C 25124 (Pages : 3) Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MARCH 2012

(CCSS)

Complementary Physics

PH 2C 03—MECHANICS, RELATIVITY WAVES AND OSCILLATION

Time : Three Hours Maximum : 30 Weightage

Section A

Answer **all** *questions.*

1. The motion of a projectile as observed from a matter projectile is :

   (a) Parabolic. (b) Elliptical.

   (c) Straight line. (d) Circular.

2. If the linear momentum of a body is increased by 50 %, its KE will increase by :

   (a) 50 %. (b) 100 %.

   (c) 125 %. (d) 150 %.

3. The centre of mass of a body lies :

   (a) At geometric centre. (b) Always inside body.

   (c) Always outside body. (d) Within or outside body.

4. The operator $\frac{d}{dx}$ operates on eigenfunction gives eigenvalue K, then corresponding eigenvector is :

   (a) Kx. (b) cos Kx.

   (c) sin Kx. (d) e^{kx}.

5. Which of the following equations represent S.H.M. ?

   (a) A sin wt + B cos wt. (b) A sin wt + B cos 2 wt.

   (c) A $\sin^2 wt$. (d) $e^{\sin wt}$.

6. A spring pendulum has period T. If the spring is broken into two halves. One that piece connected to same mass. The period of this pendulum will be :

   (a) T. (b) $\frac{T}{\sqrt{a}}$.

   (c) $T\sqrt{2}$. (d) $\frac{T}{a}$.

Turn over

7. The equation for progressive wave is $Y = A \sin (100\,\pi t - 0.02z)$. Then velocity of wave is :

(a) $500\,\pi$. (b) $5000\,\pi$.

(c) $50\,\pi$. (d) $5\,\pi$.

8. A frame of reference which is moving with constant velocity with respect to a frame at rest is :

(a) Inertial. (b) Non-inertial.

(c) Rotating. (d) Absolute.

9. Rest mass of a body m_0, its dynamic mass when it is moving with a velocity equal to half the speed of light is :

(a) $\frac{2m_0}{\sqrt{3}}$. (b) $\frac{m_0}{2}\sqrt{3}$.

(c) m_0. (d) $\frac{m_0}{2}$.

10. Angular momentum of a body under central force field :

(a) Zero. (b) Constant.

(c) Increases. (d) Decreases.

11. A bullet of mass a and velocity b is fired into large block mass c. The final velocity of system is :

(a) $\frac{cb}{a+b}$. (b) $\frac{b}{c}(a+b)$.

(c) $\frac{ab}{a+c}$. (d) $\frac{b}{a}(a+c)$.

12. If speed of a body of rest mass m and length L in the direction of motion, is equal to speed of light. Then its relativistic mass and length are :

(a) m, L. (b) 0, 0.

(c) 0, infinity. (d) Infinity, 0.

(12 × ¼ = 3 weightage)

Section B

Answer **all** *the questions.*

13. Prove that force is negative gradient of potential.
14. What is meant by linear restoring force ?
15. Define stable, neutral and unstable equilibrium using potential energy curve.
16. What is meant by inertial frame of reference ? Give example.
17. Explain energy function.
18. Under what condition Lorenz transformation reduces to Galilean transformation ?

19. Show that curl of conservative forces vanishes.
20. Show that all the inertial frames in constant relative motion are equivalent.
21. Give the basic principle of S.T.M.

(9 × 1 = 9 weightage)

Section C

Answer any **five** *questions.*

22. Show that speed of rocket is twice the exhaust speed if $\frac{M_0}{M} = e^2$.
23. The mass of a particle is triple its rest mass. What is its speed ?
24. An eigenfunction of the operator $\frac{d^2}{dx^2}$ is $\psi = e^{2x}$. Find the corresponding eigenvalue.
25. A particle of mass 0.1 kg. is in a field of potential $U = 5x^2 + 10$ J/kg. Find the frequency of oscillation.
26. Two particles of masses 2 kg. and 10 kg. with position vectors $3i + 2j + k$ and $i - j + k$ respectively. Find out the position vector of centre of mass.
27. Prove that gravitational force is conservative.
28. The position vector of a particle of mass m under the influecne of force is $r = A \sin wt\, \hat{i} + B \cos wt\, \hat{j}$. Find out expression for force.

(5 × 2 = 10 weightage)

Section D

Answer any **two** *questions.*

29. What are Fundamental postulates of special theory of relaivity ? Obtain Lorentz transformation equation.
30. What is meant by wave function ? Develop Schrödinger's one-dimensional time dependent equation.
31. Give the basic principles of rocket propulsion. Hence derive an expression for final velocity of rocket.

(2 × 4 = 8 weightage)

(6)

D 31899 (Pages : 4) Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION DECEMBER 2012

Physics—(Complementary Course)

PH 2C 03—MECHANICS, WAVES, RELATIVITY AND OSCILLATIONS

Time : Three Hours Maximum : 30 Weightage

Section A

Answer **all** *the questions.*

1. A body is projected at an angle to the horizontal. Then path of the body in a frame of reference which is moving with velocity equal to horizontal component of velocity of body :
   (a) Vertical straight line. (b) Horizontal straight line.
   (c) Parabola. (d) Hyperbola.

2. A plumb line is suspended from the roof of a rail road car. When car is moving on a circular track, the plumb line inclines ?
   (a) Forward. (b) Rearward.
   (c) Towards centre of path. (d) Away from centre of path.

3. Two trains A and B are running in same direction on parallel roads such that A is faster than B, Packets of equal weight are transferred between them. What do you think will happen due to this ?
   (a) A will be accelerated B will be retarded.
   (b) B will be accelerated A will be retarded.
   (c) No change in A but B will be accelerated.
   (d) No change in B but A will be accelerated.

