

Reg. No. :

Name :

First Semester B.Sc. Degree Examination, March 2023

First Degree Programme under CBCSS

Physics

Core Course – I

PY 1141 – BASIC MECHANICS AND PROPERTIES OF MATTER

(2018 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer ALL questions in 1 or 2 sentences; each question carries 1 mark.

1. State the condition for translational equilibrium of a body.
2. How is angular momentum related to linear momentum?
3. State perpendicular axis theorem.
4. What is meant by simple harmonic motion?
5. What is energy density of a wave?
6. What is a compound pendulum?
7. What do you mean by Poisson's ratio?
8. What is the difference between streamline and turbulent flows?
9. What is bending moment of beam?
10. Define coefficient of viscosity.

(10 × 1 = 10 Marks)

P.T.O.

SECTION – B

Answer **any eight** questions, not exceeding a paragraph; each question carries **2** marks.

11. Derive an expression for the moment of inertia of a solid sphere.
12. Calculate the moment of inertia of a circular cylinder of radius R and length h about a line at right angles to its axis and passing through the middle point.
13. Obtain an expression for moment inertia of a uniform bar of rectangular cross section.
14. State and explain work energy theorem.
15. How do you find the acceleration due to gravity using bar pendulum?
16. Explain the difference between progressive wave and stationary wave.
17. Obtain an expression for equation of motion of a torsional pendulum.
18. State and explain Bernoulli's theorem.
19. What is cantilever? Write an expressions for depression of cantilever when the load is fixed at the centre.
20. Obtain an expression for twisting couple per unit twist of a wire.
21. Derive the relation connecting between three elastic constants.
22. Explain why small drops of mercury are spherical while large ones are flat?

(8 × 2 = 16 Marks)

SECTION – C

Answer **any six**, each question carries **4** marks.

23. A solid cylinder of mass 20kg rotates about its axis with angular speed 100 rad/sec. The radius of the cylinder is 0.25m. What is the kinetic energy associated with the rotation of the cylinder? What is the magnitude of angular momentum of the cylinder about its axis?

24. A flywheel in the form of a solid circular disc of mass 5000kg and radius 1 meter is rotating making 120 revolutions per minute. Compute the kinetic energy.
25. A solid sphere of mass 100gm and radius 2.5cm rolls without sliding with a uniform velocity of 10 cm per second along a straight line on a smooth horizontal table. Calculate its total energy?
26. A particle moves along half the circumference of a circle of 1 meter radius. Calculate the work done if the force at any point is inclined at 60° to the tangent at the point and has 5 newtons magnitude.
27. The total energy of a particle executing a simple harmonic motion of period 2π second is 10.24×10^{-4} joule. The displacement of the particle at $\pi/4$ second is $8\sqrt{2}$ cm. Calculate the amplitude of the motion?
28. If in air a plane wave of frequency 256 Hz and amplitude 1/1000 mm is produced. Calculate the radiated energy per unit volume and the energy current. Given velocity of sound = 332m/sec and density of air = 1.29kg/m^3 .
29. A light metal rod of length 60cm and of radius 1 cm is clamped at one end loaded at the free end, with 5.5 kg. Calculate the depression of the free end, assuming $Y = 9 \times 10^{11}$ dynes/sq.cm and $g = 980$ cm/sec².
30. What would be the pressure inside a small air bubble of 0.1 mm radius, situated just below the surface of water? Surface tension of water = 0.072 n/m and atmospheric pressure = 1.013×10^5 n/m².
31. A spherical ball of radius 1×10^{-3} m and density 10^4kg/m^3 falls freely under gravity through a distance h before entering a tank of water. If after entering the water, the velocity of the ball does not change. Find h . The coefficient of viscosity of water is 9.8×10^{-4} n.s/m².

(6 × 4 = 24 Marks)

SECTION – D

Answer **any two** questions; each question carries **15** marks.

