2020/TDC(CBCS)/ODD/SEM/
PHSSEC–501T/159

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

PHYSICS

(5th Semester)

Course No. : PHSSEC–501T

(Basic Instrumentation Skills)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer the following as directed (any *fifteen*) : 1×15=15

1. Define sensitivity in measurements.

2. What is the resolution range in measurements?

3. Write one significance of a multimeter.

4. What is relative error in measurements?

5. Define loading effect.

6. Write one cause of poor precision in scientific measurements.

7. What is rectifier?

8. The resistance of an ideal voltmeter is

   (a) low

   (b) high

   (c) infinite

   (Choose the correct option)

9. Electronic voltmeters are designed to measure

   (a) only very small voltage

   (b) only very high voltage

   (c) both very small and high voltages

   (Choose the correct option)

10. The range of electronic voltmeter can be extended by using

    (a) functional switch

    (b) input attenuator

    (c) rectifier

    (Choose the correct option)

11. The input impedance of an electronic voltmeter is

    (a) low

    (b) high

    (c) medium

    (d) zero

    (Choose the correct option)

12. The sensitivity of an electronic voltmeter is very high.

    (Write True or False)

13. CRO is used for the measurement of

    (a) AC as well as DC current

    (b) AC current only

    (c) DC current only

    (Choose the correct option)

14. In a radio application, CRO is used for measuring

    (a) audio frequency range

    (b) a narrow range of frequencies

    (c) a wide range of frequencies

    (d) radio frequency range

    (Choose the correct option)

15. In medical application, CRO can be used for

(a) measuring the heartbeats

(b) monitoring the brain

(c) displaying cardiograms

(Choose the correct option)

16. A CRO cannot be used in transmission lines.

(Write True or False)

17. If the negative potential on the control grid of a CRT is increased the intensity of the spot

(a) is increased

(b) is decreased

(c) remains same

(Choose the correct option)

18. Rays emitted by a cathode ray tube are

(a) lights

(b) radiations

(c) signals

(d) electrons

(Choose the correct option)

19. Define *Q*-factor.

20. What is a *Q*-meter?

21. State the principle of working of a *Q*-meter.

22. In a series *R-L-C* circuit operating above the resonant frequency, the current

(a) lags the applied voltage

(b) leads the applied voltage

(c) is in phase with the applied voltage

(Choose the correct option)

23. What is the use of a pulse generator?

24. Which bridge is used for the measurement of inductance?

25. Output of a digital multimeter is

(a) mechanical

(b) optical

(c) electrical

(Choose the correct option)

26. What is the basic difference between analog and digital instruments?

27. The range of a digital voltmeter is

(a) 1 V to 1 MV

(b) 1 V to 1 kV

(c) 1 kV to 1 MV

(Choose the correct option)

28. What is frequency counter?

29. What is timebase stability?

30. A quantity having discrete numerical value is

(a) an analog quantity

(b) a digital quantity

(c) a binary quantity

(Choose the correct option)

SECTION—B

Answer any *five* of the following questions : 2×5=10

31. What are the basic specifications of a multimeter?

32. Distinguish between accuracy and precision.

33. Explain two advantages of an electric voltmeter over conventional voltmeter.

34. What is the difference between rectifier and amplifier?

35. State the basic working principle of CRO.

36. Which two CRO controls can be used together to obtain sharp and fine display pattern?

37. What is the impedence at the resonant frequency of a series *R-L-C* circuit with L = 20 mH, $C = 0 \cdot 02$ μF and $R_W = 90\ \Omega$?

38. What is the significance of a capacitor in Maxwell bridge?

39. Define the following parameters of digital meter :

(a) Accuracy

(b) Sensitivity

40. Name the basic building block of digital multimeter.

SECTION—C

Answer any *five* of the following questions : 5×5=25

41. Explain the principles of measurements of a.c. voltage and a.c. current with the help of multimeter.

42. Explain how you will measure d.c. voltage, d.c. current and resistance with the help of a multimeter.

43. Draw the block diagram of a.c. millivoltmeter and state its significance.

44. Explain the specification and significance of an electronic voltmeter.

45. Draw the labelled block diagram of CRO and state the functions of each block.

46. Explain the four basic parts of CRT.

47. Draw a labelled block diagram of a pulse generator with explanation and state its function.

48. Explain with block diagram the working principle of *R-L-C* bridge. Also state its specification.

49. Explain with block diagram the working of a digital multimeter.

50. State the characteristics and working of a digital voltmeter.

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2020/TDC(CBCS)/ODD/SEM/
PHSDSE-501T/157

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

PHYSICS

(5th Semester)

Course No. : PHSDSE-501T

(Classical Dynamics)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer any *twenty* of the following questions as directed : 1×20=20

1. Which of the following is not affected by a magnetic field?

(a) Moving charge

(b) Stationary charge

(c) Direction of motion of charge

(d) Current flowing in a conductor

(Choose the correct option)

2. When a charge particle moves at right angles to the magnetic field, the variable quantity is

   (a) momentum

   (b) speed

   (c) energy

   (d) moment of inertia

   (Choose the correct option)

3. What is the ratio of magnetic force to the electric force on a charged particle staying undeflected in a field?

4. Three particles viz proton, electron and alpha particle enter a region of constant magnetic field with same velocities. The magnetic field is perpendicular to the velocity. Which particle will have maximum force?

5. What is meant by crossed electric field and magnetic field?

6. What will be the Coriolis force for a particle moving with certain velocity as observed from a non-rotating frame?

7. What will be the Coriolis force on a particle moving along the axis of rotation of earth?

8. In which direction a moving body turns in the northern hemisphere due to Coriolis effect?

9. Suppose an ant is free to move on the surface of a spherical ball. Considering centre at the origin, write the constraint equation.