4. A satellite is revolving round earth, which of the following is not conserved :
   (a) Linear momentum. (b) Angular momentum.
   (c) Areal velocity. (d) Total energy.

5. An object of mass 'm' moving with a velocity υ is approaching a second object of same mass at rest. Total kinetic energy as viewed from the centre of mass is :
   (a) $m\upsilon^2$. (b) $\frac{1}{2}m\upsilon^2$.
   (c) $\frac{1}{4}m\upsilon^2$. (d) None of these.

Turn over

6. Eigenvalue of the operator $\frac{d}{dx}$ is 5 then corresponding eigenfunction is :

(a) $5x$. (b) $\sin 5x$.

(c) e^{5x}. (d) 5.

7. If frequency in S.H.M. is f then frequency of its kinetic energy is :

(a) $\frac{f}{2}$. (b) f.

(c) $2f$. (d) $4f$.

8. The equation for progressive wave is $Y = 10 \sin 2\pi (5t - 20x)$. Then wavelength of wave is :

(a) 50. (b) 20.

(c) 0.5. (d) 0.05.

9. Which of the following frames of reference is non-inertial ?

(a) A car in circular motion.

(b) A car in uniform motion.

(c) A car at rest.

(d) A car is moving along straight line with same velocity.

10. If speed of a body of rest mass m and length L in the direction of motion is L, is equal to speed to light, Then its relativistic mass and length are :

(a) m, L. (b) 0, 0.

(c) 0, Infinity. (d) Infinity, 0.

11. Amplitude of damped oscillations :

(a) Increases linearly with time.

(b) Decreases linearly with time.

(c) Increases exponentially with time.

(d) Decreases exponentially with time.

12. Energy radiated per unit volume through progressive waves is :

(a) Directly proportional to amplitude.

(b) Directly proportional to square of the amplitude.

(c) Inversely proportional to amplitude.

(d) Inversely proportional to square of amplitude.

(12 × ¼ = 3 weightage)

Section B

Answer **all** *nine questions.*

13. What is meant by Galeelian Transformation ?
14. What are the conclusions do you draw from Michelson-Morley experiment ?
15. Distinguish between free oscillations and Damped oscillations.
16. 'In the abscence of external forces, velocity of Centre of mass is a constant' Prove it.
17. What is potential energy curve ? Draw P.E. Curve and mark the points of unstable and stable equilibria ?
18. Explain Fourier Theorem.
19. What is a second pendulum ? Find out its length.
20. List out the postulates of Quantum Mechanics.
21. Explain about centrifugal force.

(9 × 1 = 9 weightage)

Section C

Answer any **five** *questions.*

22. A body at rest explods, braking into three pieces, two pieces having equal masses, Fly-off perpendicular to one another with same speed of 30 m/s. The third piece has three times mass of each other pieces. Find out velocity of third piece.
23. Three masses 1 kg, 2 kg, 1 kg are at the vertices of a right-angled triangle at A, B, C with $\angle B = 90°$, AB = 3 m, BC = 4 m. Find out the position of centre of mass of this system.
24. Prove that oscillations of simple pendulum are simple harmonic.
25. Calculate the Coriolis acceleration of a rocket moving with a velocity of 2 kms^{-1} at 60° South latitude.
26. A plane wave of frequency 512 Hz and amplitude 0.001 mm are produced in air. Calculate energy radiated per unit volume of medium. (ρ_{air} = .0013 g/cc

    V_{sound} = 338 m/s).
27. How fast would a rocket have to go relative to an observer for its length to be contracted t 99% of its length at rest ?
28. A particle is limited to X-axis has the wave function $\psi = e^{ikx}$ between $x = 0$ and $x = 1$. Fin out the probability that the particle can found between $x = 0.5$ to 0.6.

(5 × 2 = 10 weightag

Turn ov

Section D

Answer any **two** *questions.*

29. Derive relativistic formula for variation of mass.

30. Derive one dimensional time dependent Schrödinger equation. Convert it into three dimensional form.

31. What is the basic principles of Rocket Propulsion ? Derive expression for final velocity of Rocket.

(2 × 4 = 8 weightage)

C 41823 (Pages : 3) Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, APRIL/MAY 2013

(CCSS)

Physics

PH 2C 03—MECHANICS, RELATIVITY, WAVES AND OSCILLATIONS

Time : Three Hours Maximum : 30 Weightage

Section I

Answer **all** *questions.*

Each question carries $\frac{1}{4}$ *weightage.*

1. The transformation of Co-ordinates of a particle from one inertial frame to another is known as :

   (a) Relativistic transformations. (b) Galilean transformations.

   (c) Lorentz transformations. (d) Newtonian transformations.

2. The fictitious or Pseudo force on a particle is mathematically :

   (a) $F_0 = -m a_0$. (b) $F_0 = m a_0$.

   (c) mrw^2. (d) None of the above.

3. For conservative forces, the sum of potential and kinetic energies is :

   (a) Zero. (b) Infinity.

   (c) Constant. (d) Negative.

4. In planetary motion, for the conservation of angular momentum the planet must move ——— at the point of closest approach to the sun.

5. The life time of high energy particles in flight is always greater than the time measured in a decay at rest. This is because of :

   (a) Length contraction. (b) Time dilation.

   (c) Doppler effect. (d) Relativistic Doppler effect.

6. Identify the particle having zero rest mass :

   (a) Neutron. (b) Proton.

   (c) Photon. (d) Electron.