32. Derive an expression for the moment of inertia of a solid cylinder about an axis through its centre of mass and perpendicular to its own axis.
33. Derive an expression of moment of inertia of a flywheel.
34. Derive an expression for the energy density of the plane progressive waves.
35. Derive Stokes's formula for the velocity of small sphere falling through a viscous fluid.

(2 × 15 = 30 Marks)

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First Semester B.Sc. Degree Examination, March 2023

First Degree Programme under CBCSS

Physics

Complementary Course for Mathematics

PY 1131.1 : MECHANICS AND PROPERTIES OF MATTER

(2018 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** questions in **one** or **two** sentences. Each question carries **1** mark.

1. What are the uses of a fly wheel?
2. State parallel axis theorem.
3. Define radius of gyration.
4. Define simple harmonic motion.
5. Define centre of suspension of a pendulum.
6. What is bending moment?
7. What is called surface energy?
8. 'Antiseptics have low surface tension'. Why?

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9. Why mercury does not wet glass?
10. A tiny liquid drop is spherical but a larger drop has oval shape. Why?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions not exceeding a paragraph. Each question carries **2** marks.

11. Why the circular ring has more moment of inertia than a circular disc?
12. Obtain an expression for moment inertia of a uniform bar of rectangular cross section.
13. Obtain an expression of, kinetic energy of rotating body.
14. What is progressive wave and its types?
15. What is compound pendulum? Write the time period of a compound pendulum.
16. How do you find the acceleration due to gravity using bar pendulum?
17. What are the limitations of Poiseulli's formula?
18. How does Young's modulus increase?
19. How is Poiseulli's equation used in determining the relative viscosity?
20. Explain the term angle of shear and angle of twist.
21. What is the difference between free oscillations and forced oscillations?
22. How to measure the viscosities of liquid using an Ostwald's viscometer?

(8 × 2 = 16 Marks)

SECTION – C

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

23. Calculate the moment of inertia of a uniform circular disc of mass 500gm and radius 10 cm about axis tangent to the disc and parallel to diameter.
24. A rectangular metal hoop of mass 1 kg and radius 0.2 meter makes 10 revolutions per second about its centre. The axis of rotation being normal to the plane of the hoop. Find the moment of inertia about this axis? Also determine angular momentum about the same axis?
25. A particle moves in the potential energy field $U = U_0 - Px - Qx^2$. Find the expression for the force. Also calculate the force constant and time period.
26. If in air a plane wave of frequency 256 Hz and amplitude 1/1000 mm is produced. Calculate the radiated energy per unit volume and the energy current. Given velocity of sound = 332m/sec and density of air = 1.29kg/m³.
27. A body having a mass of 4gm executes simple harmonic motion. The force acting on the body, when displacement is 8 cm, is 24gm. Find the period? If the maximum velocity is 500 cm/sec, find the amplitude and maximum acceleration.
28. A sphere of mass 0.8 kg and radius 0.03 m is suspended from a wire of length 1m and radius 5×10^{-4} m. If the period of torsional oscillations of this system is 1.23 sec. Calculate the modulus of rigidity of the wire.
29. A cylindrical rod of diameter 14 mm rests on two knife - edges 0.8 m apart and a load of 1 kg is suspended from its mid-point. Neglecting the weight of the rod, calculate the depression of the mid-point if Y for its material be $2.04 \times 10^{11} N / m^2$.
30. Calculate the mass of water flowing in 10 minutes through a tube of 0.1cm in diameter, 40 cm long, if there is a constant pressure head of 20 cm of water. The coefficient of viscosity of water is 0.0089 SI units.
31. Calculate the work done against surface tension force in blowing a soap bubble of 5 cm radius if the surface tension of soap solution is 0.025n/m.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. **Each** question carries **15** marks.