10. Number of generalized coordinates to describe a system is always equal to the degrees of freedom.

    (State True or False)

11. Define virtual work.

12. Write the relation between Lagrangian and action.

13. How many Euler-Lagrangian equations will be there, if a system is described by three generalized coordinates?

14. State d'Alembert's principle.

15. What do you mean by scleronomic constraint?

16. State Hamilton's principle.

17. Define canonical momentum.

18. Write down the expression of Hamiltonian in terms of Lagrangian, generalised coordinate and generalised momentum.

19. Number of initial conditions remains same for both Hamiltonian and Lagrangian formulations.

(State True or False)

20. Define central force.

21. Angular momentum is conserved for central force problem because potential is independent of θ.

(State True or False)

22. For $E < 0$, what will be the trajectory of a particle under a central force field?

23. Is the central force always attractive?

24. Write Hamilton's equations of motion.

25. What do you mean by equilibrium in the context of oscillation?

26. When is an equilibrium said to be stable?

27. Give an example of a system with stable equilibrium.

28. Around stable equilibrium, potential energy can be linearly dependent on position coordinates.

(State True or False)

29. What is secular equation?

30. What do you mean by small oscillations of a mechanical system?

31. Define normal coordinates.

32. What are eigenfrequencies?

33. What is the relation between fluid density and pressure?

34. Write the dimensional formula of pressure.

35. Pressure of 1 atm is _____ Pa.

(Fill in the blank)

36. What is streamline motion?

37. Turbulence results in loss of pressure.

(State True or False)

38. Equation of continuity is based on which conservation law?

39. What is Reynolds number?

40. Mention a limitation of Poiseuille's equation.

SECTION—B

Answer any *five* of the following questions : 2×5=10

41. Coriolis force does no work. Justify the statement.

42. Define gyrofrequency and gyroradius.

43. Check whether the following constraint is holonomic or not :

$$2z\,dz + y\,dy - x\,dx = 0$$

44. What are the characteristics of constraint forces?

45. Show that angular momentum of a body under the action of a central force is a constant of motion.

46. Prove that if L is not an explicit function of time, H is a constant of motion.

47. The potential energy of a particle is given by

$$V(x) = 3x^4 - 8x^3 - 6x^2 + 24x$$

Determine the points of stable and unstable equilibrium.

48. A particle moves in a potential field given by

$$V(x) = bx^2 + \frac{a}{x^2};\ a, b > 0$$

Show that its frequency of oscillation is $\sqrt{\frac{8b}{m}}$.

49. If a liquid enters a pipe of diameter d with a velocity v, find its velocity at the exit if the diameter reduces to $0{\cdot}5d$.

50. What conclusions can we draw from the equation of continuity in the case of fluid?

SECTION—C

Answer *any* **five** questions

51. A charge particle of mass $19{\cdot}9\times10^{-27}$ kg and charge $1{\cdot}6\times10^{-19}$ C moves with a speed of 3×10^5 m/s at right angles to a magnetic field of 0·75 T. Find the force acting on the charge, centripetal acceleration and radius of the circle in which the charge particle moves. 2+3+3=8

52. What is Coriolis force? Why is Coriolis force called a pseudo force? Mention some of the real effects of Coriolis force on earth. Show that for a single particle with constant mass, the equation of motion can be put in the form $\frac{dT}{dt} = \vec{F} \cdot \vec{V}$, where T is the kinetic energy, $\vec{F}$ is the force applied and $\vec{V}$ is the velocity. 1+1+2+4=8

53. Deduce d'Alembert's principle. A particle is acted upon by a number of forces. Applying d'Alembert's principle, find the equation of motion of the particle. 3+5=8

54. Starting from d'Alembert's principle, deduce Lagrangian equation of motion. 8

55. Starting from a generalised Lagrangian $L(q_i, \dot{q}_i, t)$, deduce Hamilton's canonical equations. For a conservative system, show that the Hamiltonian function is equal to total energy. 4+4=8

56. Show that the differential equation for the orbit of any particle under the action of a central force F is given by

$$\frac{d^2u}{d\theta^2} + u = \frac{m}{L^2u^2}F\left(\frac{1}{u}\right)$$

where $u = \frac{1}{r}$ and (r, θ) is the coordinate of a particle of angular momentum L. Prove that no central force can enable a particle to move in a straight line. 5+3=8

57. Explain briefly the importance of formulation of small oscillations in physics. Two masses m_1 and m_2 are joined by a spring of force constant k. The spring gets compressed and released so that the system vibrates with a frequency ω. Show that

$$\omega = \sqrt{\frac{k(m_1 + m_2)}{m_1 m_2}}$$

2+6=8

58. The Lagrangian of a system is given by

$$L = \frac{1}{2}(\dot{x}^2 + \dot{y}^2) - \frac{1}{2}(\omega_1 x^2 + \omega_2 y^2) + \alpha xy$$

Find the normal frequencies and normal coordinates. 4+4=8

59. What are the assumptions made by Poiseuille? Deduce Poiseuille's equation. 2+6=8

60. Obtain the relation between critical velocity and Reynolds number for a liquid flowing through a capillary tube.
Use Poiseuille's formula to show that if two capillary tubes of radii r_1 and r_2 and length l_1 and l_2 respectively are connected in series, the rate of flow V is given by

$$V = \frac{\pi P}{8\eta}\left(\frac{l_1}{r_1^4} + \frac{l_2}{r_2^4}\right)^{-1}$$

where P is the atmospheric pressure and η is the coefficient of viscosity. 3+5=8

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