

2018/TDC/ODD/PHYC-102T/055

TDC (CBCS) Odd Semester Exam., 2018

PHYSICS

(1st Semester)

Course No.: PHSHCC-102T

(Mechanics)

Full Marks: 50
Pass Marks: 20

Time: 3 hours

The figures in the margin indicate full marks for the questions

Answer all questions

UNIT—I

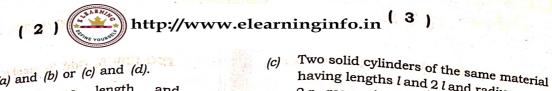
1. Answer any two questions of the following:

 $2 \times 2 = 4$

- (a) Explain reference frames and Galilean transformations.
- (b) Explain, in brief, conservative and non-conservative forces.
- (c) Two particles of masses 100 g and 300 g have at a given time position vectors $(2\hat{i} + 5\hat{j} + 13\hat{k}) m$ and $(-6\hat{i} + 4\hat{j} 2\hat{k}) m$ respectively. Find the position vector of centre of mass.

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having lengths l and 2l and radius r and

restoring torque that comes to play

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2. Answer either (a) and (b) or (c) and (d).

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Explain, in brief, rigidity modulus and

Poisson's ratio.

 2. Answer either (a) and (b) of (c) (a) Show that whereas length and acceleration are invariant with respect to Galilean transformation, velocity is not. (b) Prove that in centre of mass system, the magnitude of the velocities (or speeds) of the particles remain unaltered in elastic collision. 	3	2 r respectively are joined coaxially. Under a couple applied between free ends, the shorter cylinder shows a twist of 30°. Calculate the twist of large cylinder. 2 Answer either (a) and (b) or (c) and (d). (a) Show that angular momentum L of a system of particles at
(c) Establish the law of conservation of linear momentum with the help of	3	system of particles about a point can be expressed as $\vec{L} = \vec{L}_{CM} + \vec{R}_{CM} \times \vec{MV}_{CM}$
(d) What is the potential energy curve of a particle? From a potential energy curve, explain the terms, states of stable and unstable equilibrium.	3	(b) If Y, K and σ represent Young's modulus, bulk modulus and Poisson's ratio respectively, then show that $K = \frac{Y}{3(1-2\sigma)}$
Unit—II Answer any two questions of the following: (a) Show that the time rate of change of	7	(c) State the theorems of parallel and perpendicular axes of moment of inertia.
angular momentum of a particle is equal to the torque acting on it. (b) Explain, in brief, rigidity modulus and	2	(d) A cylinder of length l and of radius a is clamped at one end and a torque is applied at the other end. Establish the

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during the twisting of the cylinder is given by

 $\tau = \frac{\pi \eta a^4}{2l} \varphi$

when η is the modulus of rigidity and ϕ is the angle of twist.

UNIT-III

- 5. Answer any two questions:
 - (a) Define inertial mass and gravitational mass.
 - (b) Calculate the gravitational potential on the surface of earth using the following data:

Radius of the earth = 6.37×10^8 cm Mean density of earth = 5.53 g

Gravitational const. = 6.66×10^{-8} CGS units

(c) Describe in brief global positioning system (GPS).

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6. Answer either (a) and (b) or (c) and (d):

- (a) Obtain an expression for gravitational potential due to a solid sphere at a point outside the sphere. What will be the potential when the point lies on the surface of the sphere?
- (b) Explain in brief how a satellite may be placed in its orbit round the earth and find an expression for its orbital velocity.
- (c) Show how two-body problem under central forces can always be reduced to the form of one-body problem.

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(d) State Kepler's laws of planetary motion and using the deductions from Kepler's laws, show that the force of attraction between the sun and the planet is directly proportional to the product of their masses.

UNIT-IV

- 7. Answer any two questions:
 - (a) Explain the term resonance in connection with forced oscillations.
 - (b) Write the differences between inertial and non-inertial frames of references. 2

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(6) http://www.elearninginfo.in (7)

Explain in brief the outcome (c) Calculate the displacement to amplitude Michelson-Morley experiment. ratio in case of SHM, when the KE is Write a short note on relativistic doppler 90% of total energy. 2 8. Answer either (a) and (b) or (c) and (d). 10. Answer either (a) and (b) or (c) and (d). (a) Show that the time period of a simple Write down Lorentz transformation equation and show that for ordinary harmonic oscillator is given by speed, Lorentz transformation equation $T = 2\pi \sqrt{\frac{\text{displacement}}{\text{acceleration}}}$ reduces to Galilean transformation. 3 Deduce Einstein's formula for addition (b) What is Coriolis force? Under what of velocities. conditions does it come into play? 3 What do you understand by time dilatation? Explain the term proper time Write down differential equation of in connection with the theory of damped vibration and solve it to find the general equation of displacement. relativity. 3 Deduce Einstein's mass-energy relation. State the components of velocity and acceleration in cylindrical coordinate 3 system. UNIT-V

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9. Answer any two questions:

(a) A particle of mass 10^{-24} kg is moving with a speed of 1.8×10^8 ms⁻¹. Calculate

its mass when it is in motion.

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