32. Derive an expression for moment of inertia of a rectangular bar about an axis passing through its centre of gravity and perpendicular to its length.
33. Derive the one dimensional general equation of wave motion.
34. Describe the Jaeger's method for determining the surface tension of given liquid.
35. Obtain an expression for the twisting couple per unit twist of a uniform solid cylinder.

(2 × 15 = 30 Marks)

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First Semester B.Sc. Degree Examination, March 2023

First Degree Programme under CBCSS

Physics

Complementary Course for Home Science

PY 1131.5 : MECHANICS AND PROPERTIES OF MATTER

(2018 Admission onwards)

Time : 3 Hours

Max. Marks : 80

PART – A

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

1. Define a rigid body.
2. What the factors on which moment of inertia of a body depends?
3. Give the equation of moment of inertia about a tangent the plane of a ring.
4. What is a beam?
5. Define progressive wave.
6. Give the equation of frequency of oscillation.
7. What is flywheel?

8. What is meant by viscosity?
9. Write down the equation for the rate of flow of a liquid through a capillary tube.
10. Two soap bubbles have radii in the ratio 2:1. What is the ratio of the excess pressure inside these bubbles?

(10 × 1 = 10 Marks)

PART – B

Answer **any eight** questions. Each carries **2** marks.

11. What is theorem of perpendicular axes?
12. What are the conditions for the motion of a particle to be simple harmonic?
13. Does mass affect oscillation spring? Explain.
14. Write the expression for depression at loaded end of a cantilever.
15. Explain bending moment.
16. Find the moment of inertia of a thin ring about an axis passing through its diameter.
17. Distinguish between surface tension and surface energy.
18. A clock has a pendulum that performs one full swing every 1.0 second. The object at the end of the string weighs 10.0 N. What is the length of the pendulum?
19. How does surface tension depend on temperature?
20. For which property of the liquid the shape of a liquid drop is spherical? State and explain.
21. Why hot water is preferred to cold water for washing clothes?
22. Bring out the expression for excess of pressure inside a spherical liquid drop and a spherical bubble.

(8 × 2 = 16 Marks)

PART – C

Answer any six questions. Each carries 4 marks.

23. A flywheel of mass 100 kg and radius of 0.5 m makes 10 revolutions per second. Calculate the angular velocity and moment of inertia. Assume the whole mass is concentrated at the rim.
24. The equation of a particle executing SHM is $y=5(\sin\pi t + \pi/3)$. Calculate (a) amplitude (b) period (c) maximum velocity and (d) velocity after 1 second (is in metre).
25. The acceleration due to gravity on the surface of moon is 1.7 ms^{-2} . What is the time period of a simple pendulum on the surface of the moon, if its period on the Earth is 3.5s?
26. Derive the differential equation of simple harmonic motion.
27. Give the properties of properties of longitudinal progressive waves.
28. A drop of water having surface tension $7.12 \times 10^{-2} \text{ Nm}^{-1}$ of radius $6 \times 10^{-3} \text{ m}$ is split into 216 equal tiny drops. Find the excess of pressure in any one of the small drops.
29. Calculate the excess pressure inside a soap bubble of radius 3 mm. Surface tension of soap solution is $20 \times 10^{-3} \text{ N/m}$. Also calculate the surface energy of the bubble.
30. A capillary tube of length 0.35 m and radius $0.38 \times 10^{-3} \text{ m}$ fitted horizontally at the bottom of a constant pressure head arrangement in which water level remains constant at a height of 0.25 m above the axis of the tube. If 40×10^{-6} cubic metre of water flows out through the capillary in 10 minutes, calculate the viscosity of water.
31. What are the important assumptions made in deriving Poiseuille's formula?

(6 × 4 = 24 Marks)

PART – D

Answer any two questions. Each carries 15 marks.

32. Derive the expression for moment of inertia of a solid sphere about (a) its diameter (b) a tangent.
33. With necessary theory, describe a method for determining the moment of inertia of a fly wheel.
34. What is a cantilever? Derive an expression for the depression produced at the free end of cantilever loaded at its free end.
35. Derive the expression for the excess of pressure on a curved liquid surface. Hence obtain the expression for the excess pressure inside a bubble.

