

2023

4th Semester Examination

PHYSICS (Honours)

Paper : GE 4-T

[CBCS]

Full Marks : 40

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 answers wherever necessary.

[Electricity and Magnetism]

Group - A

Answer any *five* of the following questions :

2×5=10

1. If unit vectors $\hat{a}$ and $\hat{b}$ are inclined at an angle θ then prove that $|\hat{a} - \hat{b}| = 2 \sin\left(\frac{\theta}{2}\right)$.
2. Discuss the nature of electric field due to a charge that suddenly starts and stops moving.
3. The electric potential in a given space is represented by

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$V = 3x + 5y - 6z$. Show that electric field intensity is uniform everywhere in the space.

4. What is an electric dipole? Write down the expression for the moment on an electric dipole.
5. The magnetic flux through a circular loop is $0.033t^3$ weber. What is the induced emf in the loop in 1 second?
6. State and explain the Ampere's circuital law.
7. What is the value of $\vec{\nabla} \cdot \vec{B}$ and $\vec{\nabla} \times \vec{B}$ for point inside a current loop?
8. What is the significance of non-diverging $\vec{J}$? Write down the equation of continuity for steady state current.

Group - B

Answer any *four* of the following questions : $5 \times 4 = 20$

9. Calculate the electric field at a point due to an infinite plane sheet of charge by using Gauss's law. 5
10. Find the expression for capacitance of a cylindrical capacitor. 5
11. Consider the magnetic field produced by a long straight wire carrying current I , at a point P at a distance r from it. Calculate the length of the current carrying conductor that contributes 90% of the total field at P . 5
12. Differentiate between dia, para and ferro magnetic substances. Give the domain theory of ferromagnetism.

3+2

13. State Faraday's laws of electromagnetic induction. Express it in integral and differential forms. A circular coil of a single turn of thin conducting wire has self-inductance L . If the number of turns is increased to 8, then calculate the new self-inductance. 2+1+2
14. State Poynting vector and prove Poynting theorem. 2+3

Group - C

Answer any *one* of the following questions :

10×1=10

15. (a) A circular wire of radius a has linear charge density $\lambda = \lambda_0 \cos^2 \theta$, θ is the angle with respect a fixed radius. Calculate the (i) total charge and (ii) potential and electric field at the centre.
- (b) An electric dipole of moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$. Show that its potential energy is $-\vec{p} \cdot \vec{E}$. 6+4
16. (a) State and explain Biot-Savart law in vector form. Using this law calculate magnetic field at the axis of a solenoid.
- (b) Give the integral form of Maxwell's equation and give their physical significances.
- (c) Write two characteristics of electromagnetic wave. (2+4)+3+1

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(7)

OR

[Digital, Analog Circuits and Instrumentation]

Group - A

Answer any *five* of the following : $2 \times 5 = 10$

1. Convert decimal number 38 to binary number.
2. State De Morgan's theorem.
3. Do the binary subtraction using 2's complement method :
 $1101 - 1011$.
4. What do you mean by static and dynamic resistance?
5. Establish the relation between the current gains (α and β) of CB mode and CE mode n-p-n transistor.
6. What are class A and class B amplifiers?
7. What do you mean by CMRR in op-amp?
8. What is the position of Fermi level in case of p and n -type semiconductor? Explain it through band diagram.

Group - B

Answer any *four* of the following : $5 \times 4 = 20$

9. (a) Verify the Boolean Expression $A + BC = (A + B)(A + C)$.
- (b) Design a two-input XOR gate exclusively with the help of NAND gates.

2+3

P.T.O.

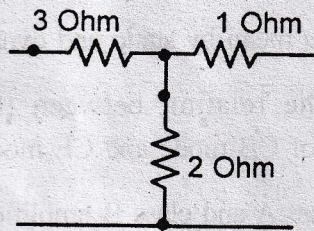
10. Explain the operation of AND gate using transistor. 5

11. Simplify the Boolean function using K-map

$$F(A, B, C, D) = \Sigma(0, 1, 2, 4, 5, 6, 8, 9, 12, 13, 14). \quad 5$$

12. Draw the circuit diagram of the CE mode npn transistor. Draw and explain its output characteristic. Why is the current increased slightly in the saturation region of the transistor? 1+3+1

13. (a) Find the values of the h parameters of the given circuit



(b) Write down one advantage of the h -parameters. 4+1

14. Establish the output expression of voltage for inverting adder in terms of input voltage using op-amp. What do you mean by virtual ground? 4+1

Group - C

Answer any *one* of the following : $10 \times 1 = 10$

15. Explain the operation of Zener diode and draw the I-V characteristic. Determine its ripple factor. What is the basic use of Zener diode? 4+4+2

16. (a) Calculate the ripple factor for half wave and full wave rectifier considering the load current is a sinusoidal wave.
- (b) Express the output voltage in terms of input voltage in case of a differentiator OPAMP circuit.
- (c) If v_1 and v_2 are two voltages (with respect to ground), how would you construct an OPAMP circuit to get the output voltage $v_0 = 2v_1 - v_2$?
- 4+3+3

বঙ্গানুবাদ

বিভাগ - ক

নীচের যেকোনো পাঁচটি প্রশ্নের উত্তর দাও। $2 \times 5 = 10$

- ১। দশমিক সংখ্যা 38-কে বাইনারি সংখ্যায় রূপান্তর কর।
- ২। ডি মরগ্যানের উপপাদ্যটি বিবৃত কর।
- ৩। 2's কমপ্লিমেন্ট পদ্ধতিতে বাইনারি বিয়োগ কর : 1101 - 1011।
- ৪। স্থির এবং গতিশীল রেসিস্টেন্স বলতে কি বোঝ?
- ৫। CB মোড এবং CE মোড n-p-n ট্রানজিস্টরের প্রবাহমাত্রার বিবর্ধন (α এবং β) মধ্যে সম্পর্ক স্থাপন কর।
- ৬। ক্লাস A এবং ক্লাস B এ্যামপ্লিফায়ার কী?
- ৭। অপ-অ্যাম্পে CMRR বলতে কী বোঝ?

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