

CENTRAL TEXAS COLLEGE
SYLLABUS FOR ENGR 2301
Engineering Mathematics I (Statics)

Semester Hours Credit: 3

INSTRUCTOR: Dr. Word

I. INTRODUCTION

- A. Engineering Mathematics, ENGR 2301, is a three-semester hour course that is a Calculus based study of compositions and resolution of forces, equilibrium of force systems, friction, centroids, and moments of inertia.
- B. This course is occupationally related and serves as preparation for careers in engineering. This course satisfies lower division, undergraduate requirements for most degrees in engineering.
- C. Prerequisites: PHYS 2425; Co-requisite: MATH 2414

II. Learning Outcomes

Upon successful completion of this course, College Algebra, the student will be able to:

- A. Define mechanics
- B. Discuss and apply the Fundamental Concepts and Principles
- C. Discuss systems of units
- D. Convert from one system of units to another.
- E. Discuss the Method of Problem Solving
- F. Discuss Numerical Accuracy
- G. Solve problems involving forces in plane.
- H. Solve problems involving forces in space
- I. Use vector mechanics to solve problems involving equivalent systems of forces.
- J. Solve problems involving equilibrium of rigid bodies.
- K. Solve problems involving equilibrium in two dimensions.
- L. Solve problems involving equilibrium in three dimensions.
- M. Solve problems involving centroids and center of gravity.
- N. Solve problems involving areas and lines.
- O. Solve problems involving volumes.
- P. Solve problems involving analysis of structures using trusses.
- Q. Solve problems involving analysis of structures using frames and machines.
- R. Solve problems involving forces in beams and cables.

- S. Solve problems involving friction.
- T. Solve problems involving moments of inertia of areas.
- U. Solve problems involving moments of inertia of masses.
- V. Solve problems involving the method of virtual work. ****

**** Optional: As time allows.

III. INSTRUCTIONAL MATERIALS

- A. Required Text: Berr, Johnston and Eisenberg, Vector Mechanics for Engineers: Statics, 7th edition, New York, NY; McGraw Hill, 2004.
- B. Other Materials: A graphing calculator is required. It is recommended that students who choose to purchase a graphing calculator use the TI-89 TI Graphlink for the TI-9 is available in the CTC Advanced Math Lab.

IV. COURSE REQUIREMENTS

- A. Assignments will be made daily. All assignments are to be completed by the following class meeting. Assignments may be collected and examined at any time.
- B. Students are expected to attend every class and to arrive at each class on time and remain in class for the entire class period. Students who are absent from class 12.5% of the number of class meetings for any reason will be dropped from the class with a grade of "F". Instructors may choose to lower a student's grades because of tardiness.
- C. The instructor will post office hours after the semester commences. Consult the instructor during office hours. If your visit may tend to be lengthy, make an appointment with the instructor so that he may set aside some time for you.

V. EXAMINATIONS

- A. Examinations will be given at the end of each unit. If a unit is short and simple, it might be included with another short, simple unit for one exam. A final exam will be given and students must take the final exam in order to pass the course. The final exam date is announced about two weeks prior to the examination week.
- B. Students who miss an exam should discuss with the instructor the circumstances surrounding the absence. The instructor will determine whether a make-up exam is to be given. Make-up examinations are given by appointment only.

VI. SEMESTER GRADE COMPUTATIONS

- A. Your point total is determined by adding the points earned on each unit examination. Your letter grade for the course is then determined by the following formula:

$$\frac{\text{Your Point Total}}{\text{Total Points Possible}} \times 100$$

If the result is between	90	and 100	your grade is	A
	80		89	B
	70		79	C
	60		69	D
	0		59	F

** NOTE: Grade Computation is determined by instructor. Please see your instructor for how your grade will be determined. This is just an example.

VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM COURSE INSTRUCTOR

- A. Withdrawal from Course: It is the student's responsibility to officially drop a class if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file an Application for Withdrawal or an Application for Refund. The withdrawal form must be signed by the student.

Application for Withdrawal will be accepted at any time prior to Friday of the 12th week of classes during the 16 week fall and spring semesters. The deadline for sessions of other lengths is as follows.

11 week session	Friday of the 8th week
8 week session	Friday of the 6th week
52 week session	Friday of the 4th week

The equivalent date (75% of the semester) will be used for sessions of other lengths. The specific last day to withdraw is published each semester in the Schedule Bulletin.

Students who officially withdraw will be awarded the grade of "W", provided the student's attendance and academic performance are satisfactory at the time of official withdrawal. Students must file a withdrawal application with the college before they may be considered for withdrawal.

A student may not withdraw from a class for which the instructor has previously issued the student a grade of "F" or "FN" for nonattendance.

