D 12040 (Pages : 3) Name.....

Reg. No.....

THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2021

Physics/Applied Physics

PHY 3C 03—MECHANICS, RELATIVITY, WAVES AND OSCILLATIONS

(2019—2020 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in question paper have their usual meanings.

Section A (Short Answer Type)

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. What do you mean by centrifugal force ? What is its direction ? Give an expression for the centrifugal force.
2. What do you mean by a conservative force ? Is the central force conservative ?
3. What was the purpose of Michelson-Morley experiment ? Why we say that the result of Michelson-Morley experiment was negative ?
4. What do you mean by twin paradox ?
5. Write down the principle of equivalence of mass and energy. Give an experiment to illustrate the principle.
6. Write down the relativistic expression connecting energy and momentum. What are the terms involved ?
7. What do you mean by simple harmonic motion? Give the differential equation for a simple harmonic oscillator.
8. Give an expression for the time period of a loaded spring system. What are the terms involved in the expression ?
9. Give an example of an anharmonic oscillator. What is the effect of increasing the amplitude on the time period of an anharmonic oscillator ?

Turn over

10. What is ultraviolet catastrophe ?

11. Write down the general eigen value equation. Give the momentum operator in three dimensions.

12. Write down the time independent Schrödinger equation. What are stationary states ?

(8 × 3 = 24 marks)

Section B (Paragraph/Problem Type)

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. Obtain Galilean transformation equations. Show that the distance between two points is invariant under a Galilean transformation.

14. Determine the fictitious force and the total force acting on a freely falling body of mass 20 kg with reference to a frame moving with a downward acceleration of $6 m/sec^2$.

15. Three interacting particles of masses 100, 200 and 400 grams, each having a velocity of 20 m/s magnitude move along the positive X, Y, Z axes, having unit vectors $\hat{i}, \hat{j}, \hat{k}$, respectively. Estimate the velocity of the first particle, if due to the force of attraction, the third particle stops and the velocity of the second particle becomes $\left(10\,\hat{j} + 5\,\hat{k}\right)$.

16. In a laboratory, the life-time of a particle moving with speed 2.8×10^8 m/sec is observed to be 2.5×10^{-7} sec. Determine the proper life-time of the particle.

17. A plane progressive wave is given by $y = 0.3 \sin (40t - 3x)$ m. Determine the wavelength of the wave and the phase difference between two points at $x = 2$ m and $x = 7.232$ m.

18. The photoelectric threshold for a material is 3000 A°. Determine the kinetic energy of an electron emitted from it by a radiation of wavelength 1000 A°

19. An electron moves in the x direction with a speed of 3.6×10^6 m/s. Suppose that we can measure its speed to a precision of 1 %. With what precision can we simultaneously measure its position ?

(5 × 5 = 25 marks)

Section C (Essay Type)

Answer any **one** *question.*
The question carries 11 *marks.*

20. Discuss the conservation theorem for angular momentum. Illustrate the origin for the shape of a galaxy using the angular momentum conservation theorem.

21. What do you mean by a simple pendulum. Obtain an expression for the time period of a simple pendulum.

(1 × 11 = 11 marks)