

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FOURTH SEMESTER EXAMINATION, MAY 2024

SECOND YEAR [BATCH 2022-25]

PHYSICS [GENERAL]

Paper : IV

Date : 29/05/2024

Time : 11 am – 1 pm

Full Marks : 50

Answer **any five** questions:

[5×10]

1.
 - a) Convert the binary number $(1101.101)_2$ into its decimal equivalent.
 - b) State DeMorgan's theorems.
 - c) Write down the truth table of NAND gate. Show that AND, OR & NOT gates can be implemented using NAND gates only and draw the corresponding circuit diagrams. [2+2+1+(2+2+1)]
2.
 - a) Draw the circuit diagram of RS flip-flop and write down its truth table.
 - b) Draw the output characteristic curves of npn transistor schematically for three different base currents I_1 , I_2 and I_3 , having $I_1 = 0$ and $I_2 < I_3$. Indicate saturation, active and cut-off regions in the graph.
 - c) Describe briefly the formation of depletion region in a PN diode.
 - d) Draw I-V characteristics of a zener diode. What is zener breakdown. [3+3+2+(1+1)]
3.
 - a) Set up the emf equation in a series RLC circuit driven by a sinusoidal voltage.
 - b) Solve the equation to find the instantaneous current.
 - c) How does the impedance of circuit behave at resonance.
 - d) Find the half power frequencies and hence the Q factor of the circuit. [2+3+1+(2+2)]
4.
 - a) State the postulates of special theory of relativity.
 - b) What do you understand by proper length.
 - c) How fast would a rocket have to go relative to an observer for its length to be contracted to 99% of its length at rest.
 - d) Calculate the K.E. of an electron moving with a velocity of 0.98 times the velocity of light in the laboratory system. [2+2+3+3]
5.
 - a) Discuss Planck's law of black body radiation. Give the basic assumption on which the law is based.
 - b) An X-ray photon is found to have its wavelength doubled on being scattered through 90° . Find the wavelength and energy of the incident photon.
 - c) The half-lives of radium and radon are 1622 years and 3.825 days. What is the volume of radon gas at NTP equivalent to 1 curie? [(3+2)+3+2]
6.
 - a) A proton is confined to a nucleus of radius 5×10^{-15} m. Calculate the minimum uncertainty in its momentum. Also calculate the minimum kinetic energy the proton should have. The proton mass is 1.67×10^{-27} kg.
 - b) Distinguish between crystalline solids and amorphous solids.

- c) What are miller indices? Deduce the miller indices of a plane which cuts of intercepts in the ratio $1a : 3b : -2c$ along the three axes, where a,b,c are primitives. [3+2+(2+3)]
7. a) Define Gauss's law.
 b) Find electric field near a point of a infinite charged sheet.
 c) Determine the potential energy of a dipole in an external electric field. [2+3+5]
8. a) Define electric displacement ($\vec{D}$) , polarization ($\vec{P}$) and Electric field ($\vec{E}$) . and find a relation along them.
 b) Prove that magnetic field due to a small current loop behaves like a magnetic dipole. [(1+1+1+3)+4]

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