Ahmedabad University

School of Arts and Sciences

PHY 111 Classical Mechanics

BS (Physics)

End-Sem Examination 2022 (Bi-Semester)

Total Marks = 40 **Time – 2 hours**

Enrolment Number:.....

Date: 11-03-2022

No. of printed pages: 02

Answer Any Eight (08) Questions

All Questions Carry Equal Marks

1) A spacecraft that landed on moon, travelled there at speed relative to earth of 1.08×10^4 mt/ sec. To an observer on earth, how much longer his own day than a day on the spacecraft?

2) A spacecraft antenna is at an angle 10 degree relative to the axis of the spacecraft. If the spacecraft moves away from earth with a speed 0.70c, what will be angle of the antenna as seen from earth? (c=speed of light)

3) Assume the earth is rotating about its axis with an angular speed ω. A straight river flows with a velocity v in a direction α degrees east of north. Show that the effect of Coriolis force will be to erode the right bank. Calculate the magnitude of the Coriolis force. (Ignore Centrifugal Force).

4) A relativistic particle has a kinetic energy which is 20 times its rest energy. Find the speed of the particle in terms of c(speed of light).

5) What will be the hour of a day on earth (we know it is 24 hrs in usual scenario), if a person of mass $80kg$ standing at the equator "flies away" due to the rotation of earth around its axis?
(Given: Earth Radius: 6400 km, Mass of Earth: $6 \times 10^{24} kg$, $G = 6.67 \times 10^{-11} Nm^2 Kg^{-2}$)

6) If l_0^3 is volume of a cube at rest, then what is volume viewed from a reference frame that is moving with uniform velocity v in a direction parallel to one of the edges of the cube.

7) A circular disc of mass M and radius R is rolling (around the axis through its centre) without slipping over an inclined plane which makes an angle θ with the horizontal ground. If it is released from rest from a height h, how along will it take to reach the ground?

8) Using Lorentz Transformations, show that if two events at different space positions are simultaneous in time in a reference frame S, they are not in general simultaneous in a different reference frame moving with a uniform velocity w.r.t to the frame S.

9) Calculate the Moment of Inertia for a rectangular plate with mass M and length L and width d, with respect to an axis at one end of the plate and perpendicular to the length of the plate. Assume uniform density for the plate.

10) A relativistic particle of rest mass m and speed v collides and stick to a stationary particle of rest mass M. What is final speed of the composite particle?

11) Calculate the Moment of Inertia of a hollow sphere of thickness d with respect to an axis going through its centre. The sphere has uniform density and its mass and radius is M and R.

12) To loosen the lid on a jar of pickles whose diameter is $10cm$, a torque of $9Nm$ must be applied to the circumference of the jar. If a jar wrench whose handle is $10cm$ long from the surface of the jar, is attached to the lid, what is the minimum force required to open the lid?