PHYSICS 218

Week 1 Essentials of Calculus

a. Use the Delta Method to find derivatives of polynomials
b. Use the summation of areas to find integrals of polynomials
c. Utilize formulae for derivatives and integrals for simple functions
d. Be able to prove that differentiation and integration are mutual inverses

Week 2 Kinematics in One Dimension

a. Derive equations of motion for a given acceleration by integration
b. Find kinematic equations for constant acceleration
c. Apply the equations for one dimensional motion

Week 3 Vectors and Two Dimensional Motion

a. Find the resultant of a number of vectors
b. Express any vector in terms of components and unit vectors
c. Derive the two dimensional equations of motion for arbitrary time dependent acceleration
d. Apply kinematic equations in two dimensions, e.g. projectile motion

Week 4 Newton's Laws

a. To distinguish the forces acting on a system and identify their origins
b. To apply Newton's Second Law to obtain the third law
c. To become familiar with friction and elastic forces

Week 5 Applications of the Second Law

a. To isolate a body and draw a free body diagram
b. To apply Newton's Laws to simple systems
c. To solve for accelerations in more complicated systems including pulleys and strings

Week 6 Work and the Work Energy Theorem

a. To calculate the line integral for simple forces and paths
b. To derive the Work Energy Theorem for constant forces
c. To derive the Work Energy Theorem in general
d. To solve various problems, e.g. springs, using the Work Energy Theorem

Week 7 Potential Energy Functions

a. To calculate work for various forces for different paths
b. To determine whether or not a potential energy function exists for particular forces
c. Utilize a procedure for finding the potential energy function for conservative forces

Week 8 Conservation of Energy

a. To combine the Work Energy Theorem and the definition of U to obtain the law of Conservation of Energy
b. To determine whether this law is applicable in given situations
c. To solve Conservation of Energy problems
d. To determine system behavior given graphical representation of U

Week 9 Conservation of Momentum

a. Calculate the position, velocity and acceleration of the center of mass of a system of particles
b. Incorporate Newton's Third Law to relate external forces to center of mass motion
c. Determine whether Conservation of Momentum applies to a system
d. Solve general collision or explosion problems
e. Utilize Conservation of Momentum when only approximately valid

Week 10 Polar Coordinates

a. Derive the expressions for the components of the velocity and acceleration in polar coordinates
b. Identify angular velocity and acceleration
c. Derive kinematic relations for given, time dependent angular accelerations

Week 11 Circular Motion

a. To obtain Newton's Law in terms of polar components
b. Apply the law to circular motion with special emphasis on the correct free body diagram
c. To determine period and frequency for circular motion
d. To relate rotational motion to translation for non-slipping motion

Week 11 Torque and Angular Momentum

a. Calculate torque and angular momentum given forces and momentum
b. To relate torque and angular momentum
c. To ascertain whether angular momentum is conserved for a point particle and solve simple Conservation of Momentum problems

Week 12 Conservation of Angular Momentum

a. To determine the relationship between torque and angular momentum for a system of particles, i.e. and extended body.
b. To calculate the moment of inertia for a symmetric body
c. To calculate the angular momentum of a symmetric body about the symmetry axis
d. To apply Conservation of Angular Momentum for extended systems

e. Use the relationship between external torque and angular momentum for problems such as those with real pulleys

Week 13 Harmonic Motion

a. To obtain the differential equation for systems with linear restoring forces
b. To solve the equations and analyze the motion, including energy considerations
c. To obtain the differential equation when damping and forcing are present
d. To recognize the existence of resonances in such systems

Week 14 Frames of Reference

a. To derive the Galilean transformation equations for position, velocity and acceleration
b. To show the relationship between inertial and non-inertial frames and understand the invention of fictitious forces such as the centrifugal force
c. To be acquainted with the basic elements Einstein's corrections