Let us suppose a particle of mass m is executing SHM. If x be its displacement at any instant from the equilibrium position, then the restoring force is $F = - kx$.\\

From Newton's law, the equation of motion is

\begin{equation}

m\frac{d^2x}{dt^2} = -kx

\end{equation}

\begin{equation}\label{diffeqn}

\text{or,}\frac{d^2x}{dt^2} + \omega^2x = 0,

\end{equation}

where $\omega^2 = k/m$. Equation \eqref{diffeqn} is the differential equation of motion of a simple harmonic oscillator.

\section{Solution:}

The general solution of equation \eqref{diffeqn} is

\begin{equation}\label{sol}

x = a \sin(\omega t + \phi)

\end{equation}

\end{document}

10

U.G. 3rd Semester Examination-2024

PHYSICS

[HONOURS]

Skill Enhancement Course (SEC)

Course Code : PHY-H-SEC-T-01(A-D)

[CBCS]

Full Marks : 40 Time : 2 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer all the questions from Selected Option.

OPTION–A

PHY-H-SEC-T-01

(Basic Instrumentation Skills)

GROUP–A

1. Answer any **five** questions: 2×5=10

   a) What is "loading effect"?

   b) What are the uses of CRO?

   c) Explain what do you mean by impedance bridge?

   d) What are the essential components of Cathode Ray Tube?

e) Write down the full form of DAC and ADC.

f) What type of error can occur in an experiment?

g) What do you mean by digital storage oscilloscope?

h) Write down some uses of signal generators.

GROUP-B

2. Answer any **two** questions: 5×2=10

a) Draw the basic block diagram of an electronic voltmeter and explain each block. 2+3

b) Write down the steps for measuring AC and DC voltage by using multimeter. 5

c) Write a short note on low frequency signal generator. What are the differences between signal generators and function generators? 3+2

d) Write down the colour code for measuring resistance of a resistor. Explain briefly with a suitable example for measuring resistance of a resistor by colour code. 2+3

GROUP-C

3. Answer any **two** questions: 10×2=20

a) What do you mean by impedance bridge? Write down the working principle of RLC bridge. What is the specification of digital LCR meter. 2+5+3

b) Discuss accuracy, precession and resolution of an instrument used in some measurement. What do you mean by average deviation and standard deviation? A set of independent voltage measurement taken by four observers was recorded as 117.02 V, 117.11 V, 117.08 V and 117.03 V. Calculate average voltage and average deviation. 3+4+3

c) Discuss the working principle of Electronic Voltmeter. What are the advantages of Electronic Voltmeter over conventional Voltmeter? Why the input impedance of an electronic voltmeter is high? How many types of electronic voltmeters are available in the market? Draw a block diagram of AC voltmeter specifying clearly each block. 2+2+2+1+3

d) Draw the block diagram of a general purpose CRO and indicates its basic components. Write short note on pulse generator. (3+2)+5

OPTION–B

PHY-H-SEC-T-01

(Electrical Circuit and Network Skills)

GROUP–A

1. Answer any **five** questions: 2×5=10

   a) Define power factor of an AC circuit.

   b) State Thevenin's Theorem.

   c) What are the advantages of 3 phase circuits over single phase circuits?

   d) Show that the quantity L/R has the dimension of time.

   e) Give two examples where Ohm's is not valid.

   f) How can a multimeter be used to test a diode?

   g) Define current density.

   h) What is the main purpose of commutators and brushes for a generator?

GROUP-B

2. Answer any **two** questions: 5×2=10

   a) State the maximum power transfer theorem. Explain the procedure to convert a practical Voltage source into an equivalent Current source. 2+3

   b) What is the significance of back EMF? An alternating voltage is given by $V=220sin(100t)$. Calculate (i) frequency, (ii) maximum value. (iii) average value. (iv) RMS value of the above mentioned voltage. 1+4

   c) If $Z_1=3+j7$ and $Z_2=12+j16$ are connected in parallel, find the equivalent impedance of combination.

   Derive the expression for resonance frequency for parallel LCR circuit. 2+3

   d) Calculate the r.m.s. value and the form factor of a periodic voltage having the following values for equal time intervals changing suddenly from one value to the next: 0, 5, 10, 20, 50, 60, 50, 20, 10, 5, 0, -5,-l0 V etc. What would be the r.m.s value of sine wave having the same peak value? 4+1

GROUP-C

3. Answer any **two** questions: 10×2=20

   a) What are the various types of drawing used for electrical wiring? Explain in detail. An alternating voltage of 240 V. 60 Hz is applied to a coil which takes 10Amp of current. The power absorbed by the circuit is 0.5 KW. Calculate the resistance and reactance of the coil. 5+5

   b) With a neat circuit diagram, explain the construction and principle of operation of AC Motor. Write short notes on DC generators. 5+5

c) With a neat circuit diagram explain the construction and principle of operation of DC Generator. An alternating voltage is given by $V=220\sin(314t)$. Calculate i) frequency, ii) maximum value, iii) average value, iv) RMS value. Why no transient is produced in pure resistive circuit? 5+4+1

d) Explain the basic principle of a magnetic contactor. List the various parts of a transformer and write the emf equation involved. Write a short note on conduit wiring. 3+4+3

