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2018/TDC/ODD/PHYG–101 T/056

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

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

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

are perpendicular to each other.

(ii) If

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

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

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

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 : 1×3=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 : 1×3=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.

(Turn Over)

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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 occuring 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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