# COURSE OUTLINE: MCH298 - APPLIED MECHANICS

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Approved: Greg Mapp, Chair, Aviation Technology - Flight

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| **Course Code: Title** | MCH298: APPLIED MECHANICS |
| **Program Number: Name** | 4061: AVIATION TECHNOLOGY |
| **Department:** | AVIATION TECHNOLOGY |
| **Semesters/Terms:** | 19W |
| **Course Description:** | This course entails a thorough study of statics, providing fundamental skill for further development in mechanical studies. Topics include: force vectors, components, resultants, moments, couples, equilibrium in force systems, trusses and frames, centrolds, friction laws, impending motion, centroids and centers of gravity |
| **Total Credits:** | 4 |
| **Hours/Week:** | 4 |
| **Total Hours:** | 60 |
| **Prerequisites:** | PHY125 |
| **Corequisites:** | There are no co-requisites for this course. |
| **This course is a pre-requisite for:** | MCH111, MCH221 |
| **Essential Employability Skills (EES) addressed in this course:** | EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.<br>EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication.<br>EES 3 Execute mathematical operations accurately.<br>EES 4 Apply a systematic approach to solve problems.<br>EES 5 Use a variety of thinking skills to anticipate and solve problems.<br>EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others.<br>EES 10 Manage the use of time and other resources to complete projects.<br>EES 11 Take responsibility for ones own actions, decisions, and consequences. |
| **Course Evaluation:** | Passing Grade: 0%, |
| **Books and Required Resources:** | Engineering Mechanics - Statics by Hibbeler<br>Publisher: Pearson Education Edition: 14<br>ISBN: 9780133918922<br>Required Text<br><br>Study Pack for Engineering Mechanics - Statics 14ed. by Hibbeler<br>Publisher: Pearson Education<br>ISBN: 9780134055800<br>Optional Purchase |

**Course Outcomes and Learning Objectives:**

| Course Outcome 1 | Learning Objectives for Course Outcome 1 |
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| INTRODUCTION | 1) Write both a verbal and a mathematical statement of the basic<br>principle known as the Pythagorean theorem.<br>2) Illustrate with a sketch of a right-angled triangle the accepted method of labeling both the sides and the angles of this triangle.<br>3) Recall the six trigonometric functions and apply these to simple right-angled triangle problems to solve for the lengths of unknown sides or the magnitude of unknown angles.<br>4) Recall both the sine law and the cosine law and apply these to the solution of triangles which are non-right-angled. Show that for a right-angled triangle the cosine law reduces to the Pythagorean theorem.<br>5) Recall the relationships that exist by way of conversion factors between the S.I. metric and the Imperial system of units for quantities such as length, mass, weight and force. Convert between systems of units using the method of multiplying by ratios equal to one.<br>6) Recall the two main concepts of dimensional analysis that an algebraic relationship involving quanties must satisfy.<br>7) Recall the basic rules of geometry involving: intersecting straight lines, supplementary angles, complementary angles, the relationships between angles when a straight line intersects two parallel lines, interior angles of a triangle, similar triangles and the equations for the circumference and the area of a circle. |
| **Course Outcome 2** | **Learning Objectives for Course Outcome 2** |
| VECTOR ANALYSIS | 1) Define what is meant by a scalar quantity and list at least a dozen examples of scalar quantities.<br>2) Define what is meant by a vector quantity and list seven examples of vector quantities.<br>3) List the various types of forces along with their characteristics and the commonly used units for forces both in the S.I. metric and the Imperial system of units.<br>4) Describe what is meant by the resultant of a system of forces.<br>5) Describe what is meant by the equilibrant of a system of forces.<br>6) Using the method known as the parallelogram method, determine the resultant of two vector quantities using both a graphical and a mathematical approach.<br>7) Using the method known as the string polygon method, determine the resultant of two or more vector quantities using a graphical approach.<br>8) Given a vector quantity superimposed onto an x-, y-coordinate plane, resolve the vector into its two orthogonal components, namely its x-component and its y-component.<br>9) Determine the resultant of two or more vector quantities by the analytical method known as the method of components. |
| **Course Outcome 3** | **Learning Objectives for Course Outcome 3** |
| MOMENTS AND COUPLES | 1) Define and describe a moment or torque force about a given |

