

B.Sc. 4th Semester (Honours) Examination, 2023 (CBCS)
Subject : Physics
Course : SEC-2
(Electrical Circuits & Network Skills)

Time: 2 Hours**Full Marks: 40**

The figures in the margin indicate full marks.

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

Group-A

1. Answer any five questions from the following: $2 \times 5 = 10$
- Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.
 - The equation of an alternating current is $I = 20 \sin 300\pi t$. Calculate the frequency and r.m.s. value of current.
 - What is eddy current loss in a transformer? How to minimize eddy current loss?
 - Explain the working principle of the circuit breaker.
 - Two bulbs of 100W and 40W are connected in a series across a 230V supply. Which bulb will glow brighter and why?
 - What is the magnetizing current for an induction motor compared to a transformer?
 - Why fuse wires are always thin in home appliances? What happens if it is thick?
 - What is the function of an extension board?

Group-B

2. Answer any two questions from the following: $5 \times 2 = 10$
- State Ohm's law. In copper, there are 10^{28} free electrons in unit cubic metre, all of which contribute to a current of 2 Amp in copper wire of cross-sectional area $1 \times 10^{-6} \text{ m}^2$. What is the electric field in the wire? Given resistivity of the wire— $1.6 \times 10^{-8} \Omega \text{m}$. $1+4$
 - What does the term 'Phasors' mean in a.c. circuit analysis? A 40 ohm resistor, 3mH inductor and $2 \mu\text{F}$ capacitor are connected in series to a 110V, 5000Hz a.c. source. Calculate the value of the current in the circuit. $2+3$
 - Define r.m.s. and average value of a.c. voltage. Prove that in pure inductive circuit, current lags behind applied voltage by 90° . $2+3$

- (d) (i) What is the importance of blueprint?
 (ii) How is ladder logic used in PLCs?

2+3

Group-C

3. Answer *any two* questions from the following:

10×2=20

- (a) (i) What is an a.c. generator? Derive an expression of the instantaneous value of e.m.f. induced in the coil of a generator.
 (ii) A transformer having efficiency 90% is working on 100V and at 2kW power. If the current in the secondary coil is 5A, calculate the current in the primary coil and voltage across the secondary coil.

1+5+4

- (b) Derive an expression for average power consumed in a series LCR circuit.

A coil is in series with a $20\mu F$ capacitor across a 230V, 50Hz supply. The current taken by the circuit is 8A and the power consumed is 200W. Calculate the inductance of the coil if the power factor of the current of the circuit is (i) leading and (ii) lagging.

5+5

- (c) Define mean life of a carrier. Draw V-I characteristics of a *p-n* junction diode. Explain, why the current under reverse bias is almost independent of the applied voltage up to the critical voltage.

A germanium diode carries a current of 10 mA when it is forward biased with 0.2 V at 27°C.

- (i) Find reverse saturation current.
 (ii) Find the bias voltage required to get a current of 100 mA.

2+2+2+4

- (i) A full-wave rectifier used two diodes, the internal resistance of each diode may be assumed constant at 20Ω . The r.m.s. secondary voltage of a transformer from centre tap to each end of secondary is 50 V and load resistance is 980Ω . Find the mean load current and the r.m.s. value of load current.

- (ii) What is a *p-n* junction diode? Define the term 'dynamic resistance' for the junction diode. With the help of a circuit diagram, explain the working of a *p-n* junction diode as a half wave rectifier.

2+2+6

B.Sc. 4th Semester (Honours) Examination, 2023 (CBCS)**Subject : Physics****Course : SEC-2 (OR)****(Computational Physics Skill)****Time: 2 Hours****Full Marks: 40***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words
as far as applicable.***Group-A**

1. Answer *any five* questions from the following: $2 \times 5 = 10$
- What are Sub-programmes?
 - What is a flowchart?
 - What are the basic data types in FORTRAN?
 - How to write a complex number in FORTRAN?
 - Describe how to write a Greek letter within a text line in LaTex with example.
 - How to compile a .tex file to get an output in .pdf file in Latex?
 - Explain how gnuplot input file is created.
 - Describe any two features of gnuplot.

Group-BAnswer *any two* of the following questions. $5 \times 2 = 10$

- Explain Nested Do loop and Block if statement in FORTRAN with syntax.
- Write a program in FORTRAN to calculate factorial of a number.
- Explain how to insert figure and table of contents using LaTex with example.
- Describe with example, how to fit a curve to a given data in gnuplot.

Group-CAnswer *any two* of the following questions. $10 \times 2 = 20$

6. Write the following expressions in LaTex:

(a) (i) $w = \frac{a}{s(s-a)}$

(ii) $x = a^2 - b^2$

$$(iii) \quad d = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$(iv) \quad y^2 = 4ax$$

$$(v) \quad y = \int_0^1 \sin x \, dx$$

(b) Write a program in FORTRAN to print the even numbers up to 100.

5+5

7. Write the basic structure of a LaTex document and write the steps to generate output from the LaTex source file.

Write the LaTex code to include a list of references in a document with an example.

6+4

8. Describe the tabular environments in the LaTex and write a LaTex code to generate a table given below:

Table 1 : Observation Table

Mass (gm)	Position (mm)	Force (N)
100	30	0.75
150	35	0.96
200	42	1.45
250	58	1.92
300	62	2.43

9. Describe how to plot generated by gnuplot may be saved in a file. Describe how the parametric curves may be plotted.

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