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(Pages : 2)

Name.....

Reg. No.....

**THIRD SEMESTER (CBCSS—U.G.) DEGREE EXAMINATION
NOVEMBER 2025**

Physics/Applied Physics

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

(2020-2023 Admissions)

Time : Two Hours

Maximum : 60 Marks

*The symbols used in this question paper have their usual meanings.***Section A (Short Answer Type)***Answer **all** questions in two **or** three sentences, each correct answer carries a maximum of 2 marks.*

1. Explain Galilean invariance.
2. What is energy function ?
3. Define P.E. curve.
4. Explain length contraction.
5. Define non-conservative force.
6. Give two examples for law of conservation of angular momentum.
7. Write down the momentum energy relation.
8. Explain anharmonic oscillations.
9. Write down the general equation of wave motion.
10. Define a black body.
11. What is photoelectric effect ?
12. What are the factors on which Photo electric current depends ?

(Ceiling - 20)

Turn over

Section B (Paragraph / Problem Type)

Answer **all** questions in a paragraph of about **half a page to one page**, each correct answer carries a maximum of 5 marks.

13. A body of mass 2 kg. is attached to a horizontal spring of $k = 8 \text{ N/m}$ and a constant force 6 N is applied along the length. Find speed when displaced through 0.5 m.
14. Show that the force is conservative $\mathbf{F} = yz \mathbf{i} + zx \mathbf{j} + xy \mathbf{k}$.
15. A particle experiences a force associated with the P.E. $U = 3x^2 - x^3$. Find the position of stable and unstable equilibrium.
16. Define centre of mass and explain with equation.
17. If the centre of mass of three particles of masses 10, 20, 30 gm. at the point (1, 1, 1) m, then where should a fourth particle be place so that the combined centre of mass be at (0, 0, 0) ?
18. Explain the principle and theory of satellite motion.
19. Calculate the radiated energy per unit volume of a plane wave of frequency 256 Hz and amplitude 1/1000 nm. velocity of sound = 332 m/s.

(Ceiling - 30)

Section C (Essay Type)

Essays - Answer in about **two pages**, any **one** question.

Answer question carries 10 marks.

20. With figure explain the theory and working of Michelson Morley experiment.
21. Define Plane progressive harmonic wave. Derive the equation for the energy density of a plane progressive wave Derive to get $2\pi^2 n^2 a^2 \rho$.

(1 × 10 = 10 marks)

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Name.....

Reg. No.....

THIRD SEMESTER (CBCSS-UG) DEGREE EXAMINATION, NOVEMBER 2024

Physics/Applied Physics

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

(2019—2023 Admissions)

Time : Two Hours

Maximum Marks : 60

The symbols used in this question paper have their usual meanings

Section A (Short Answer Type)*Answer all questions in two or three sentences.**Each question carries 2 marks.**(Ceiling 20 marks)*

1. What is Twin Paradox ?
2. Write a note on Coriolis force.
3. What is meant by time dilation ?
4. Explain potential energy curve.
5. Define non-conservative force.
6. Give one application of Newton's third law.
7. Write down the mass energy relation and explain.
8. Define simple harmonic motion.
9. What is a damped harmonic oscillator ?
10. What is photoelectric effect ?
11. Define a black body.
12. Explain the term threshold potential.

Section B (Paragraph/Problem Type)*Answer all questions in a paragraph of about half a page to one page.**Each question carries 5 marks.**(Ceiling 30 marks)*

13. What is a conservative force ? Show that a central force is always conserved.
14. Show that the force is conservative :

$$\mathbf{F} = (2xy + yz^2)\mathbf{i} + (x^2 + xz^2)\mathbf{j} + 2xyz\mathbf{k}.$$

Turn over

15. Explain the principle of rocket propulsion.
16. With figure, explain the scattering of α particle by a heavy nucleus.
17. Write and explain Lorentz transformation equations.
18. Write a note on UV catastrophe.
19. Define and explain uncertainty principle.