7. A pendulum suspended from the ceiling of a train has a period T when the train is at rest. When the train is accelerating with a uniform acceleration, the period of oscillation will :

   (a) Increase. (b) Decrease.

   (c) Not change. (d) Become infinite.

Turn over

8. In a SHM, when the displacement is one half the amplitude, what fraction of the total energy is kinetic ?

(a) Zero. (b) $\frac{1}{4}$.

(c) $\frac{1}{2}$. (d) $\frac{3}{4}$.

9. Which of the following is transmitted by a wave ?

(a) Amplitude. (b) Velocity.

(c) Energy. (d) Momentum.

10. Which of the following expressions is that of a progressive wave ?

(a) $a \sin(wt - kx)$. (b) $a \sin wt$.

(c) $a \cos kx$. (d) $a \sin (wt) \cos (kx)$.

11. Wave function has no direct ————.

12. The allowed values of energies of a particular system are called :

(a) Eigenvalues. (b) Eigenfunctions.

(c) Hamiltonian. (d) Wave function.

(12 × $\frac{1}{4}$ = 3 weightage)

Section II

Answer **all** *questions.*
Each question carries 1 *weightage.*

13. State the hypothesis of Galilean invariance. Is it consistent with the theory of special relativity ?

14. Explain the basic principle of rocket propulsion.

15. What is a centrifugal force ? How does it affect the acceleration due to gravity ?

16. What is a centre of mass frame of reference ? Is it an inertial frame or non-inertial frame ?

17. What is meant by length contraction ?

18. What is anharmonic oscillator ?

19. Give the general equation of wave motion. What is its significance ?

20. Give the limitations of classical mechanics.

21. Explain probability density.

(9 × 1 = 9 weightage)

Section III

Answer any **five** *questions.*
Each question carries 2 weightage.

22. Calculate the fictitious and total force on a body of mass 2.5 kg. relative to a frame moving vertically upwards on earth with an acceleration of 10 m/sec^2.

23. Prove that if no external force is acting on a system of particles its linear momentum remains constant.

24. What do you understand by the potential energy curve ? What are the positions of stable or unstable equilibrium and why ? What is neutral equilibrium ?

25. A meson has a speed of 0.8C relative to the ground. Find how far the meson travels relative to the ground, if its speed remains constant. The time of flight relative to the system is 2×10^{-8} sec.

26. Two masses 0.01 kg. and 0.09 kg. are connected by a spring of length 0.1 m. If the force constant of the spring is 10^3 N/m, calculate the frequency of oscillation.

27. Derive an expression for the energy density of a plane progressive wave.

28. Find the energy of an electron moving in one dimension in an infinitely high potential box of width 1 A°. mass of electron = 9.1×10^{-31} kg, h = 6.6×10^{-34} J-S.

(5 × 2 = 10 weightage)

Section IV

Answer any **two** *questions.*
Each question carries 4 weightage.

29. Describe the Michelson Morley experiment and discuss the importance of the null result.

30. Set up the differential equation of a harmonic oscillator and solve it to find the velocity, displacement and period.

31. Derive the Schrödinger time dependent equation. What is a Hamiltonian operator ? Express the motion of a material particle in terms of the Hamiltonian operator.

(2 × 4 = 8 weightage)

(3)

C 62706

(Pages : 3)

Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2014

(UG-CCSS)

Complementary Course—Physics

PH 2C 03—MECHANICS, RELATIVITY WAVES AND OSCILLATIONS

Time : Three Hours

Maximum : 30 Weightage

I. Answer all *twelve* questions, each question carries ¼ weightage :

1 The meson has a speed 0.8 c relative to ground. If its time of flight in its frame is 2×10^{-8} sec, how far the meson travels relative to ground ?

(a) 2m (b) 4m.

(c) 6m (d) 8m.

2 At what velocity along its length will a rod contract 50% :

(a) $c/2$. (b) $\frac{\sqrt{3}\,c}{2}$.

(c) $\frac{\sqrt{3}\,c}{4}$. (d) $\frac{\sqrt{3}\,c}{5}$.

3 Energy mass relation is :

(a) $E = mc$. (b) $E = p^2 c$.

(c) $E = mc^2$. (d) $E = mc^3$.

4 Two particles are travelling in opposite direction *s* with speed 0.9 *c* relative to the laboratory. Their relative speed is

(a) 0 . 0 948 c. (b) Zero.

(c) c. (d) 0.995 c.

5 The momentum energy relation is :

(a) $E = p/m$. (b) $E = p^2/m$.

(c) $E = p^2/2m$. (d) $E = p/2m$.

Turn over

6 A particle executing SHM has amplitude 0.6 m. The time taken by particle in covering a distance 0.3m from mean position, if time period is 3.14 s is :

(a) 2.6 s. (b) 0.26 s.

(c) 6.2 s. (d) 0.62s.

7 The amplitude of a damped oscillator becomes ½ after t second. If the amplitude becomes $(1/x)$ after 3 t second, then x is equal to

(a) 0.8 (b) 8.

(c) 0.4 (d) 4.

8 The relation between driving frequency f_d and natural frequency f is :

(a) $f_d = f$. (b) $f_d = f$.

(c) $f_d = f$. (d) $f_d = f$.

9 Friction is _____ force.

10 TEM stands for _____.

11 The expression for energy density is _____.

12 According to Schrodinger a particle is equivalent to a :

(a) Single wave. (b) Wave packet.

(c) Light wave. (d) Cannot behave as wave.

