Homework 2 Name: Estelle Eke Nov. 9, 2013

Learning Objectives for ENGR 110- Analytic Mechanics-Dynamics:

By the end of the course students should be able to:

1. Calculate velocities and accelerations of particles. (Level 3)
2. Use first principle methods to relate forces to the motion of particles in the plane. (Level 3)
3. Calculate the kinematic properties of rigid bodies. (Level 3)
4. Use first principle methods to relate forces and moments to the motion of a rigid body in planar motion. (Level 3)
5. Use energy methods to determine the motion of particles and rigid bodies in planar motion. (Level 3)

Mini Project: **2-D Projectile Motion (**Higher-order thinking skills than Level 3)

Objective: In this project you will use the equations for uniformly accelerated motion to help you better understand projectile motion of objects in 2-dimensions. Effects of changes in initial velocities and launching angles will be investigated. Two projectiles, A and B, are shot at the same instant from the same spot. Determine which projectile will hit the ground first.

Kinematic Equations: Using the kinematics equations discussed in lectures, the horizontal position, x(t), and vertical position, y(t), of the objects as functions of time are:

$$x(t) = v_0(\cos\theta)\, t\,, \quad y(t) = v_0(\sin\theta)\, t - \frac{1}{2}\, g\, t^2$$

where θ is the launch angle, v_0 is the initial velocity, t is time, and g is the acceleration due to gravity.

Procedure: Numerical Analysis using Matlab

1. Select the system of *units* that you wish to use (metric or US Customary);
2. Let $v_{A_0} = 560\frac{units}{sec}, \theta_A = 43deg$
3. Generate the expressions for x(t) and y(t); guess a value for time, t.
4. Use the Matlab command *subplot(3,1,p)* to create three areas on the same page arranged in three rows and one column. P is the position where you want the plot to appear.
5. Plot of y(t) versus x(t) for projectile A in the 1st area of the subplot. Hint : from the time chosen in step 3, you can estimate when the projectile hits the ground and adjust the time value accordingly.
6. Let $v_{B_0} = 680\frac{units}{sec}, \theta_A = 50deg$
7. Repeat steps 3 to 5. Note you will create the plot for projectile B in the 2nd area of the subplot.
8. Overlay the plots of both projectiles in the 3rd area of the subplot.
9. Create a table that lists only the results for start time, time at maximum height, and time to hit the ground.
10. Briefly comment on your observations regarding the effect of changing the initial velocities and launch angles.