- B. An Administrative Withdrawal: An administrative withdrawal may be initiated when the student fails to meet College attendance requirements. The instructor will assign the appropriate grade on the Administrative Withdrawal Form for submission to the registrar.
- C. An Incomplete Grade: The College catalog states, "An incomplete grade may be given in those cases where the student has completed the majority of the course work but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course..." Prior approval from the instructor is required before the grade of "I" is recorded. A student who merely fails to show for the final examination will receive a zero for the final and an "F" for the course.
- D. Cellular Phones and Beeper: Cellular phones and beepers will be turned off while the student is in the classroom or laboratory.
- E. Americans With Disabilities Act (ADA): Students requiring accommodations for disabilities are responsible for notifying the instructor. Reasonable accommodations will be granted in full compliance with federal and state law and Central Texas College policy.
- F. Instructor Discretion: The instructor reserves the right of final decision in course requirements.
- G. Civility: Individuals are expected to be cognizant of what a constructive educational experience is and respectful of those participating in a learning environment. Failure to do so can result in disciplinary action up to and including expulsion.
- H. The Math Department operates an Advanced Mathematics Lab in Building 152, Room 145. All courses offered by the Math Department are supported in the lab with appropriate tutorial software. Walk-in tutoring is also available in Building 152, Room 236. Calculators and Graphlink are available for student use in the lab. Students are encouraged to take advantage of these opportunities. See posted hours for the Walk-in tutoring and Math Lab.

VIII. COURSE OUTLINE

A. Unit One: Introduction and Statics of Particles (Chapter 1 & 2)

1. Learning Outcomes: Upon successful completion of this unit, the student will be able to:

- a. Write and discuss the definition of mechanics.
- b. Discuss the fundamentals of concepts and principles of mechanics.
- c. Apply and discuss systems of units.
- d. Convert from one system of units to another.
- e. State and discuss the method problem solution.
- f. Discuss numerical accuracy.
- g. Solve problems involving forces on a particle by computing the resultant of two forces.
- h. Discuss vectors.
- i. Add vectors
- j. Compute the resultant of several concurrent forces.
- k. Resolve a force into components.
- l. Solve problems involving rectangular components of a force.
- m. Add forces by summary x and y components of a force.
- n. Write the definition of and solve problems involving the equilibrium of a particle.
- o. Discuss and apply Newton's First Law of Motion.
- p. Solve problems involving the equilibrium of a particle using Free-Body Diagram.
- q. Solve problems involving rectangular components of a force in space.
- r. Solve problems involving force defined by its magnitude and two points on its line of action.
- s. Add concurrent forces in space.
- t. Discuss and solve problems involving equilibrium of a particle in space.

2. Learning Activities:

- a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
- b. Read the chapter section as assigned. (F1)
- c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Unit Outline:

- a. Section.1.1 (What is Mechanics?)
- b. Section 1.2 (Fundamental Concepts and Principles)

- c. Section 1.3 (Systems of Units)
- d. Section 1.4 (Conversion from One System of Units to Another)
- e. Section 1.5 (Method of Problem Solution)
- f. Section 2.1 (Introduction)
- g. Section 2.2 (Force on a Particle Resultant of Two Forces)
- h. Section 2.3 (Vectors)
- i. Section 2.4 (Addition of Vectors)
- j. Section 2.5 (Resultant of Vectors)
- k. Section 2.6 (Resolution of a Force into Components)
- l. Section 2.7 (Rectangular Components of a Force. Unit Vectors)
- m. Section 2.8 (Addition of Forces by Summing x and y components)
- n. Section 2.9 (Equilibrium of a Particle)
- o. Section 2.10 (Newton's First Law of Motion)
- p. Section 2.11 (Problems involving the equilibrium of a particle . Free-Body Diagrams)
- q. Section 2.12 (Rectangular Components of a Force in Space)
- r. Section 2.13 (Force Defined by its Magnitude and Two Points on its Line of Action)
- s. Section 2.14 (Addition of Concurrent Forces in Space)
- t. Section 2.15 (Equilibrium of a Particle in Space)

B. **Unit Two**: Rigid Bodies: Equivalent Systems of Forces and Equilibrium of Rigid Bodies (Chapters 3 and 4)

1. **Unit Objectives**: Upon successful completion of this unit, the student will be able to:

- a. Solve problems involving External and Internal Forces.
- b. Solve problems involving the Principle of Transmissibility.
- c. Compute vector products.
- d. Compute moments of forces using vector products.
- e. Solve problems involving moments of couples and forces.
- f. Solve problems involving systems of forces.
- g. Construct free-body diagrams.
- h. Solve problems involving equilibrium of rigid bodies in two and three dimensions.