(12 × ¼ = 3 weightage)

II. Answer all *nine* questions. Each question carries 1 weightage.

13 What is Coriolis force ?

14 Explain the difference between inertial frame and non inertial frame.

15 Explain the potential energy curve.

16 Explain the significance of mass energy relation.

17 Define Simple Harmonic Motion.

18 What do you meant by energy density ?

19 Explain the expression for time period of a loaded spring.

20 Write down an expression for equation of plane progressive wave and explain each term.

21 Discuss the principle of Electron Microscope.

(9 × 1 = 9 weightage)

III. Answer any *five* questions, each question carries 2 weightage :

22 Show that mass of the particle moving with $4/5^{th}$ the speed of light will appear as 5/3 times its rest mass.

23 Distinguish between centrifugal force and Coriolis force with suitable example.

24 With suitable example explain motion of a body under central force.

25 Obtain the period of oscillation of a simple pendulum.

26 State and explain Fourier theorem.

27 What are the postulates of quantum mechanics ?

28 With suitable example explain Eigen value and Eigen function.

(5 × 2 = 10 weightage)

IV. Answer any *two*, each question carries 4 weightage :

29 Derive the Galilean transformation equation and explain its invariance.

30 What are the postulates of special theory of relativity and explain the significance of Michelson Morley experiment.

31 Derive Time dependent Schrodinger equation of matter waves. Give the physical interpretation of the wave function.

(2 × 4 = 8 weightage)

C 83003 (Pages : 3) Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2015

(CUCBCSS–UG)

Complementary Course

Physics

PH2 C02—MECHANICS, RELATIVITY, WAVES AND OSCILLATIONS

Time : Three Hours Maximum : 80 Marks

Section A

Answer **all** *questions.*
Each question carries 1 *mark.*

1. Any frame of reference moving relative to an identical frame with constant velocity will be _____.
2. Two colliding particle in CM frame approaches as well as separate with _____.
3. Multistage rockets are used in practice to _____.
4. Give the expression for the relativistic equivalence of mass and energy.
5. What happens to amplitude as time increases during damping ?
6. By which theorem can you explain the different quality of sound produced by different musical instruments ?
7. According to Schrödinger a particle is equivalent to a _____.

State whether the following statements are True / False :—

8. The speed of a comet is highest at its Aphelion.
9. An electron microscope can magnify objects by 10X.
10. A collision is said to be elastic if the kinetic energy is conserved.

(10 × 1 = 10 marks)

Section B

Answer **all** *questions.*
Each question carries 2 *marks.*

11. Does a flying projectile experience deviations due to Coriolis force ? Explain.
12. Distinguish between internal and external forces.
13. How does a rocket work ?
14. Give *two* important kinematical features which are derived from the special theory of relativity.

Turn over

15. Explain profer time interval.
16. What is logarithmic decrement ?
17. Distinguish between elastic and inelastic collisions.
18. What is intensity of a wave. Give the inverse square law.
19. Explain probability density.
20. What is an operator ? Give example.

(7 × 2 = 14 marks)

Section C

Answer any **five** *questions. Each question carries* 4 *marks.*

21. Explain non inertial frames and factious forces.
22. What is a central force ? Show that the central forces are conservative.
23. State the law of conservation of angular momentum. Explain one application.
24. How does mass change with velocity ? Show that 'c' is the ultimate speed of the particles.
25. Prove that for a harmonic oscillator the average PE and average KE are equal.
26. State Fourier's theorem. What are its conditions of applicability ? Analyze a saw tooth curve.
27. What are eigen values and eigen functions ? Illustrate with examples.

(5 × 4 = 20 marks

Section D

Answer any **four** *questions. Each question carries* 4 *marks.*

28. Prove that the total angular momentum of an isolated system of particles is conserved.
29. Prove that in a perfectly elastic collision the total final KEn of the colliding particles is equal to their inertial KE.
30. What will be the apparent length of a meter stick measured by an observer at rest, when the stick is moving with a velocity of 0.851C.
31. The average lifetime of a neutron as a free particle at rest is 15 minutes. It disintegrates spontaneously into an electron, proton and neutrino. What is the average minimum velocity with which – a neutron must leave the sun to reach the earth before breaking 1.29 ? Distance between earth sun = 11×10^7 km.
32. A plane wave of frequency 256 Hz and amplitude 0.001 mm is produced in air. Calculate the energy density and energy current, given velocity of sound in air = 332 m/s and density of air = 1.29 kg/m^3.
33. A mass of 1.6 kg extends a spring by 8 cm from its unstretched position. The mass is replaced by a body of mass 50 gm. Find the period of oscillation if the mass is pulled and released ?
34. Obtain the time dependent Schrödinger equation in three dimensions.

(4 × 4 = 16 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

35. Prove that the linear momentum of a system of particles in centre of mass frame is zero.

36. State the postulates of the special theory of relativity and hence derive the Lorentz transformation equations.

37. Write notes on :

    (a) Electron microscope ;

    (b) Scanning tunneling microscope.

38. Prove that the pressure variations in a medium due to a sound wave is $P = -E\, dy/dx$. Hence show that the velocity of longitudinal waves in a gas depends on elasticity and density of the medium.

(2 × 10 = 20 marks)

— logarithmic decrement : natural logarithm of ratio of amplitudes of any two successive peaks.

— Intensity of a wave is the power delivered per unit area.

