**Midterm Exam Date:27/5/2021 Time:1.25 hours**

**Instructor: Dr. E. Badran**

Q1) (10pt) Consider a frictionless puck on a horizontal turntable that rotates counterclockwise with a constant angular velocity Ω. Ignore the rotation of the Earth. In a coordinate system attached to the turntable with the origin on the rotation axis the puck has initial coordinate (*x0*,0) and initial velocity (*vx*, *vy*). Determine the subsequent motion of the puck on the turntable given by *x*(t), *y*(t). Hint: It is convenient to consider the variable *s* = *x*+i*y*

Q2) (10pt) A symmetric top with one point fixed in a uniform gravitational field and starts with initial conditions

θ = 60o, θ = 0, ψ = (3I – I3)(MgL/3I I23)1/2, ϕ = 2(MgL/3I)1/2

A. Find the conserved momenta pϕ and pψ

B. Find the effective potential Veff(θ). Use a sketch of Veff  to discuss the qualitative form of the solution θ(t).

Q3) (10pt) A particle is attracted to a force center by a force which varies inversely

**as** the cube of its distance from the center.

1. Derive the equations of motion
2. Find the constants of motion.
3. Solve for the orbits. Discuss how the nature of the orbits depends

on the parameters of the system. Note the orbit equation :