THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2016

(CUCBCSS-UG)

Physics- Core Course

CC15UPH3 B05- MECHANICS

(2015 Admission)

Time: Three Hours   Maximum: 80 Marks

Section A

(Answer *all* questions. Each carries *one* mark)

1. What is Coriolis force?

2. State work-energy theorem.

3. Write the relation between angular momentum and torque.

4. Distinguish between elastic and inelastic collision.

5. What is central force? Give an example.

6. What is escape velocity? What is its value for earth?

7. What are holonomic and non-holonomic constraints?

8. Show that particles with zero rest mass travels with speed of light.

9. State the postulates of special theory of relativity.

10. Define a four vector with an example.   **(10×1= 10 Marks)**

Section B

(Answer *all* questions. Each carries *two* marks)

11. Explain inertial and non -inertial frames of reference with example.

12. Express the force as the negative gradient of potential.

13. Obtain an expression for the centre of mass of a uniform thin rod having length L.

14. Derive an expression for the orbital velocity of a satellite.

15. Derive the D'Alemberts principle.

16. Write a note on Minkowski four dimensional space.

17. Explain principle of covariance.   **(7×2= 14 Marks)**

Section C

(Answer *any five* questions. Each carries *four* marks)

18. Deduce the law of conservation of linear momentum with the help of Galilean invariance and conservation of energy.

19. What is potential energy curve? Explain potential well.

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20. Derive the relation for the distance of closest approach in the case of scattering of a proton by a heavy nucleus.
21. Derive expressions for the time period and height of geostationary satellite.
22. Explain the symmetry properties of space and conservation of linear momentum.
23. Using Langrange's equation, derive Newton's second law.
24. Explain the consequences of Lorentz transformations.

(5×4= 20 Marks)

Section D
(Answer *any four* questions.Each carries*four* marks)

25. Calculate the effective weight of an astronaut ordinarily weighing 60kg when his rocket moves vertically upward with 5g acceleration.
26. Show that gravitational force between two masses (m and M) is conservative.
27. A gas molecule having a speed of 300m/s collides elastically with another molecule of the same mass which is initially at rest. After the collision the first molecule moves at an angle of 30° to its initial direction. Find the speed of each molecule after collision and the angle made with the incident direction by the recoiling target molecule.
28. If earth has mass nine times and radius twice that of the planet mars. Calculate the velocity required by a rocket to pull out of the gravitational force of mars. Escape velocity on the surface of the earth is 11.2km/s.
29. Setup Langragian of a simple pendulum and obtain the equation of motion.
30. The average lifetime of a muon at rest is $2.21×10^{-6}$s. The muons are found to travel with velocities 0.99c. What will be the average distance which they will be observed to traverse before decaying?
31. How fast would a rocket ship have to go relative to an observer for its length to be contracted to 40% of its length when at rest?

(4×4=16 Marks)

Section E
(Answer *any two* questions.Each carries*ten* marks)

32. Explain the principle of a rocket. Derive an expression for the velocity of rocket at any instant.
33. Deduce Kepler's laws using Newton's law of gravitation.
34. Derive Langrange's equation of motion from D'Alemberts equation.
35. Explain Michelson- Morley experiment. Discuss the importance of negative results of this experiment.

(2×10 = 20 Marks)

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