C 5624 (Pages : 3) Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2016

(CUCBCSS—UG)

Complementary Course

PHY 2C 02—MECHANICS, RELATIVITY WAVES AND OSCILLATIONS

Time : Three Hours Maximum : 64 Marks

Part A (One word)

Answer **all** *questions.*

Each question carries 1 *mark.*

1. The Michelson Morley experiment proved the non-existence of ————.
2. In the case of conservative forces, the work done is ———— independent.
3. Angular momentum conservation is subject to the condition of zero ————.
4. Velocity of all massive objects is limited to the velocity of ————.
5. If the frequency of a SHM is *f*, the frequency of its kinetic energy is ————.
6. ———— is an example for a non-conservative force.
7. The unit of angular velocity is ————.
8. The variable in sound waves is ————.
9. In orbital motion, the gravitational pull is balanced by ———— force.
10. Operators associated with observable variables are ————.

(10 × 1 = 10 marks)

Part B (Short answers)

Answer **all** *questions.*

Each question carries 2 *marks.*

11. Distinguish between inertial and non-inertial frames of reference.
12. What are the *two* fictitious forces acting on rotating frames of reference ?
13. State the postulates of the special theory of relativity.

Turn over

14. Explain the concept of centre of mass of a system.

15. Define simple harmonic motion.

16. What is damping ?

17. Why does not a running bicycle fall ?

(7 × 2 = 14 marks)

Part C (Paragraph answers)

Answer **two** *questions.*
Each question carries 4 *marks.*

18. Derive the relationship between torque and angular momentum.

19. Explain the twin paradox.

20. Explain the concept of length contraction.

21. Discuss the basic postulates of quantum mechanics.

22. Prove the work energy theorem.

(2 × 4 = 8 marks)

Part D (Problems)

Answer **three** *questions.*
Each question carries 4 *marks.*

23. The kinetic energy of a body is increased by 300%. Give the percentage increase in momentum.

24. Two masses, 59 kg and 73kg are located at the ends of a rod 3.5m long. At what distance from the first mass is the centre of mass of the system located ?

25. What is the mean life of a burst of Pi mesons travelling with a velocity of 0.73 times the velocity of light if the proper mean life time is 2.5×10^{-8} s ? Find the distance travelled in this life time under both relativistic and non-relativistic conditions.

26. An SHM is represented by the equation $y = 0.2 \sin (50\Pi t + 1.57)$, y and t are in meters and seconds respectively. Determine the amplitude, frequency and time period of motion.

27. A particle executes SHM of amplitude α. At what distance from the mean position is the kinetic energy and potential energy equal.

(3 × 4 = 12 marks)

24. 59 at 0, R, 73 at 3.5

$R = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2} = \frac{59 \times 0 + 73 \times 3.5}{59 + 73} = \frac{255.5}{132} = 1.935\ m$

Part E (Essays)

Answer **two** *questions.*
Each question carries 10 *marks.*

28. Arrive at the Lorentz transformation equations in accordance with the special theory of relativity.

29. Derive the time dependent Schrödinger equation.

30. Drive the expressions for kinetic, potential and total energies of an oscillator discussing their variations and hence prove the conservation of energy.

(2 × 10 = 20 marks)

$\frac{\Delta KE}{KE} = 0.3$

$\Delta KE + KE = KE_2$

$0.3KE + KE = KE_2$

$1.3KE$

23- $K.E_i = \frac{1}{2}mv_i^2$, $P_i = mv_i$

increased by 300%

~~$\therefore K.E_f = 400 + \frac{1}{2}mv_i^2$, $P_f = mv_f$~~

$K.E_f = \frac{1}{2}mv_f^2$ $\therefore P_f = mv_f$

But $K.E_f = 4 \times \frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2$

$4v_i^2 = v_f^2$

$v_f = 2v_i$

$\therefore P_f = m \times 2v_i = 2P_i$

$\therefore$ increase = 100%

$KE = \frac{P^2}{2m}$

$P = \sqrt{2m\,KE}$

$P_1 = \sqrt{2m\,KE_1}$

$P_2 = \sqrt{2m\,KE_2}$

$\frac{P_2}{P_1} = \sqrt{\frac{KE_2}{KE_1}} = \sqrt{1.3}$

C 24765 (Pages : 4) Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2017

(CUCBCSS—UG)

Complementary Course

PHY 2C 02—MECHANICS, RELATIVITY, WAVES AND OSCILLATIONS

Time : Three Hours Maximum : 64 Marks

Symbols used in this question paper have their usual meanings.

Section A

(Answer in a word **or** *phrase)*

Answer **all** *questions. Each question carries* 1 *mark.*

1. Which of the following relations between force $\vec{F}$ and potential energy V is correct :

(a) $\vec{F} = -\text{grad } V$. (b) $\vec{F} = -\text{div } V$.

(c) $\vec{F} = -\text{curl } V$. (d) $\vec{F} = -\int v\, dx$.

2. The rest mass of particle is m_0. If it moves with velocity v ,its mass becomes m, then :

(a) $m = m_0$. (b) $m = \dfrac{m_0}{\sqrt{1-\dfrac{v^2}{c^2}}}$.

(c) $m = m_0\sqrt{1-\dfrac{v^2}{c^2}}$. (d) $m = \dfrac{m_0}{1-\dfrac{v^2}{c^2}}$.

3. The rest mass of a particle is zero; then its relation between momentum (p) and energy (E) is :

(a) $E = \dfrac{p^2}{2m}$. (b) $E = pc$.

(c) $E = \dfrac{p}{c^2}$. (d) $E = pc^2$.

Turn over

4. What do you mean by energy density ?

5. A Physical system is invariant under rotation about a fixed axis. Then the following quantity is conserved ————.

(a) Linear momentum. (b) Angular momentum.

(c) Kinetic energy. (d) Potential energy.

6. The deviation of a freely falling body from thevertical in northern hemisphere is towards:

(a) East. (b) West.

(c) South. (d) Zero.

