# EML 5215

# Exam 1

# Spring 2015

# 25 February 2015

## What Allowed During Examination

You may use any books, your personal notes, or electronic aid, provided that you find the material on your own without having it provided to you by anyone else (either implicitly or explicitly). You may not, under any circumstances, communicate with anyone about this exam.
Any violations of the exam rules will result in further action on my part in a manner consistent with the academic honesty policy of the University of Florida. The academic honesty policy can be found at the Student Conduct and Conflict Resolution website:
https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/

## Guidelines for Solutions

Communication is an extremely important part of demonstrating that you understand the material. To this end, the following guidelines are in effect for all problems on the examination:

1. Your handwriting must be neat. I will not try to decipher sloppy handwriting and will assume that something is incorrect if I am unable to read your handwriting.

2. You must be crystal clear with every step of your solution. In other words, any step in a derivation or statement you write must be unambiguous (i.e., have one and only one meaning). If it is ambiguous as to what you mean in a step, then I will assume the step is incorrect.

In short, please write your solutions in an orderly fashion so that somebody else can make sense of what you are doing and saying. Finally, credit will be given only if a relevant concept is applied properly, and no credit will be given for an incorrectly applied concept even if the final answer is correct.

## University of Florida Honor Code

On your exam you must state and sign the University of Florida honor pledge as follows:

**On my honor, I have neither given nor received unauthorized aid in doing this examination.**

**Signature:** **Date:**

**University of Florida ID:**

**Total points: 100**

**Question 1: 25 points**

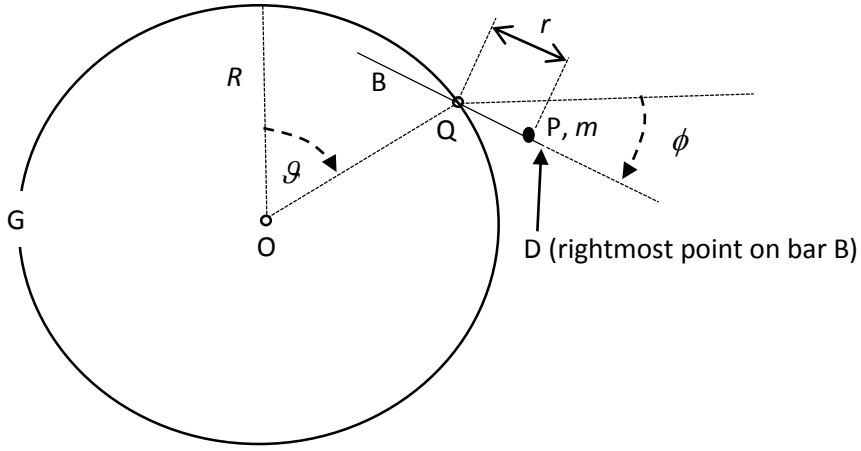
Derive the kinematics relationship between angular velocity and Euler angles sequence 121 for a rigid body (20 points).

Show, both geometrically and mathematically, what happens when the second rotation is 0 degrees (5 points).

**Question 2: 20 points**

The rigid slender bar (B) in figure below has its center constrained to move on a circular guide (G) of radius *R* which is fixed to the ground. B can also rotate about its center Q. A point mass P can slide along the bar, and its distance from the center of the bar is denoted with *r*.

Given viscous friction with coefficient *C* between B and P, provide an expression for the friction force acting on the point mass.



**Question 3: 30 points**

Starting from the system in question 2, assume G inertial, constant $\phi = 0$ degrees, $\vartheta = \vartheta(t)$ given, and find the equations of motion for the point mass.

**Question 4: 25 points**

The rigid wheel (W) of radius *r* in figure below rolls without slip on a flat rigid surface (G). On the other end of the wheel, a rigid bar (B) is constrained to remain parallel to the ground, and there is roll without slip between the wheel and the bar.

What are the velocity and acceleration of point P on the rightmost point of the bar, as seen by an observer fixed in G?