(2 × 15 = 30 Marks)

First Semester B.Sc. Degree Examination, March 2023

First Degree Programme under CBCSS

Physics

Complementary Course for Chemistry

PY 1131.2 — ROTATIONAL DYNAMICS AND PROPERTIES OF MATTER

(2018 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer all questions. Each question carries 1 mark.

1. Write the unit and dimension of moment of inertia.
2. Give example of a rigid bodies having equal values of principal moments of inertia.
3. What is the moment of inertia of a rectangular lamina?
4. Write the equation of motion of a torsion pendulum.
5. What are the types of wave motion?
6. Give one dimensional wave equation.
7. What is the unit of coefficient of viscosity?
8. What happens to viscosity, if temperature is increased?
9. What is the rate of flow of a liquid through a capillary tube?
10. What is the dimension of Young's modulus?

(10 × 1 = 10 Marks)

P.T.O.

SECTION – B

Answer any **eight** questions. Each question carries **2** marks.

11. Discuss the types of motion of a rigid body.
12. State perpendicular axis theorem.
13. Define amplitude of a wave.
14. Discuss the characteristics of wave motion.
15. What are spherical waves?
16. Oil spreads over surface of water whereas water does not spread over surface of oil. Explain.
17. What are the factors that depend on the flow of a liquid through a capillary tube?
18. What are the limitations of Poiseuille's formula?
19. Differentiate cohesive and adhesive force.
20. What is angle of twist?
21. Differentiate uniform and non-uniform bending
22. Explain torsional rigidity.

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** questions, not exceeding a paragraph. Each carries **4** marks.

23. A thin uniform disc of radius 25 cm and mass 1 kg has a hole of radius 5 cm at a distance of 10 cm from the center of the disc. Calculate the moment of inertia of the disc about an axis perpendicular to the plane and passing through the center of the hole.
24. A solid cylinder of radius 6.0 cm is suspended by a vertical wire as a torsion pendulum. The axis of the cylinder is along the wire. Find the moment of torsion, t , of the wire if the mass of the cylinder be 5.0 kg and period of vibration 4.0 s.
25. A thin circular ring is suspended from a peg so that it can oscillate about it. Determine its period of oscillation if its radius is 10 cm.

26. Surface tension of a soap solution is 0.05 N/m . How much work is done to produce the soap bubble of radius 0.03 m ?
27. Two solid cylinders of solid material having length l and $2l$ and radii r and $2r$ are joined coaxially. Under a couple applied between free ends, the shorter cylinder show twist 30° . Calculate the twist of the longer cylinder.
28. Discuss the theory of surface tension.
29. Explain the theory and principle to determine the moment of inertia of a fly wheel.
30. Calculate the Young's modulus of a wire 100 cm long and 3 mm thick, which increases by 0.1 cm when stretched by a weight of 64.1 kg ?
31. Using parallel axis theorem, calculate moment of inertia of a disc of mass 200 g and radius 5 cm about an axis passing through its edge and perpendicular to plane of the disc.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. Each question carries **15** marks.

32. (a) Discuss Parallel and perpendicular axis theorems.
- (b) Calculate the moment of inertia of an annular disc of mass M and radius R about
- (i) its own axis,
 - (ii) about tangential axis parallel to its own axis,
 - (iii) about its diameter, and
 - (iv) about a tangential axis parallel to its diameter.
33. What are plane progressive harmonic waves? What are its characteristics? Obtain the equation of energy density of a plane progressive wave. What is its significance?

34. Deduce the expression for excess of pressure on the curved liquid surface like spherical surface, cylindrical surface and catenoid.
35. What is bending of beams? What happens to a beam supported at its ends and loaded in the middle?

(2 × 15 = 30 Marks)

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