RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FOURTH SEMESTER EXAMINATION, AUGUST 2021

SECOND YEAR (BATCH 2019-22)

Date : 13/08/2021 **PHYSICS (General)**

Time : 11.00 am – 1.00 pm **Paper : IV** Full Marks : 50

Answer **any five** questions [5×10]

1. a) Find electric field near infinite plane sheet of charge.

   b) A particle with charge Q is placed at the centre of a cube with edges of L.

   i) What is the electric flux that passes through the entire cube?

   ii) Find the electric flux through one of the faces of the cube.

   iii) Calculate the electric field on one of the faces of the cube?

   c) Find a relation between $\vec{E}, \vec{P}$ and $\vec{D}$. The symbols have this conventional meaning. [2+(1+2+1)+4]

2. a) What is mutual inductance?

   b) Calculate magnetic energy density inside a solenoid carrying current I ampere.

   c) A positive charge particle with velocity $\vec{V} = x\hat{i} + y\hat{i}$ moves in a magnetic field $\vec{B} = y\hat{i} + x\hat{j}$. Find the magnitude of magnetic force. [2+4+4]

3. What are ***AC*** and ***DC***? What is the ripple factor? What are the equivalent impedances and phases in a series ***L-C-R AC*** circuit? How does impedance and current change with respect to frequency (explain with graphs)? [2+2+3+3]

4. What is the significant of zener diode in voltage regulations? Define graphically power, bandwidth and quality factor. What changes can be observed in resonance when resistance changes? [2+6+2]

5. What is the difference between ***S-R*** latch and ***S-R*** flip-flop (use ***NAND*** gate to explain)? What is reverse saturation current? How can you run a transistor in active mode? [4+2+4]

6. a) Consider two inertial frames S and S' which have their axes parallel. Starting from Lorentz transformation equation, derive the velocity transformation equations.

   b) Using the invariance of the law of momentum conservation, derive the formula for the variation of the relativistic mass with velocity. [5+5]

7. a) What is radioactive equilibrium? Distinguish between temporary and secular equilibrium.

   b) A radioactive element P disintegrates to another radioactive element Q with a disintegration constant λ_1. If Q disintegrates with a disintegration constant λ_2. Find the expression for the number of atoms of Q at any time t with respect to the initial number of P.

c) The half-life of a radioactive element is 4 years. After what time the amount of radioactive element present in a specimen reduces to $\frac{1}{64}th$ of its original mass. [3+5+2]

8. a) What is Compton effect? Arrive at the expressions for the angles of scattered photon and recoil electron in the Compton scattering. What will be the observation if photon is scattered by a molecule instead of the free electron in Compton Scattering experiment.

b) Compare between Raman effect and Compton effect. [6+4]

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