OPTION–C
PHY-H-SEC-T-01
(Physics Workshop Skills)
GROUP–A

1. Answer any **five** questions: 2×5=10
   a) What do you understand by Laser welding?
   b) What is S.I. unit of power? Find its dimension.
   c) What do you understand by metal casting?
   d) Define capacitance.
   e) Define Mechanical advantage of a Lever.
   f) Classify the manufacturing process.
   g) Find out the least count of a screw gauge having screw pitch 2 mm. The total number of division in circular scale is 100.
   h) What do you understand by a PCB board?

GROUP-B

2. Answer any **two** questions: 5×2=10
   a) Draw and explain the pin out diagram of a 555 timer. 1+4
   b) A Slide Calliper has 100 Vernier divisions in Vernier scale. The main scale is a centimeter scale with 1 m.s.d.= 0.1 cm. Find its Vernier constant (V.C.). Explain how will you measure the volume of a cylindrical block using a Slide Calliper? 2+3
   c) What are the advantages of laser beam welding over arc welding? Give some specific application of laser beam welding. 1+4
   d) Explain the construction and working principle of a power generator. 2+3

GROUP-C

3. Answer any **two** questions: 10×2=20

a) i) What are the different steps involved in making a casting?

ii) What are the advantages of metal casting?

iii) Write down some application of Metal Casting. $5+2\frac{1}{2}+2\frac{1}{2}$

b) i) Explain the operation of a transistor as a switch.

ii) What are the uses of a digital multimeter?

iii) What do you understand by avalanche breakdown and zener breakdown of a Zener diode?

iv) Draw the I-V characteristics of Zener diode. 4+2+3+1

c) i) What is a Sextant? Explain it with a schematic Diagram.

ii) A see saw is 30 ft long with a fulcrum in the middle of the board. If a 70 pound child sits 5 ft. from the fulcrum, what is the lowest weight that will lift the child? 2+4+4

d) i) What is a lever? Explain the three types of lever with proper example.

ii) What are the functions of brakes? 2+5+3

OPTION–D

PHY-H-SEC-T-01

(Computational Physics Skills)

GROUP–A

1. Answer any **five** questions: 2×5=10

a) Classify the Fortran constants with examples.

b) Write down at least two internal and two external Linux commands.

c) Define Algorithm. Why algorithm is necessary in solving any problem?

d) By default, in implicit typing of Fortran language, identify which are integer or real variables out of the following?

NLIST, KIRC, STM, ABCD2, IND1, POOL5

e) Name the usepackage to include mathematical symbols and graph in Latex.

f) What is the equation form of the following Latex commands?

```
\begin{equation}
R = \frac{2}{N^2} \left(\frac{\dot A}{A} +
\frac{\dot B}{B}\right
\end{equation}
```

g) Write down arithmetic, relational, logical and assignment operators (at least one of each) available in Fortran.

h) What is the meaning of the following command?

gnuplot> plot [–10:10][–2:2] sin(x)

GROUP-B

2. Answer any **two** questions: 5×2=10

a) Construct an algorithm and flowchart to read two numbers and determine the larger. 2+3

b) How do you include a figure in Tex? How do you insert references in Tex and recall them? $2\frac{1}{2}+2\frac{1}{2}$

c) Write down a programme in Fortran language to find the roots of a quadratic equation. 5

d) Convert the following structure into DO loop:

```
      I=1, ISUM=0
10    IF (I.LE.10) THEN
      ISUM=ISUM+I
      I=I+1
      GOTO 10
      ELSE
      WRITE(*,*) ISUM
      END IF
```

5

GROUP-C

3. Answer any **two** questions: 10×2=20

a) Prepare a flowchart for calculation of sin(x) as a series. Write down the algorithm for product of two matrices. 5+5

b) What is Gnuplot? What is Linux? Describe how will you plot the trajectory of a particle projected making an angle with the horizontal direction using Gnuplot. $1\frac{1}{2}+1\frac{1}{2}+7$

c) Write down a programme in Fortran language to find the sum and product of a finite series. 10

d) Write down the following LaTex snippet:

```
\documentclass[11pt, a4]{article}
\usepackage{amsmath}
\begin{document}
\title{Simple Harmonic Motion}
\maketitle
\section{Introduction:}
In Simple harmonic motion, restoring force acting on the particle is always directed towards a fixed point known as equilibrium position and the magnitude of force is directly proportional to the displacement of particle from the equilibrium position.
\section{Equation of motion:}
```