

TDC (CBCS) Odd Semester Exam., 2018

PHYSICS

( 1st Semester )

Course No. : PHSGEC-101 T/PHSDSC-101 T

( 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. (a) Answer any *three* questions from the following : 1×3=3
- (i) What is scalar product of two vectors?
  - (ii) Define vector product of two vectors.
  - (iii) Cite an example of first-order homogeneous differential equation.
  - (iv) What do you mean by second-order homogeneous differential equation?

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(b) Answer any one question from the following : 2

(i) Determine the value of  $a$  so that

$$\vec{A} = 2\hat{i} + a\hat{j} + \hat{k}$$

$$\text{and } \vec{B} = 4\hat{i} - 2\hat{j} - 2\hat{k}$$

are perpendicular to each other.

(ii) If

$$\vec{A} = A_1\hat{i} + A_2\hat{j} + A_3\hat{k}$$

$$\text{and } \vec{B} = B_1\hat{i} + B_2\hat{j} + B_3\hat{k}$$

prove that

$$\vec{A} \cdot \vec{B} = A_1B_1 + A_2B_2 + A_3B_3$$

2. Answer either (a) or (b) : 5

(a) Show that the vectors  $\vec{A} = 3\hat{i} - 2\hat{j} + \hat{k}$ ,  
 $\vec{B} = \hat{i} - 3\hat{j} + 5\hat{k}$ ,  $\vec{C} = 2\hat{i} + \hat{j} - 4\hat{k}$  form a  
 right-angled triangle.

(b) Prove that

$$\vec{A} \times (\vec{B} \times \vec{C}) = \vec{B}(\vec{A} \cdot \vec{C}) - \vec{C}(\vec{A} \cdot \vec{B})$$

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# UNIT—II

3. (a) Answer any three questions from the following : 1×3=3

(i) Define a frame of reference.

(ii) State Newton's second law of motion.

(iii) What do you mean by conservation of energy principle?

(iv) What is angular velocity?

(b) Answer any one question from the following : 2

(i) Find the work done in moving an object along a vector  $\vec{r} = 3\hat{i} + 2\hat{j} - 5\hat{k}$  when the applied force is  $\vec{F} = 2\hat{i} - \hat{j} - \hat{k}$ .

(ii) Explain in brief the conservation of angular momentum.

4. Answer either (a) or (b) :

(a) State Newton's first law of motion. Show that Newton's first law is contained in the second law of motion. What is centre of mass for a system of particles?

1+3+1=5

(b) What do you mean by conservation of linear momentum? Write a short note on motion of rocket.

1+4=5

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UNIT—III

5. (a) Answer any *three* questions from the following :  $1 \times 3 = 3$
- (i) What is gravitational force?
  - (ii) What do you mean by a central force field?
  - (iii) Define geosynchronous orbit.
  - (iv) What is weightlessness?
- (b) Answer any *one* question from the following :  $2$
- (i) State Newton's law of gravitation and hence obtain the universal gravitational constant.
  - (ii) Give a brief basic idea of global positioning system (GPS).
6. Answer *either* (a) or (b) :
- (a) Write the characteristics of the motion of a particle in a central force field. State Kepler's laws of planetary motion.  $2+3=5$
- (b) Given the radius of earth is  $R$ . An artificial satellite of mass  $m$  is moving around the earth in a circular orbit of radius  $(R+h)$ . Derive an expression for the speed of the artificial satellite.  $5$

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UNIT—IV

7. (a) Answer any *three* questions from the following :  $1 \times 3 = 3$
- (i) Define elasticity for a material.
  - (ii) State Hooke's law.
  - (iii) What is Poisson's ratio?
  - (iv) What do you mean by a restoring torque?
- (b) Answer any *one* question from the following :  $2$
- (i) Explain why steel is more elastic than rubber.
  - (ii) Within elastic limit, show the stress-strain diagram for a metal wire.
8. Answer *either* (a) or (b) :  $5$
- (a) Connecting the three elastic constants, derive the following relation :
- $$\frac{9}{Y} = \frac{3}{\eta} + \frac{1}{K}$$
- Here the symbols have their usual meaning.

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- (b) Describe in brief the working principle of torsional pendulum in determining the moment of inertia of a given body.

UNIT—V

9. (a) Answer any *three* questions from the following : 1×3=3

- (i) What do you mean by surface tension?
- (ii) Define the coefficient of viscosity of a liquid.
- (iii) Write the length contraction formula as per the special theory of relativity.
- (iv) Write whether an interval between two events occurring at a point in a moving frame, appears to be longer or shorter to an observer in a stationary frame.

- (b) Answer any *one* question from the following : 2

- (i) State the expression for excess pressure inside a spherical soap bubble.
- (ii) Explain in brief the time dilation in special theory of relativity.

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10. Answer *either* (a) or (b) : 5

- (a) Give a detailed explanation of surface tension.
- (b) Derive Poiseuille's formula for the determination of coefficient of viscosity of a liquid.

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