangular Components.
12.6 Motion of a Projectile.
12.7 Curvilinear Motion: Normal and Tangential Components.
12.8 Curvilinear Motion: Cylindrical Components.
12.9 Absolute Dependent Motion Analysis of Two Particles.

13. Kinetics of a Particle: Force and Acceleration.
13.1 Newton's Laws of Motion.
13.2 The Equation of Motion.
13.3 Equation of Motion for a System of Particles.
13.4 Equations of Motion: Rectangular Coordinates.
13.5 Equations of Motion: Normal and Tangential Coordinates.
13.6 Equations of Motion: Cylindrical Coordinates.
13.7 Central-Force Motion and Space Mechanics.

14. Kinetics of a Particle: Work and Energy.
14.1 The Work of a Force.
14.2 Principle of Work and Energy.

14.3 Principle of Work and Energy for a System of Particles.
14.4 Power and Efficiency.
14.5 Conservative Forces and Potential Energy.
14.6 Conservation of Energy.

15. Kinetics of a Particle: Impulse and Momentum.
15.1 Principle of Linear Impulse and Momentum.
15.2 Principle of Linear Impulse and Momentum for a System of Particles.
15.3 Conservation of Linear Momentum for a System of Particles.
15.4 Impact.
15.5 Angular Momentum.
15.6 Relation Between Moment of a Force and Angular Momentum.
15.7 Angular Impulse and Momentum Principles.
15.8 Steady Fluid Streams.

16. Planar Kinematics of a Rigid Body
16.1 Planar Rigid-Body Motion.
16.2 Translation.
16.3 Rotation About a Fixed Axis.
16.4 Absolute General Plane Motion Analysis.
16.5 Relative-Motion Analysis: Velocity.
16.6 Instantaneous Center of Zero Velocity.
16.7 Relative-Motion Analysis: Acceleration.
16.8 Relative-Motion Analysis Using Rotating Axes.

17. Planar Kinetics of a Rigid Body: Force and Acceleration.
17.1 Moment of Inertia.
17.2 Planar Kinetic Equations of Motion.
17.3 Equations of Motion: Translation.
17.4 Equations of Motion: Rotation About a Fixed Axis.
17.5 Equations of Motion: General Plane Motion.

18. Planar Kinetics of a Rigid Body: Work and Energy.
18.1 Kinetic Energy.
18.2 The Work of a Force.
18.3 The Work of a Couple.
18.4 Principle of Work and Energy.
18.5 Conservation of Energy.

19. Planar Kinetics of a Rigid Body: Impulse and Momentum.
19.1 Linear and Angular Momentum.
19.2 Principle of Impulse and Momentum.
19.3 Conservation of Momentum.

INSTRUCTIONAL METHODS:

1. Lectures and interactive lecture demonstration (ILDs), Activity-based physics and other audio-visual aids and technologies.

2. Homework assignments and related class discussion sessions.

3. Micro – computer based laboratory exercises.

4. Modeling and guided practice of a variety of physics problems.

INSTRUCTIONAL MATERIALS:

Text: Engineering Mechanics, Statics and Dynamics, R.C. Hibbeler 13th Edition,

STUDENT REQUIREMENTS AND METHODS OF EVALUATION:

Reading of textbook, note taking, and participation in classroom discussions as well as performing laboratory experiments are required of the students. Students are assigned approximately 15 homework problems per Chapter. Solutions of graded problems are discussed after grading if and when necessary. Evaluation of the students will include written problem class tests and one problem-orientated comprehensive final exam, written reports of laboratory experiments, quizzes and homework assignments

OTHER REFERENCES

Vector Mechanics For Engineers - Schwaum's Outline Series, McGraw-Hill Publishing Company

Engineering mechanics, 6th ed., Kraige L. G, and Meriam J.L.

Course Competency/Assessment Methods Matrix

Course Prefix, Number and Name	Assessment Options																																	
For each competency/outcome place an "X" below the method of assessment to be used.	**Assessment of Student Learning**	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.	**Direct/ Indirect**	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D	D		D	D		D	D
Students will be able to demonstrate a basic understanding of electric fields including the sources of the fields and the concept of electrical potential.					X			X	X									X									X			X	X	
Students will be able to demonstrate a basic understanding of resistive and R-C circuits, power, and basic circuit design.					X			X	X									X									X			X	X	
Students will be able to demonstrate a basic understanding of magnetic fields including the sources of the fields and the effects they have on moving particles.					X			X	X									X									X			X	X	
Students will be able to demonstrate a basic understanding of dynamic electromagnetic fields and their applications to simple electronics.					X			X	X									X														
Students will be able to demonstrate a basic understanding of geometrical					X			X	X									X									X			X	X	

optics including refraction, reflection, lenses, mirrors, and various optical devices.																																
Students will be able to demonstrate a basic understanding of the wave nature of light and its effects					X			X	X									X											X			X
Students will be able to demonstrate a basic understanding modern physics including, quantum mechanics, wave/particle duality, atomic physics, nuclear physics, and relativity					X			X	X									X											X			