



B.Sc./4th Sem (H)/PHYS/24(CBCS)

2024

4th Semester Examination

PHYSICS (Honours)

Paper : SEC 2-T

[CBCS]

Full Marks : 25

Time : Two Hours

*The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.*

Illustrate the answer wherever necessary.

[Computational Physics]

Group - A

Answer any *three* questions : $2 \times 3 = 6$

1. What is computer programming language? Explain with example.
2. Write down four Linux commands.
3. What are the differences between function and subroutine in Fortran?
4. What is GOTO statement in Fortran?
5. Write down the nested DO loop syntax in Fortran.

P.T.O.

(2)

Group - B

Answer any *two* questions :

5×2=10

6. Explain different types of operators in Fortran.
7. What is algorithm? Write down the algorithm for sum of two matrices. 2+3
8. What is conditional statement? Write down the IF-ELSE statement and explain with flowchart. 1+2+2

Group - C

Answer any *one* question :

9×1=9

9. (a) What is Gnuplot? Write down Gnuplot commands for plotting $f(x) = \frac{1}{\sqrt{1+x^2}} \exp(-x^2)$ function and for plotting data from a file. 1+2+2
- (b) Explain different data types in Fortran. 4
10. What is Latex? Discuss the basics of a Latex file. 2+7

(3)

OR

[Basic Instrumentation Skill]

Group - A

Answer any *three* questions : $2 \times 3 = 6$

1. Calculate the value of multiple resistance on the 10 V range of a DC voltmeter that uses a galvanometer with $200 \mu\text{A}$ full scale deflection with an internal resistance of $1 \text{ k}\Omega$.
2. How a CRO can be used for the measurement of frequency?
3. What are the advantages of using digital instruments over analog instruments?
4. Explain sensitivity and resolution of an instrument.
5. In terms of input impedance and sensitivity, how is an electronic voltmeter better than an analog voltmeter?

Group - B

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

6. Explain the principle of working of Digital Storage Oscilloscope (DSO).
7. Explain the working principle of a pulse generator with the help of a block diagram.

P.T.O.

8. A set of independent voltage measurement taken by four observers was recorded as 105.02 V, 105.12 V, 105.07 V and 105.03 V. Calculate average voltage and average deviation.

Group - C

Answer any *one* question : $9 \times 1 = 9$

9. (a) Draw the basic circuit diagram for a Q-meter. Explain its operation and write the equation for Q factor. 5+4
- (b) How is the universal counter used for the measurement of frequency? 5+4
10. (a) A Maxwell Bridge is used to measure inductive impedance.

At balance, the bridge constants are $C_1 = 0.01 \mu F$, $R_1 = 470 k\Omega$, $R_2 = 5.1 k\Omega$, $R_3 = 100 k\Omega$. Find the series equivalent of unknown impedance.

- (b) Discuss the working principle of any basic (balancing type) RLC bridge in detail with the help of necessary diagram. 4+5

OR

[Renewable Energy and Energy Harvesting]

Group - A

Answer any *three* questions : $2 \times 3 = 6$

1. What is solar pond?
2. Suggest two methods to harvest piezoelectric energy.
3. What is geothermal energy? Schematically explain its harvesting.
4. What do you mean by overtopping device?
5. Give an account on the biogas generation along with its limitations.

Group - B

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

6. What is fossil fuel? Discuss various types of fossil fuels and their formation. $2+3$
7. What do you mean by offshore wind energy? Describe how wind turbine speed changes with the speed of the wind. $2+3$
8. How do linear generators work in content of electromagnetic energy harvesting and what are the key physical and mathematical models that describe their operation? $2+3$

P.T.O.

Group - C

Answer any **one** question : $9 \times 1 = 9$

9. What do you mean by solar cells? Describe how does a solar cell work and draw its characterization curve. Draw equivalent circuit of a solar PV module.

$2+3+2+2$

10. What resources are needed for hydroelectric power generation? Discuss environmental impact of hydropower generation. Discuss potential of ocean energy against wind and solar.

$3+4+2$

(7)

OR

[Applied Optics]

Group - A

Answer any *three* questions : $2 \times 3 = 6$

1. How does population inversion facilitate the amplification of light in a laser and why is it a critical condition for laser operation?
2. Whether lasing action is possible in a two level system? Justify your answer.
3. A hologram is broken in to several pieces. Will you still be able to observe the image?
4. A mean optical power of $120 \mu\text{W}$ is launched in to an optical fiber of length 8 km. The mean optical power at the output is measured to be $3 \mu\text{W}$. What is the signal attenuation per km for the fiber?
5. What is a Fiber Bragg Grating (FBG)?

Group - B

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

6. Consider the formation of a hologram with a point object and a plane reference wave. Choose the z-axis to be along the normal from the point source to the plane of the hologram, assumed to be coincident with the plane

P.T.O.

- $z = 0$. Obtain the interference pattern recorded by the hologram. (For simplicity you may assume the reference wave falls normally on the hologram).
7. What is Fourier transform and how can it be performed optically?
8. (a) Consider a laser oscillator having an active medium with gain coefficient Y placed between a Fabry-Perot cavity consisting of rear mirror of reflectivity R_1 and output coupler of reflectivity R_2 . If the attenuation constant per pass inside the cavity be α , find out the threshold condition to begin the laser oscillation.
- (b) What is the basic principle of Fourier Transform Nuclear Magnetic Resonance spectroscopy. 3+2

Group - C

Answer any *one* question : $9 \times 1 = 9$

9. (a) A gain medium, capable of producing lasing action at wavelength 800 nm, is under thermal equilibrium at $T = 800^\circ\text{K}$. Calculate the ratio of the number of spontaneous emission to stimulated emission.
- (b) Write down the working principle of a He-Ne Laser.
- (c) With a schematic diagram discuss the origin of evanescent wave in an optical fiber. What are the precautions to be taken to prevent the energy loss due the evanescent wave? $3+3+3$

10. What are the basic components of an optical fiber? Explain with a diagram. What happens if an optical fiber lacks cladding? What is the fundamental principle of optical fibers, and how does light propagate within an optical fiber?

3+2+2+2
