Q.P. Code – 42148

First Semester B.Sc. Degree Examination, October/November 2019

(Revised CBCS – 2018 Onwards)

Physics

Paper 101 — MECHANICS AND SPECIAL THEORY OF RELATIVITY

Time : 3 Hours] *[Max. Marks : 90*

Instructions to Candidates : Answers should be written in English only.

PART – A

Answer any **FIVE** of the following questions. Each question carries 8 marks : **(5 × 8 = 40)**

1. (a) Define inertial and non inertial frames of reference.

   (b) Show that Newton's Second Law is not valid in a frame of reference which is moving with an uniform acceleration with respect to a fixed frame. **(2 + 6)**

2. (a) State and explain work-energy theorem.

   (b) Deduce an expression for velocity and acceleration of rocket propulsion of any instant of time. **(2 + 6)**

3. (a) State and prove theorem of parallel axis for moment of inertia.

   (b) Obtain an expression for moment of inertia of a circular disc about an axis passing through its centre and perpendicular to its plane. **(4 + 4)**

4. (a) State and prove Kepler's Second law of planetary motion.

   (b) Derive an expression for orbital velocity of a satellite. **(4 + 4)**

5. (a) Define SHM of a particle.

   (b) Obtain an expression for the instantaneous kinetic and potential energies for a particle executing SHM and hence show that their sum is a constant. **(1 + 7)**

6. (a) Define Poisson's ratio.

   (b) Define the term bending moment and obtain an expression for bending moment. **(1 + 7)**

7. Describe the Michelson-Morley experiment with a neat diagram and necessary theory and discuss its negative result. **(8)**

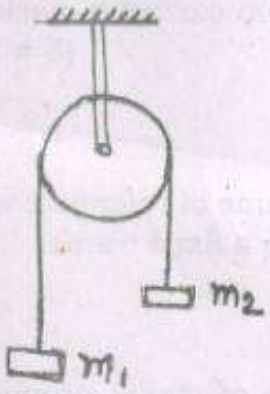
8. (a) Define proper length and proper time.

   (b) Obtain an expression for variation of mass with velocity in special theory of relativity. **(2 + 6)**

PART – B

Answer any **SIX** from the following questions. Each question carries 5 marks : **(6 × 5 = 30)**

9. Two bodies of mass m_1 = 5 kg and m_2 = 3 kg are connected by light inextensible string passing over a light smooth pulley. Find the acceleration of the system and tension in the string. ($g = 10 ms^{-2}$)



10. A hunter fires a bullet of 10 g with a velocity of 500 ms^{-1} from a gun of mass 5 kg. Calculate the final momentum and kinetic energy of bullet and rifle.

11. A grinder is in the form of a circular disc of mass 10 kg and diameter 0.4 m, calculate the constant torque that has to be applied, so that the disc acquires an angular velocity of 4 revolutions/second in 5 seconds. Calculate the rate at which work is done by the torque at the end of 5 seconds.

12. A body weighs 270 kg on the surface of the earth. How much it will weighs on the surface of mars, whose mass is $\frac{1}{9}$ times and radius $\frac{1}{2}$ times that of the earth.

13. A hydrogen atom of mass 1.67×10^{-27} kg is vibrating with a frequency 10^{14} Hz. Amplitude of vibration is 10^{-9} m, calculate

   (a) force constant

   (b) maximum velocity and

   (c) average energy of hydrogen atom.

14. A load of 2 kg wt produces an extension of 0.12 mm in a wire of length 3 m and 1 mm in diameter. Calculate the Young's modulus of the wire ($g = 9.8 ms^{-2}$)

15. The mean life of the μ-mesons at rest is found to be about $2.2 \times 10_{s}^{-6}$. The mean life time of μ-mesons in a burst of cosmic rays is found to be $1.5 \times 10_{s}^{-5}$. What is the speed f these cosmic ray μ-mesons.

16. An electron of rest mass 9.1×10^{-31} kg is moving with a speed of 0.9 C. What is its kinetic energy?

PART – C

Answer any **TEN** of the following. Each question carries 2 marks : **(10 × 2 = 20)**

17. (a) Why does a cricketer moves his hands backwards while holding a catch?

(b) Write any two basic forces in nature.

(c) Can kinetic energy of a body be negative? Justify.

(d) Write two examples of conservative force.

(e) Why are spokes fitted in the cycle wheel?

(f) Does the gravitational interaction depends upon intervening medium? Justify.

(g) Expand GPS. What is source of power for GPS satellite?

(h) Why is spring made of steel and not of copper?

(i) What happens to the time period of a SHM when its amplitude is doubled?

(j) What are the postulates of special theory of relativity?

(k) A moving clock runs slower than stationary one. Explain.

(l) Can a body be accelerated to the velocity of light? Justify.