Section C (Essay Type)

*Answer any **one** questions in about **two** pages.
The question carries 10 marks.*

20. Define (a) P.E. curve ; (b) Potential well and different equilibrium conditions ; (c) Define neutral equilibrium.
21. Explain the three cases of Damped harmonic oscillator under damped, over damped, critically damped.

(1 × 10 = 10 marks)

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Name.....

Reg. No.....

**THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2023**

Physics/Applied Physics

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

(2019—2022 Admissions)

Time : Two Hours

Maximum : 60 Marks

*The symbols used in this question paper have their usual meanings.***Section A (Short Answer Type)***Answer **all** questions in two **or** three sentences.**Each correct answer carries a maximum of 2 marks.*

1. Give the significance of mass energy relation.
2. Define with example, fictitious forces.
3. What is a conservative force ?
4. Explain length contraction.
5. What is the purpose of two stages in a rocket ?
6. Give one application of Newton's third law.
7. What is the relation connecting length and period of oscillation of a simple pendulum.
8. Give three examples for periodic motion.
9. Define a black body.
10. What are matter waves ?
11. What are the factors on which Photo electric current depends ?
12. Explain the term threshold potential.

(Ceiling - 20)

Turn over

Section B (Paragraph / Problem Type)

Answer all questions in a paragraph of about half a page to one page.

Each correct answer carries a maximum of 5 marks.

13. What is a conservative force ? Show that a central force is always conserved.
14. Show that a conservative force is represented by the relation $F = -\text{grad } U$, and curl of it is zero.
15. Find the momentum of an electron which is accelerated by a potential difference 20 volt.
16. Explain the principle of rocket propulsion.
17. With figure explain the scattering of a particle by a heavy nucleus.
18. Write the equation and explain the variation of mass with velocity.
19. Explain the terms Eigen values and Eigen vectors.

(Ceiling - 30)

Section C (Essay Type)

Answer any one in about two pages.

Answer carries 10 marks.

20. Define Damped harmonic oscillator. Derive the general equation.
21. Write law of conservation of angular momentum. Illustrate with :
 - a) Satellite motion ;
 - b) Scattering of α particle by a heavy nucleus ; and
 - c) Shape of galaxy.

(1 × 10 = 10 marks)

D 31829

(Pages : 2)

Name.....

Reg. No.....

**THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2022**

Physics/Applied Physics

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

(2019 Admission onwards)

Time : Two Hours

Maximum : 60 Marks

*The symbols used in question paper have their usual meanings.***Section A (Short Answer Type)**

*Answer **all** questions in two **or** three sentences,
each correct answer carries a maximum of 2 marks.*

1. Distinguish between inertial and non-inertial frames of references.
2. Show that the path of a particle moving in the influence of a central force lies in a plane.
3. What do you mean by a non-conservative force ? Give two examples.
4. State the postulates of the special theory of relativity.
5. Plot the potential energy versus displacement curve of a simple harmonic oscillator.
6. What do you mean by a simple pendulum ?
7. Write down the differential equation for a damped harmonic oscillator. What are the terms involved in the equation ?
8. What do you mean by the term Q-factor of an oscillator ? What is the Q-factor of an undamped oscillator ?
9. Distinguish between a progressive and a stationary wave.
10. Draw the spectrum of a blackbody.
11. Write down expressions for energy and momentum operators in three dimensions.
12. Write down the time dependent Schroedinger equation. What are the terms involved ?

(Ceiling 20)

Turn over

Section B (Paragraph/Problem Type)

Answer all questions in a paragraph of about half a page to one page, each correct answer carries a maximum of 5 marks.

