**TDC (CBCS) Odd Semester Exam., 2020
held in March, 2021**

PHYSICS

(1st Semester)

Course No. : PHSDSC/PHSGE–101T

(Mechanics)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

SECTION—A

Answer any *fifteen* questions :   1×15=15

1. Define scalar product of two vectors.

2. State the triangle law of vector addition.

3. Does commutative law hold good in vector product?

(Turn Over)

4. For the orthogonal triad of unit vectors $\hat{i}$, $\hat{j}$ and $\hat{k}$, what are the values of $\hat{i} \times \hat{k}$ and $\hat{k} \times \hat{j}$?

5. Give an example of first order homogeneous differential equation.

6. What do you mean by degree of a differential equation?

7. Define inertial frame of reference.

8. State Newton's second law of motion.

9. State the law of conservation of energy.

10. Define centre of mass.

11. What do you mean by angular velocity?

12. What do you understand by angular momentum?

13. State Newton's law of gravitation.

14. What do you understand by weight-lessness?

15. State Kepler's second law of planetary motion.

16. What do you understand by a central force?

17. What is Global Positioning System (GPS)?

18. What are the dimensions of universal gravitational constant G?

19. Define bulk modulus.

20. What is Poisson's ratio?

21. What are the dimensions of Young's modulus Y?

22. Define elastic limit.

23. What is elastic fatigue?

24. Define angle of shear.

25. Define coefficient of viscosity of a fluid.

26. What do you understand by angle of contact in case of liquid?

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27. What is the SI unit of surface tension?

28. What is the value of angle of contact for pure water and clean glass?

29. Write any one postulate of special theory of relativity.

30. What is the velocity profile of a liquid flowing through a capillary?

SECTION—B

Answer any *five* questions : $2 \times 5 = 10$

31. If unit vectors $\vec{A}$ and $\vec{B}$ are inclined at an angle θ, then prove that

$$\left| \vec{A} - \vec{B} \right| = 2 \sin \frac{\theta}{2}$$

32. Prove that

$$(\vec{A} + \vec{B}) \cdot [(\vec{B} + \vec{C}) \times (\vec{C} + \vec{A})] = 2\vec{A} \cdot (\vec{B} \times \vec{C})$$

33. Show that torque is given by the time rate of change of angular momentum.

34. State Newton's third law of motion and give an example of application of this law.

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35. A sphere of mass 19 kg is attracted by another sphere of mass 150 kg when their centres are separated by a distance of 0·28 m with a force equal to the weight of 0·25 mg. Calculate the gravitational constant.

36. What are central and non-central forces? Give two examples of each.

37. What force is required to stretch a steel wire $\frac{1}{2}$ sq. cm in cross-section to double its length? $Y = 2 \times 10^{11}$ N-m^{-2}.

38. Explain the terms 'stress' and 'strain'.

39. What do you understand by synclastic and anticlastic surfaces?

40. How does viscosity change with temperature?

SECTION—C

Answer any *five* questions : $5 \times 5 = 25$

41. Show that the vectors $5\vec{a} + 6\vec{b} + 7\vec{c}$, $7\vec{a} - 8\vec{b} + 9\vec{c}$ and $3\vec{a} + 20\vec{b} + 5\vec{c}$ are coplanar, $\vec{a}, \vec{b}$ and $\vec{c}$ being three non-collinear vectors.

(6)

42. Solve the equation $y + \dfrac{dy}{dx} = 5x.$

43. State the law of conservation of linear momentum and derive it from Newton's laws of motion.

44. State and prove work-energy theorem.

45. When a particle moves under a central force, prove that the areal velocity of the radius vector remains constant.

46. A satellite revolves in a circular orbit around the earth at a height h from the earth's surface. Obtain the expressions for its orbital velocity and time period.

47. If Y, K and σ represent Young's modulus, bulk modulus and Poisson's ratio respectively, then prove that

$$K = \frac{Y}{3(1 - 2\sigma)}$$

48. Deduce an expression for the couple required to twist a uniform solid cylinder by an angle.

(7)

49. Starting from Lorentz transformation equations for space and time coordinates, derive equations for relativistic addition of velocities.

50. Give with necessary theory Poiseuille's method of determining the coefficient of viscosity of a liquid.

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