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| | point of rotation<br>2) Write the general equation for determining the moment or torque force about a given point of rotation<br>3) Calculate the moment of a force by:<br>a) multiplying the total force by it`s perpendicular distance to the point of rotation<br>b) multiplying each of the force`s components by their respective perpendicular distances about a given point of rotation<br>4) Determine the resultant moment for a system of moments<br>5) Name the three factors that together constitute what is known as a coupled moment<br>6) Calculate the moment of a given force couple pair<br>7) Replace the calculated couple with an equivalent couple at a different location on a rigid body<br>8) Analyze the effects of couples on a rigid body |
| **Course Outcome 4** | **Learning Objectives for Course Outcome 4** |
| EQUILIBRIUM OF FORCES IN TWO DIMENSIONS | 1) Write the 3 equations that represent the three requirements that must be met for a body to be in a state of static equilibrium.<br>2) Explain what is meant by a free body diagram<br>3) List the assumptions or conventions that one must employ when drawing free body diagrams and replacing supports with equivalent supporting forces.<br>4) Construct a free body diagram for parts or the whole of given mechanisms or structures.<br>5) Differentiate between externally applied loads and internal reactions.<br>6) Apply the three conditions of equilibrium to free body diagrams and determine the reactions.<br>7) Describe what is meant by a two force member and explain the implications for a free body diagram involving such members.<br>8) Apply the principles of equilibrium to the solution of problems involving static systems of pulleys.<br>9) Describe what is meant by and solve problems involving ÃƒÂ¢Ã¢`Â¬ oplanar concurrent force systems.<br>10) Explain the difference between what is known as a concentrated<br>load and what is known as a distributed load.<br>11) Describe what is meant by and solve problems involving coplanar parallel force systems including both uniform and non-uniform beam loading.<br>12) Describe what is meant by and solve problems involving coplanar, non-concurrent force systems |
| **Course Outcome 5** | **Learning Objectives for Course Outcome 5** |
| STRUCTURES AND MEMBERS | 1) Recognize the difference between the forces of tension and compression in structural members such as struts and ties.<br>2) Differentiate between the structures known as trusses and those known as frames.<br>3) Identify members that carry no load in trusses and frames. Appreciate the importance of identifying such members in the solution of internal forces in structural members such as trusses and frames. |

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| | 4) Describe what is meant by a two-force member and list the implications that this type of member has on the solution of forces in members of trusses and frames.<br>5) Describe what is meant by and list the assumptions that apply to, what is known as a pin connection in a truss or a frame.<br>6) Using the method known as the Method of Joints, determine the loads in individual members of coplanar pin-connected trusses and frames being certain to identify whether the members are in tension or compression.<br>7) Using the method known as the Method of Sections determine the forces in selected members of a truss being certain to identify whether the members are in tension or compression. This will require the drawing of a free body diagram of a partial truss that is part of the entire truss.<br>8) Describe what is meant by a three-force member and identify clearly the difference between this type of member and the previously used two-force member.<br>9) Using the method known as the Method of Members determine<br>the forces in members of various mechanisms being certain to identify whether the members are in tension or compression. |
| **Course Outcome 6** | **Learning Objectives for Course Outcome 6** |
| EQUILIBRIUM OF FORCES IN THREE DIMENSIONS | 1) Explain what is meant by isometric sketching and use isometric sketching to aid in visualizing forces acting on mechanisms in three dimensions.<br>2) Construct isometric free body diagrams of the whole, or parts of, three dimensional mechanisms.<br>3) Apply the six basic equations of three dimensional equilibrium,<br>sum all forces to zero: Fx = 0, ?Fy = 0, ?Fz = 0, ?Mx = 0, ?My = 0, ?Mz = 0,<br>to the three-dimensional systems of:<br>(a) Parallel forces,<br>(b) Concurrent forces, &<br>(c) Nonconcurrent forces. |
| **Course Outcome 7** | **Learning Objectives for Course Outcome 7** |
| THE LAWS OF FRICTION | 1) Write the characteristics that pertain to the force known as the<br>friction force.<br>2) Sketch the graph of the friction force versus the applied force when a force is applied to a block, initially at rest, on a horizontal, flat surface. The applied force starts at zero and increases gradually up to the point where the block begins to slide. When sliding at a constant velocity, the applied force tends to decrease, and then remain constant.<br>3) Indicate clearly the two distinct regions of the graph drawn above, namely, the static region and the kinetic region.<br>4) Explain what is meant by the coefficient of friction.<br>5) Write the equation for the coefficient of static friction.<br>6) Write the equation for the coefficient of kinetic friction.<br>7) Explain what is meant by the angle of friction.<br>8) Write the equation for the angle of friction in terms of the |

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| | maximum force of static friction and the normal reaction force between the object and the surface upon which it rests.<br>9) Solve a variety of problems involving friction. These problems will include those that require the student to determine whether motion is impending or not. Also, solve those problems that require the student to determine whether tipping or sliding will occur. |

| **Course Outcome 8** | **Learning Objectives for Course Outcome 8** |
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| Centroids and Centers of Gravity in two and three dimensions | 1) Explain what is meant by the term centroid of a planar surface or rigid body<br>2) Explain what is meant by the term center of gravity of a planar surface or rigid body<br>3) Describe, using an example, a situation where the centroid and center of gravity coincide<br>4) Describe, using an example, a situation where the centroid and center of gravity do not coincide<br>5) Calculate the centroid & center of gravity of simple areas such as: squares, rectangles, triangles, circles, semicircles, and quarter circles<br>6) Calculate the centroid & center of gravity of composite areas by breaking the composite areas into simple areas using the moments about the x and y axes |

**Evaluation Process and Grading System:**

| Evaluation Type | Evaluation Weight | Course Outcome Assessed |
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| Quizzes | 40% | |
| Tests | 60% | |

**Date:** July 30, 2018

Please refer to the course outline addendum on the Learning Management System for further information.