BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCES, Pilani
Hyderabad Campus
FIRST SEMESTER 2008-2009

TEST – II (Open BOOK)

Course No: PHY C131 **Total Marks: 60**
Course Title: PHYSICS-I **Weightage: 20%**
Date: 17th Dec. 2008 **Max. Time: 50 mins.**

- Write down your **tutorial section number** in the space marked for Sec. No. in the answer book, else write name of tut instructor and hour and day of the class
- Answer all parts of one question together. **Questions are printed on both sides**
- **All the steps in a problem should be carried out and wherever necessary proper explanations should be given.**

1. A Diwali 'chakra' is in the form of a hollow cylinder of radius R and moment of inertia I_o. It is filled with fuel of mass m_o. When the fuse is lit, the fuel is burnt and exhausted at a constant rate b. Assume that the fuel uniformly fills the entire cylinder at all times and that the cylinder is made of non-inflammable material. The cylinder is pivoted about an axis which passes through its centre and is perpendicular to its plane, so that it is free to rotate about its centre, but the center of mass does not translate. The gases are ejected with a constant velocity u relative to the circumference of the disc. Assume that there is no external torque on the system.

a) Derive the analog of the rocket equation for this case.
b) Determine the final angular velocity of the chakra once all the fuel is exhausted.

(15+5)

2. A pendulum is in the form of a thin rod of length *l* pivoted about one end. T_a is its actual period, while T_s is the period calculated on the assumption that it is a simple pendulum of length *l.* What is the fractional error in the time period if it is assumed that it is a simple pendulum of length *l?*

(10)

Two astronauts become isolated in outer space (there is no force there except the gravitational force between them).They are attached to one another by a rope 20m long. The lighter one weighing 40kgs is orbiting their center of mass with angular velocity $\omega = 0.5$ rad/sec.

a) Find the angular velocity of the other astronaut who weighs 160kgs.
(10)

b) Now the astronauts manage to pull each other closer so that the length of the rope between them gets shortened to 15m and they both have the same angular velocity. Find their new center of mass.
(5)

3) Sketch (neatly) the contour lines for the constant energy surface corresponding to the force $F=A-2xyi+x2y2j$. Show explicitly that the change in potential energy along the contour lines you have obtained is zero.
(10+5)