

19U316S

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Name:

Reg. No.....

THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CUCBCSS-UG)

CC15U PH3 B05 - MECHANICS

(Physics- Core Course)

(2015 to 2018 Admissions – Supplementary/Improvement)

Time: Three Hours

Maximum: 80 Marks

Section A

Answer *all* questions. Each question carries 1 mark.

1. State work-energy theorem.
2. Write down the relationship between torque and angular momentum.
3. What are holonomic and non-holonomic constraints?
4. Define a four vector with one example.
5. Why frictional force is non-conservative?
6. What is central force? Give an example.
7. Check whether acceleration is Galilean invariant or not.
8. Show that a particle with zero rest mass travels with speed of light.
9. What are cyclic coordinates?
10. What are inertial frames of reference?

(10 x 1 = 10 Marks)

Section B

Answer *all* questions. Each question carries 2 marks.

11. Explain inertial and non –inertial frames of reference with example.
12. Discuss the effects of Coriolis force as a result of earth's rotation.
13. A gamma ray photon cannot create an electron - positron pair in vacuum. Explain.
14. What is zero momentum frame? How does it differ from laboratory frame?
15. What is D' Alembert's principle?
16. What is Time dilation and Twin paradox?
17. Prove that the path of the particle in the influence of Central force lies in a plane.

(7 x 2 = 14 Marks)

Section C

Answer any *five* questions. Each question carries 4 marks.

18. Describe Foucault's pendulum. Explain why a Foucault pendulum situated at the equator would not detect rotation of earth about axis?
19. What is Potential energy curve of a particle? Discuss stable and unstable equilibrium in a Potential energy curve
20. State the postulates of Special theory of relativity and deduce Lorentz transformations from them.

21. Explain conservation laws and symmetry properties.
22. Using Lagrange's equation, derive Newton's second law.
23. What is Orbital velocity of a Satellite? Derive an expression for time period of a Satellite.
24. Discuss the shape of galaxy on the basis of conservation of Angular momentum.

(5 x 4 = 20 Marks)

Section D

Answer any *four* questions. Each question carries 4 marks.

25. Calculate the fictitious force and the observed force on a body of mass 5kg in a frame of reference moving vertically upwards with an acceleration of 4 m/s^2 .
26. The position of a moving particle at any instant is given by $\mathbf{r} = A \cos \theta \hat{i} + A \sin \theta \hat{j}$. Show that the force acting on it is a conservative one.
27. A 500 gm stone is revolved at the end of a 40 cm long string at the rate of 2 revolutions /second, what is its angular momentum? If after 30 seconds, it makes only $\frac{1}{2}$ revolutions /second, calculate the mean torque applied.
28. Estimate the potential energy of a mass of 1kg at a distance of 10^6 km from the centre of earth, assuming that the potential energy is zero at infinity. Given the radius of earth = $6.4 \times 10^6 \text{ m}$, Mass of earth = $6 \times 10^{24} \text{ kg}$.
29. Obtain the Lagrange's equation for a one dimensional harmonic oscillator.
30. A rod of 1 meter long is moving along its length with a velocity **0.6c**. Calculate its length as it appears to an observer on the earth.
31. A space ship is moving away from the earth with a velocity **0.5c** fires a rocket whose velocity relative to the space is **0.5c** away from earth. Calculate the velocity of the rocket as observed from earth.

(4 x 4 = 16 Marks)

Section E

Answer any *two* questions. Each question carries 10 marks.

32. Explain Michelson-Morley experiment. Discuss the importance of negative results of this experiment.
33. State Kepler's Laws of Planetary motion and show, how they can be deduced from Newton's Law of gravitation.
34. Explain Hamilton's principle and hence deduce Lagrange's equations of motion.
35. What is relativistic energy? Prove the relation $E^2 - \mathbf{P}^2 C^2 = m_0^2 C^4$. Derive an expression for velocity of particle in terms of relativistic momentum and energy.

(2 x 10 = 20 Marks)