13. What is Coriolis force ? Give an expression for the same. Under what conditions does it come into play ? What is its direction ?
14. Calculate the fictitious and the total force on a body of mass 2.5 kg relative to a frame moving vertically upwards on earth with an acceleration 10 m/sec^2 .
15. A mass m is revolving in a vertical circle at the end of a string of length r metre. Calculate the difference in kinetic energies at the bottom and top of the circle.
16. A planewave of frequency 256 Hz and amplitude 10^{-3} is produced in air. Calculate the energy density and energy flux of the wave if the density of air is 1.29 kg/m^3 and the velocity of sound in air is 332 m/s.
17. How fast a spaceship be moved for its length to be contracted to 90 % of its length at rest ?
18. Light of wavelengths 3125 \AA and 3650 \AA causes the emission of electrons having kinetic energies 2.128 eV and 1.595 eV respectively from sodium. Determine the value of Planck's constant from this data.
19. An electron is accelerated through a potential difference of 100 V. Determine the wavelength of the de Broglie wave associated with it.

(Ceiling 30)

Section C (Essay Type)

Essays-Answer in about two pages, any one question.

Answer carries 10 marks

20. Explain the law of conservation of linear momentum. What do you mean by centre of mass frame of reference ? Obtain an expression for the centre of mass of a thin uniform rod.
21. Using a suitable figure, outline the Michelson-Morley experiment.

(1 × 10 = 10 marks)

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(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 6m/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 $(10 \hat{j} + 5 \hat{k})$.
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 \AA . Determine the kinetic energy of an electron emitted from it by a radiation of wavelength 1000 \AA .
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.

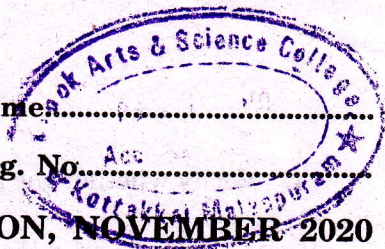
(1 × 11 = 11 marks)

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(Pages : 2)

Name.....

Reg. No.



THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION, NOVEMBER 2020

Physics/Applied Physics

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

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 an inertial frame of reference ? Are all frames moving with constant velocity w.r.t. an inertial frame inertial ?
2. Write down the Galilean law of addition of velocities. Prove that the acceleration of a particle relative to two inertial frames are identical.
3. Discuss the Coriolis force effects caused by the rotation of earth.
4. Draw a potential energy versus distance curve to indicate stable and unstable equilibria.
5. Write down the relation between torque and angular momentum. What is the unit of torque ?
6. Write down the postulates of the special theory of relativity.
7. What is twin paradox ?
8. What do you mean by a simple pendulum ? Give an expression for its time period.
9. What do you mean the energy density of a wave ? Does it depend on time ?
10. What is Photoelectric effect ? Write down Einstein's photoelectric equation.
11. What is de Broglie hypothesis ? Give an expression for the de Broglie wavelength.
12. Give expressions for energy and momentum operators.

(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. What are Coriolis and centrifugal forces ? Give expressions for the same. Describe the terms involved.

Turn over

14. Verify whether the force $F = (2xy + yz^2)\hat{i} + (x^2 + xz^2)\hat{j} + 2xyz\hat{k}$ is conservative or not.
15. Amplitude of a damped harmonic oscillator is reduced to 1/10th of its initial value after 100 oscillations. If the time period of oscillation is 2 seconds, determine the damping constant.
16. What do you mean by a plane progressive harmonic wave? Obtain an expression for a plane progressive harmonic wave.
17. Estimate the increase in relativistic mass of a particle of rest mass 1 gram when it is moving with velocity $0.8c$.
18. The work function for barium is 2.5 eV. Check whether barium can be used as a photo cell to detect visible light. Note that the visible range of the electromagnetic spectrum is 400-700 nm.
19. The average period that elapses between the excitation of an atom and the time it emits radiation is 10^{-10} s. Determine the width of the excited state.

(5 × 5 = 25 marks)

Section C (Essay Type)

Answer any **one** question.

The question carries 11 marks.

20. Explain the conservation theorems of energy, linear and angular momentum.
21. Obtain the Lorentz transformation equations for co-ordinates and time for two inertial frames.

(1 × 11 = 11 marks)