2. **Learning Activities**:

- a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
- b. Read the chapter section as assigned. (F1)
- c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Unit Outline:
- a. Section 3.1 (Introduction)
 - b. Section 3.2 (External and Internal Forces)
 - c. Section 3.3 (Principle of Transmissibility. Equivalent Forces)
 - d. Section 3.4 (Vector Product of Two Vectors)
 - e. Section 3.5 (Vector Products Expressed in Terms of Rectangular Components)
 - f. Section 3.6 (Moment of a Force about a Point)
 - g. Section 3.7 (Varignon's Theorem)
 - h. Section 3.8 (Rectangular Components of the Moment of a Force.)
 - i. Section 3.9 (Scalar Product of Two Vectors)
 - j. Section 3.10 (Mixed Triple Product of Three Vectors)
 - k. Section 3.11 (Moment of a Force about a Given Axis)
 - l. Section 3.12 (Moment of a Couple)
 - m. Section 3.13 (Equivalent Couples)
 - n. Section 3.14 (Addition of a Couple)
 - o. Section 3.15 (Couples can be represented by Vectors)
 - p. Section 3.16 (Resolution of a Given Force into a Force at O and a Couple)
 - q. Section 3.17 (Reduction of a System of Forces to One Force and One Couple)
 - r. Section 3.18 (Equivalent Systems of Forces)
 - s. Section 3.19 (Equipollent Systems of Vectors)
 - t. Section 3.20 (Further Reduction of a System of Forces)
 - u. Section 3.21 (Reduction of a System of Forces to a Wrench)
 - v. Section 4.1 (Introduction)
 - w. Section 4.2 (Free-Body Diagrams)
 - x. Section 4.3 (Reactions at Supports and Connections for Two-Dimensional Structure)
 - y. Section 4.4 (Equilibrium of a Rigid Body in Two Dimensions)
 - z. Section 4.5 (Statically Indeterminate Reactions. Partial Constraints)
 - aa. Section 4.6 (Equilibrium of a Two-Force Body)
 - bb. Section 4.7 (Equilibrium of a Three-Force Body)
 - cc. Section 4.8 (Equilibrium of a Rigid Body in Three Dimensions)
 - dd. Section 4.9 (Reactions at Supports and Connections for a Three-Dimensional Structure)

C. Unit Three: Distributed Forces: Centroids and Centers of Gravity and Analysis of Structures (Chapters 5 and 6)

1. Unit Objectives: Upon successful completion of this unit, the student will be able to:
- a. Compute centroids and centers of gravity.

- b. Solve centroid and center of gravity problems.
- c. Compute first moment of areas and lines.
- d. Solve problems involving composite plates and wires.
- e. Apply the Theorems of Pappus-Guldinus.
- f. Solve problems involving forces on submerged surfaces.
- g. Solve centroid and centers of gravity problems involving volumes.

2. Learning Activities:

- a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
- b. Read the chapter section as assigned. (F1)
- c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Unit Outline:

- a. Section 5.1 (Introduction)
- b. Section 5.2 (Center of Gravity of a Two-Dimensional Body)
- c. Section 5.3 (Centroids of Areas and Lines)
- d. Section 5.4 (First Moments of Areas and Lines)
- d. Section 5.5 (Composite Plates and Wires)
- e. Section 5.6 (Determination of Centroids by Integration)
- f. Section 5.7 (Theorems of Pappus-Guldinus)
- g. Section 5.8 (Distributed Loads on Beams)
- h. Section 5.9 (Forces on Submerged Surfaces)
- i. Section 5.10 (Center of Gravity of a Three-Dimensional Body. Centroid of a Volume)
- j. Section 5.11 (Composite Bodies)
- k. Section 5.12 (Determination of Centroids of Volumes by Integration)
- l. Section 6.1 (Introduction)
- m. Section 6.2 (Definition of Trusses)
- n. Section 6.3 (Simple Trusses)
- o. Section 6.4 (Analysis of Trusses by the Method of Joints)
- p. Section 6.5 (Joints under Special Loading Conditions)
- q. Section 6.6 (Space Trusses)
- r. Section 6.7 (Analysis of Trusses by the Method of Sections)
- s. Section 6.8 (Trusses Made of Several Simple Trusses)
- t. Section 6.9 (Structures Containing Multiforce Members)
- u. Section 6.10 (Analysis of a Frame)
- v. Section 6.11 (Frames Which Cease to be Rigid when Detached from Their Supports)
- w. Section 6.12 (Machines)

D. **Unit Four:** Forces in Beams and Cables and Friction (Chapters 7 and 8)

1. Unit Objectives: Upon successful completion of this unit, the student will be able to:

- a. Discuss internal forces in Members.
- b. Solve problems involving Beams.
- c. Solve problems involving Cables.
- d. Discuss the Laws of Dry Friction.
- e. Discuss the Angles of Friction
- f. Solve problems involving Dry Friction.
- g. Solve problems involving Wedges.
- h. Solve problems involving Square-Threaded Screws.
- i. Solve problems involving Axle Friction.
- j. Solve problems involving Disk Friction.
- k. Solve problems involving Rolling Resistance.
- l. Solve problems involving Belt Friction.