7. The rest mass of an electron is m0 when it moves with a velocity $v = 0.6c$, then its rest mass is :

(a) m_0. (b) $\frac{5}{4}m_0$.

(c) $\frac{4}{5}m_0$. (d) $2m_0$.

8. Earth is :

(a) An inertial frame. (b) A non-inertial frame.

(c) An absolute frame. (d) Inertial and rotational.

9. The graph between square of period and the length of simple pendulum is a :

(a) Straight line. (b) Circle.

(c) Parabola. (d) Hyperbola.

10. The time interval between two events in rest frame is Δt. If it is measured from a moving frame, it is $\Delta t'$,then :

(a) $\Delta t' = \Delta t$. (b) $\Delta t' < \Delta t$.

(c) $\Delta t' > \Delta t$. (d) $\Delta t' = \sqrt{2}\,\Delta t$.

(10 × 1 = 10 marks)

$$\Delta t = \frac{\Delta t_0}{\sqrt{1 - v^2/c^2}}$$

Section B

(Answer in a short paragraph- three **or** *four sentences)*
Answer **all** *questions. Each question carries 2 marks.*

11. What do you mean by length contraction?
12. State the law conservation of angular momentum.
13. Write a short note on Corioli's force.
14. Explain the significance of mass energy relation.
15. Write Galielean transformations for space and time.
16. Distinguish between transverse and longitudinal waves.
17. Explain the properties of a wavefunction.

(7 × 2 = 14 marks)

Section C

(Answer in a paragraph of about **half a page to one page)**
Answer any **three** *questions. Each question carries 4 marks.*

18. What are the postulates of quantum mechanics ?
19. Show that the curl of a conservative force vanishes.
20. Show that when v/c<<1, the Lorentz transformation equations get converted to the Galilean transformation equations.
21. Explain the working of an electron microscope.
22. Prove that a moving clock always runs slower than a clock at rest.

(3 × 4 = 12 marks)

Section D

(Problems- write all relevant formulas. All important steps carry separate marks)
Answer any **three** *questions. Each question carries 4 marks.*

23. Calculate the length of the rod moving with velocity 0.8c. Given proper length of the rod= 100cm.
24. Find the mass of electron and kinetic energy of an electron moving with a velocity is 0.99c.
25. A body having a mass of 4g executes S.H.M. The force acting on the body when the displacement is 8 cm is 24g. Find the period. If the maximum velocity is 500cm/s, find the amplitude and maximum acceleration.

Turn over

26. A pendulum is of length 50cm. Find its period when it is suspended in :

    (i) A stationary lift.

    (ii) A lift falling at a constant acceleration of 2 m/s^2.

27. A mass of 50g is moving with linear velocity of 100 cm/s normal to the axis of rotation in a rotating frame of reference. The mass is at a distance of 10 cm from the axis of rotation. Calculate the Coriolis force experienced by the mass.

(3 × 4 = 12 marks)

Section E

(Essays - Answer in about **two pages***)*

Answer any **two** *questions. Each question carries* 8 *marks.*

28. Derive the time dependent Schrodinger equation of matter waves. Give the Physical interpretation of wave function

29. Mention the consequences of Special theory of relativity and derive Einstein's mass energy relation.

30. Derive the differential equation for a damped harmonic oscillator. Explain the three cases of damping and give the graphical representation.

31. Derive Lorentz transformation equations.

(2 × 8 = 16 marks)

D 43227 (Pages : 3) Name.....

Reg. No.....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2018

(CUCBCSS–UG)

Complementary Course

PHY 2C 02—MECHANICS, RELATIVITY, WAVES AND OSCILLATIONS

Time : Three Hours Maximum : 64 Marks

Section A

Answer **all** *questions.*
Each question carries 1 *mark.*
Answer in a word **or** *phrase.*

1. The centrifugal force acting on a particle of mass m, rotating with angular velocity $\vec{\omega}$ is :

   (a) $-m(\vec{\omega}\times\vec{r})$.

   (b) $-m\left(\vec{\omega}\times\frac{d\vec{r}}{dt}\right)$.

   (c) $-m\left(\frac{d\vec{\omega}}{dt}\times\vec{r}\right)$.

   (d) $-2m\left(\vec{\omega}\times\frac{d\vec{r}}{dt}\right)$.

2. When speed of rod along its length is increased, the length of rod :

   (a) Increases.

   (b) Decreases.

   (c) Remains unchanged.

   (d) Becomes zero.

3. The mass of an electron is double its rest mass then the velocity of the electron :

   (a) $\frac{c}{2}$.

   (b) $2c$.

   (c) $\frac{\sqrt{3}}{2}c$.

   (d) $\sqrt{\frac{3}{2}}c$.

4. Energy density for a plane harmonic wave is ———.

5. A train moving with constant velocity is :

   (a) An inertial frame.

   (b) A non-inertial frame.

   (c) Something inertial and sometimes non-inertial frame.

   (d) Neither inertial nor-inertial frame.

Turn over

6. The total energy of a particle executing SHM is proportional to :

   (a) Displacement from equilibrium position.

   (b) Frequency of oscillation.

   (c) Velocity in equilibrium position.

   (d) Square of amplitude of motion.

7. The relativistic relation between momentum p and energy E is :

   (a) $E = \frac{p^2}{2m}$.

   (b) $E = p^2c^2 + m_0^2c^4$.

   (c) $E = \sqrt{p^2c^2 + m_0^2c^4}$.

   (d) $E = \frac{p^2}{2m} + m_0c^2$.

8. Which of the following is a Galilean invariant :

   (a) Velocity.

   (b) Acceleration.

   (c) Both of these.

   (d) None of these.

