Reg. No. : ....

Name : ....

K21U 1843

III Semester B.Sc. Degree CBCSS (OBE) Reg./Sup./Imp. Examination, November 2021
(2019 – 2020 Admission)
CORE COURSE IN PHYSICS
3B03PHY : Mechanics – II

Time : 3 Hours

Max. Marks : 40

PART – A

(Short answer questions, answer **all** questions, **each** question carries **1** mark.)

1. Write down the formula for obtaining velocity of sound using Newton's formula. What was Laplace correction ?
2. What is meant by quality factor (Q) of a damped harmonic oscillator ? Write an expression for Q factor.
3. State Kepler's Laws.
4. With what velocity should an electron move so that its mass doubles ?
5. A frame of reference O′ is moving with a velocity v relative to another frame O along x axis. Write down the coordinate and velocity transformation equations in the Galilean form.
6. Write down the formula for relativistic addition of velocities. Explain the terms involved.

(6×1=6)

PART – B

Short essay questions, answer **any 6** questions, **each** question carries **2** marks.

7. Show that energy dissipation in a damped oscillator is exponentially in time.
8. What is meant by fictitious forces ? What are the effects of Coriolis force due to earth rotation ?
9. Briefly explain the general properties of central force motion.
10. Obtain an expression for the energy density of a plane progressive wave.

11. What is meant by a forced harmonic oscillator ? Obtain the differential equation for a forced harmonic oscillator. Write down the general solution of the forced harmonic oscillator.

12. Show that two events that are simultaneous in one reference frame are not simultaneous in another reference frame moving with first.

13. Show that the average kinetic energy of a harmonic oscillator is equal to the average potential energy and it is half of the total energy.

14. Obtain an expression for the relativistic momentum of a particle whose mass is m and moving with a velocity v. **(6×2=12)**

PART – C

(Problems, answer **any 4** questions, **each** question carries **3** marks).

15. A paper weight suspended from a hefty rubber band had a period of 1.2 s and the amplitude of oscillations decreased by a factor of 2 after three periods. What is the quality factor of the system ?

16. A satellite of mass m = 2,000 kg is moving in an elliptical orbit about earth. At perigee (closest approach to the earth) it has an altitude of 1,100 km and at apogee (farthest distance from the earth) its altitude is 4,100 km. What are the satellite's energy and angular momentum ?

17. A simple pendulum has a period of 1 sec and amplitude of 10°. After 10 complete oscillations its amplitude is reduced to 5°. What is the damping constant, relaxation time of the pendulum and quality factor ?

18. One of the strongest emission lines observed from distant galaxies comes from hydrogen has a wavelength of 122 nm (in the ultraviolet region).

   a) How fast must a galaxy be moving away from us in order for that line to be observed in the visible region at 366 nm ?

   b) What would be the wavelength of the line if that galaxy were moving toward us at the same speed ?

19. The period of a pendulum is measured to be 3.0 s in a rest frame of the pendulum. What is the period of the pendulum when measured by an observer moving at a speed of 0.95 c with respect to the pendulum ?

20. Write down the actual and effective potential energies for a comet (or planet) moving in the gravitational field of the sun. Sketch the different potential energies involved and use the graph of $U_{eff}(r)$ to describe the motion of r. **(4×3=1**

PART – D

(Long essay questions, answer **any 2** questions, **each** question carries **5** marks).

21. Explain inertial frames of references. A frame of reference R rotates about its origin fixed in an inertial frame of reference I. Find how the velocities and acceleration in the two reference frames are related to each other. Explain the pseudo forces acting.

22. Derive an equation for the orbit of a particle moving under the influence of an inverse square central force field.

23. State Fourier theorem. What are the conditions applicable for Fourier theorem ? Find the Fourier series for the following function

$$y = \begin{Bmatrix} 0 \text{ for } 0 < t < \frac{T}{2} \\ h \text{ for } \frac{T}{2} < t < T \end{Bmatrix}.$$

24. Briefly explain Einstein's postulates on special theory of relativity and its consequences. Explain :

    i) time dilation and its experimental verification.

    ii) relativistic doppler effect and its experimental verification. **(2×5=10)**