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B.Sc. (Non-Medical) (Semester – 1st)

MECHANICS

Subject Code: BSNMS1102

Paper ID: [22131402]

Time: 03 Hours

Maximum Marks: 60

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A

(2 marks each)

Q1. Attempt the following:

- a. What do vectors and scalars have in common? How do they differ?
- b. If three vectors sum up to zero, what geometric condition do they satisfy?
- c. What is the orbital period of rotation of an artificial satellite in a geostationary orbit?
- d. Moon has no atmosphere on its surface. Why?
- e. For a mechanical spring mass system how does spring constant affect the logarithmic decrement?
- f. Differentiate between Young's modulus and modulus of rigidity.
- g. Write down the postulates of special theory of relativity.
- h. Define the Quality factor of a damped oscillator. What is its physical significance?
- i. Write the Lorentz transformations equations for a particle moving with velocity 'v' along y- direction.
- j. Write the formula for escape velocity of a particle on a planet of mass 'M' and radius 'R'. What is the value of escape velocity on earth?

Section – B

(5 marks each)

- Q2. A body executing S.H.M. describes 180 oscillations per minute and has a maximum velocity of 6 m/s. Determine its amplitude and velocity when it is half way between its mean and extreme positions.
- Q3. Show that the reduced mass of a two-body system is less than the mass of any of the two bodies.
- Q4. A particle of mass 'm' is moving under the action of central force with potential $V(r) = kr^3$. Calculate the time period of circular motion of the mass.
- Q5. A bullet is fired with velocity $c/3$ from a spaceship moving with velocity $c/2$ in stationary frame of reference. Determine the velocity of the bullet in stationary frame of reference. ('c' is the speed of light in vacuum).
- Q6. A particle of mass 'm' is thrown upwards from the surface of a planet. Mass and radius of the planet are 'M' and 'R', respectively. If the velocity of the fired mass is $\sqrt{(GM/2R)}$, find the maximum height which the particle attains.

Section – C

(10 marks each)

- Q7. State Kepler's laws of planetary motion and deduce the first law for inverse square law force $f(r) = -K/r^2$.
- Q8. Show that the time slows down for a moving frame of reference with respect to the stationary one. Give an experimental verification of time dilation.
- Q9. Establish the differential equation for damped oscillator and find its solution. Using this solution, explain various types of damping with suitable schematic diagrams.