9. The motion of one projectile as seen from another projectile is :

   (a) A straight line.

   (b) A parabola.

   (c) A circle.

   (d) An ellipse.

10. At what speed the length of rod becomes half of its proper length :

   (a) $\frac{c}{2}$.

   (b) $\frac{c}{\sqrt{2}}$.

   (c) $\frac{\sqrt{3}}{2}c$.

   (d) $\sqrt{\frac{3}{2}}c$.

(10 × 1 = 10 marks)

Section B

Answer **all** *questions.*
Each question carries 2 *marks.*
Answer in **a short paragraph** — *three* **or** *four sentences.*

11. Name the types of frames of reference. Differentiate between them.

12. Give two examples of conservative and two examples of non-conservative forces.

13. What do you mean by time dilation ?

14. Explain the hypothesis of Galilean invariance.

15. What is centrifugal force ? Illustrate with example.

16. What is the significance of wave function ?

17. Why was the Michelson Morley experiment performed ?

(7 × 2 = 14 marks)

Section C

Answer any **three** *questions.*
Each question carries 4 *marks.*
Answer in **a paragraph** *of about* **half a page to one page.**

18. Derive an equation for the energy density of a wave.
19. Write a note on electron microscope.
20. Show that motion of a particle under a central force takes place in a plane.
21. Explain the twin paradox.
22. Explain Lorentz Fitzgerald contraction and derive an expression for the same.

(3 × 4 = 12 marks)

Section D

Answer any **three** *questions.*
Each question carries 4 *marks.*
Problems-write all relevant formulas.
All important steps carry separate marks.

23. A particle of rest mass m is moving with a velocity 0.9c, calculate (i) its relativistic mass ; (ii) its kinetic energy.
24. The potential energy possessed by a particle moving under the influence of a conservative force is given by $U(x) = x^3 - 9x^2 + 24x$. Find the force on the particle.
25. A pendulum is of length 50 cm. Find its period when it is suspended in (i) a lift falling at a constant velocity of 5 m/s. (ii) a lift rising at a constant acceleration of 2 m/s.^{2}
26. Consider a ship moving with a uniform velocity of 18 m/s relative to the earth. Let a ball be rolled at a speed of 2 m/s. relative to the ship, in the direction of motion of the ship. Find the speed of the ball relative to the earth, according to Galilean transformations.
27. A young man goes to the pole star and comes back to the earth on a rocket. Calculate the age difference between him and his twin brother who preferred to stay on the earth. The rocket velocity $v = (4/5)\,c$ and the distance between the earth and the pole star is 40 light years. (Light year is a unit of distance, 1 light year = $3 \times 10^8 \times 60 \times 60 \times 24 \times 365$ m.)

(3 × 4 = 12 marks)

Section E

Answer any **two** *questions.*
Each question carries 8 *marks.*
(Essays. Answer in about **two** *pages).*

28. What is ether hypothesis ? Explain the Michelson Morley experiment.
29. Derive the time dependent Schrödinger equation.
30. Derive the differential equation of a particle executing simple harmonic motion. Also derive expression for its period, velocity and acceleration.
31. Mention the consequences of special theory of relativity and derive Einstein's mass energy relation.

(2 × 8 = 16 marks)

C 82451 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION, APRIL 2020

Physics

PHY 2C 02—OPTICS, LASER, ELECTRONICS

Time : Two Hours Maximum : 60 Marks

Section A (Short Answer Type)

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

1. What do you mean by the term coherence length ?
2. For interference in thin films in a reflected system, write down the condition for constructive and destructive interferences.
3. Compare Fresnel and Fraunhofer types of diffractions.
4. What do you mean by the grating constant of a plane transmission grating ?
5. It is possible to polarize a sound wave ? Why ?
6. What is Brewster's law ?
7. Distinguish between positive and negative doubly refracting crystals.
8. What are polaroids ? Mention two applications.
9. Write down de Morgan's theorems.
10. What do you mean by the term ripple factor ? Give its value for a half wave rectifier.
11. Distinguish between spontaneous and stimulated emission processes.
12. What do you mean by population inversion in a laser ? Name a mechanism to attain the same.

(Ceiling-20)

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. Light of wavelength 5000 Å from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen placed 100 cm away is 0.5 cm, determine the fringe separation.
14. Calculate the minimum number of lines on a grating that will just resolve the sodium lines 5890 Å and 5896 Å in the first order spectrum.

Turn over

15. Show that when unpolarized light is passed through a polarizer, the intensity of the transmitted light is half that of the incident light.

16. Calculate the thickness of doubly refracting glass plate capable of producing a path difference of $\lambda/4$ between the ordinary and extraordinary waves. Given, the wavelength of light used λ = 5890 Å, refractive index for the ordinary ray = 1.54 and the refractive index for the extra ordinary ray = 1.53.

17. A 10 V Zener diode along with a series resistance is connected across a 40 V supply. Calculate the minimum value of the resistance required, if the maximum Zener current is 50 mA.

18. Show how an OR operation be realized using three NAND gates.

19. Using a suitable energy level diagram, explain the working principle of a Ruby laser.

(Ceiling-30)

Section C (Essay Type)

Essays. Answer in about **two pages**, *any* **one** *question.*
Answer carries 10 *marks.*

20. Using a neat diagram, discuss the method of forming Newton's rings by reflected light. Write down the condition for bright and dark rings. Obtain an expression for the radii of the rings formed.

21. What do you mean by the CE configuration of a transistor ? Drawing suitable figures, explain the input and output characteristics of a transistor in CE configuration.