2. Learning Activities:

- a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
- b. Read the chapter section as assigned. (F1)
- c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. Unit Outline:

- a. Section 7.1 (Introduction)
- b. Section 7.2 (Internal Forces in Members)
- c. Section 7.3 (Various Types of Loading and Support)
- d. Section 7.4 (Shear and Bending Moment in a Beam)
- e. Section 7.5 (Shear and Bending-Moment Diagrams)
- f. Section 7.6 (Relations among Load, Shear, and Bending Moments)
- g. Section 7.7 (Cables with Concentrated Loads)
- h. Section 7.8 (Cables with Distributed Loads)
- i. Section 7.9 (Parabolic Cable)
- j. Section 7.10 (Catenary)
- k. Section 8.1 (Introduction)
- l. Section 8.2 (The Laws of Dry Friction. Coefficients of Friction)
- m. Section 8.3 (Angles of Friction)
- n. Section 8.4 (Problems Involving Dry Friction)
- o. Section 8.5 (Wedges)
- p. Section 8.6 (Square-Threaded Screws)
- q. Section 8.7 (Journal Bearings. Axle Friction)

- r. Section 8.8 (Thrust Bearings. Disk Friction)
- s. Section 8.9 (Wheel Friction. Rolling Friction)
- t. Section 8.10 (Belt Friction)

E. **Unit Five:** Distributed Forces: Moments of Inertia and Method of Virtual Work (Chapters 9 and 10)

1. **Unit Objectives:** Upon successful completion of this unit, the student will be able to:

- a. Solve problems involving moments of inertia of areas.
- b. Solve problems involving moments of inertia of masses.
- c. Solve problems involving the work of a force.
- d. Discuss the Principle of Virtual Work.
- e. Solve problems involving applications of the Principle of Virtual Work.
- f. Solve problems involving Mechanical Efficiency.
- g. Solve Problems involving Work of a Force during a Finite Displacement.
- h. Solve problems involving potential energy and equilibrium.

2. **Learning Activities:**

- a. Participate in classroom lecture and discussion. (F5, F6, F7, F8)
- b. Read the chapter section as assigned. (F1)
- c. Work problems as assigned by the instructor. (F2, F7, F8, F9, F10, F11, F12)

3. **Unit Outline:**

- a. Section 9.1 (Introduction)
- b. Section 9.2 (Second Moment, or Moment of Inertia of an Area)
- c. Section 9.3 (Determination of the Moment of Inertia of and Area by Integration)
- d. Section 9.4 (Polar Moments of Inertia)
- e. Section 9.5 (Radius of Gyration of an Area)
- f. Section 9.6 (Parallel-Axis Theorem)
- g. Section 9.7 (Moments of Inertia of Composite Areas)
- h. Section 9.8 (Product of Inertia)
- i. Section 9.9 (Principal Axes and Principal Moments of Inertia)
- j. Section 9.10 (Mohr's Circle for Moments and Products of Inertia)
- k. Section 9.11 (Moment of Inertia of a Mass)
- l. Section 9.12 (Parallel-Axis Theorem)
- m. Section 9.13 (Moments of Inertia of Thin Plates)

- n. Section 9.14 (Determination of the Moment of Inertia of a Three-Dimensional Body of Integration)
- o. Section 9.15 (Moments of Inertia of Composite Bodies)
- p. Section 9.16 (Moments of Inertia of a Body with Respect to an Arbitrary Axis through O . Mass Products of Inertia)
- q. Section 9.17 (Ellipsoid of Inertia. Principal Axes of Inertia)
- r. Section 9.18 (Determination of the Principal Axes and Principal Moments of Inertia of a Body of Arbitrary Shape)
- s. Section 10.1 (Introduction)
- t. Section 10.2 (Work of a Force)
- u. Section 10.3 (Principle of Virtual Work)
- v. Section 10.4 (Applications of the Principle of Virtual Work)
- w. Section 10.5 (Real Machines. Mechanical Efficiency)
- x. Section 10.6 (Work of a Force during a Finite Displacement)
- y. Section 10.7 (Potential Energy)
- z. Section 10.8 (Potential Energy and Equilibrium)
- aa. Section 10.9 (Stability of Equilibrium)