(1 × 10 = 10 marks)

C 43201 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2023

Physics/Applied Physics

PHY 2C 02—OPTICS, LASER, ELECTRONICS

(2019—2022 Admissions)

Time : Two Hours Maximum : 60 Marks

Section A (Short Answer Type)

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

1. What are the conditions for obtaining sustained interference ?
2. What is the origin for colors exhibited by thin films ?
3. What is diffraction? What is the condition for obtaining a noticeable diffraction effect ?
4. Mention two features of Fresnel diffraction.
5. In the Fraunhoffer diffraction at a single slit, draw the intensity distribution.
6. Distinguish between transmission and reflection gratings. Give an expression for the principal maximum of order, say n, in the diffraction spectrum.
7. Write any *two* differences between interference and diffraction patterns.
8. What do you mean by double refraction ? Distinguish between positive and negative crystals.
9. What do you mean by a plane polarized light ? When a plane polarized light is passed through a polarizer, how many times will it be extinguished in one full rotation of the polarizer ?
10. What do you mean by a filter circuit ? Explain the construction of a π-section filter.
11. What do the Einstein's co-efficients stand for ?
12. List any three essential characteristics of spontaneous emission.

(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. In Newton's rings experiment with reflected light, the diameter of 15th ring is 0.6 cm and that of 5th ring is 0.3 cm. If the radius of the plano-convex lens is 100 cm, what is the wavelength of light used in the experiment. ?

14. In Fraunhoffer diffraction pattern due to a narrow slit, a screen is placed 2 m away from the lens to obtain the pattern. If the wavelength of light used is 5×10^{-5} cm and the first minimum lie at 5 mm on either side of the central maximum, what is the slit width ?

15. Using suitable figures, explain the term optical activity.

16. Calculate the minimum thickness of a calcite plate which would convert a plane polarized light to circularly polarized. Given, the wavelength of light λ =5890 Å, refractive index of ordinary ray = 1.658 and the refractive index of extra ordinary ray =1.486.

17. A transistor has $\alpha = 0.98$, $I_B = 100\ \mu A$ and $I_{CBO} = 5\ \mu A$. Determine emitter current, collector current and the amplification factor β.

18. Give the truth table of an exclusive OR gate. How will you construct it using basic gates ?

19. Give the construction and the basic details of a He-Ne laser.

(Ceiling 30)

$\beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{1-0.98} = \frac{0.98}{.02} = 49$

$\frac{I_C}{I_E} = 0.98$, $\frac{I_C}{I_B} = 49$

$I_C = 49 I_B$

$= 49 \times 100\ \mu A$

$I_C = 4.9 \times 10^{-3} A$

Section C (Essay Type)

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

20. Give the analytical treatment of interference of two sinusoidal waves. Discuss the conditions for maximum and minimum intensity. Plot the energy distribution as a function of phase angle.

21. Discuss the working principle of a centre-tapped full wave bridge rectifier using suitable figures. Obtain an expression for its efficiency.

(1 × 10 = 10 marks)

D 103781 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER (CBCSS-UG) DEGREE EXAMINATION
APRIL 2024

Physics/Applied Physics

PHY 2C 02—OPTICS, LASER, ELECTRONICS

(2019—2023 Admissions)

Time : Two Hours Maximum : 60 Marks

Section A (Short Answer Type)

Answer **all** *questions in two* **or** *three sentences.*
Each correct answer carries a maximum of 2 marks.
Ceiling 20.

1. What are the conditions for two light sources to be coherent ?
2. Distinguish between the Newton's rings formed by reflected and transmitted monochromatic light.
3. For interference in thin films in the reflected system, write down the condition for constructive and destructive interferences.
4. Write any two differences between Interferences and Diffraction patterns.
5. What is diffraction ? Write down the condition for diffraction.
6. What do you mean by double refraction ? What do you mean by the optic axis of an anisotropic crystal ?
7. Explain the term optical activity. Give two examples of optically active substances.
8. Draw the current-voltage characteristics of a Zener diode. What is the use of a Zener diode ?
9. State the working principle of a transistor amplifier.
10. What are the basic requirements of an oscillator ?
11. What do you mean by population inversion ? Mention any two mechanisms to achieve population inversion.
12. Draw the energy level diagram showing the different transistions in a ruby laser.

(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.*
Overall ceiling 30.

13. Light of wavelength 6000 Å from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen placed 100 cm. away is 1 cm., determine the fringe separation.
14. Newton's rings are formed with red light of wavelength 670 nm. The radius of the 20th ring is found to be 1.1×10^{-2} m. Find the radius of curvature of the lens and the radius of the 30th ring.
15. Find the angular separation between the two sodium lines of wavelength 589 nm and 589.6 nm. when a parallel beam of light is incident on a plane transmission grating of 6×10^5 lines per meter in the second order spectrum.
16. Explain Brewster's law. Give two applications of Brewster's law.
17. A plane polarized light passes through a uniaxial crystal with its optic axis parallel to the faces. Determine the least thickness of the plate for which the emergent beam is plane-polarized. Given $\mu_e = 1.5533$, $\mu_o = 1.5442$ and $\lambda = 500$ nm.
18. For a transistor circuit, the values of base current and emitter current are 50 μA, 2 mA, respectively. Find α and the collector current.
19. Explain the processes spontaneous emission, stimulated absorption and simulated emission using suitable figures.

(Ceiling 30)

Section C (Essay Type)

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

20. Discuss the Fraunhofer diffraction pattern due to a single slit. Draw the intensity distribution.
21. What are universal gates ? Give truth tables for NOR and NAND gates. Construct OR, AND and NOT gates using NOR and NAND gates.

(1 × 10 = 10 marks)