

Date:

Registration number:

ST. JOSEPH’S COLLEGE (AUTONOMOUS), BENGALURU-27

B.Sc. Physics - II SEMESTER

SEMESTER EXAMINATION: APRIL 2022

(Examination conducted in July 2022)

**PH 221 - Electricity and Magnetism**

 Time- 2 ½ hrs Max Marks-60

This question paper contains **two** printed pages and **three** parts

**Part A**

**Answer any four of the following: ( 4 x 8 =32**).

1. Derive an expression for the force exerted on the surface of a charged

 conductor and hence arrive at an expression for the electric pressure.

2. Show that there is always a loss of energy due to sharing of charges

 between two charged capacitors.

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3. Obtain an expression for the growth of charge in CR circuit connected to a

 DC source. Define time constant of the CR circuit and represent the growth

 of charge graphically.

4. (a) State and explain Ampere’s circuital law. Obtain an expression for

 the magnetic field at a point due to a straight current carrying conductor.

 (b) State Faraday’s laws of electromagnetic induction. (6+2)

5. Using vector method, derive expression for the Impedance of a parallel LCR circuit

 and hence arrive at resonant frequency. (With resistance in the inductance arm.)

6. (a) Derive Maxwell’s equations(i)$ \vec{∇}$ **X** $\vec{E}$ **=** $-$$∂\vec{B}/∂t$(ii)$\vec{∇}$$∙\vec{B}$ **= 0**

 Write theirphysical significance. (4+4)

**Part B**

**Solve any four of the following: (4 x 5 = 20)**

 7**.** Determine the constant ‘**a**’ so that the vector field $\vec{S}$ = (**x + 2y)**$ \hat{i}$ **+ (2y** $–$ **z)** $\hat{j}$ **+ (2x + a z)** $\hat{k}$

 is solenoidal.

 8. Two Charges + 2x10-6 C and $-$ 2x10-6 C are separated by a distance of 10-2 m.

 Find the magnitude and direction of electric field intensity at a point on a line inclined

 at 60º to the line joining the two charges, if the point is at a distance of 0.1m from the

 midpoint between the charges**.**

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 9. A parallel plate capacitor consists of 2 square metal plates of side 5 x 10-2m and separated

 by 1cm. Sulphur slab of 6 x 10-3 m thickis placed between the plates.

 Calculate the capacitance of the capacitor. Dielectric constant of Sulphur is 4.

 10. A current of 3A flows along the length of a metal bar with rectangular cross section of 6mm2.. When a static magnetic field of 2 tesla is applied along one side of its cross-sectional face, a Hall voltage of 10 μv develops between a pair of parallel surfaces that are separated by 2mm. Calculate the Hall coefficient and electron concentration.

 11. The average power radiated by a broadcasting station is 8 kW. Assume the power

 to be radiated over the surface of a hemisphere of radius 10 km with the station at its

 centre. Calculate (1) the magnitude of the Poynting vector on the surface of the

 hemisphere and (ii) the maximum electric and magnetic intensities at points on the

 surface of the hemisphere.

 12. A straight solenoid of length 4m is wound uniformly on a glass tube of diameter 0.02m.

 If there are 1000 turns, calculate the strength of the field (i) at the centre of the solenoid and (ii) at one of its ends when a current of 1A flows through it.

**Part C**

 **Answer any four of the following: (4 x 2 = 8)**

13. (a) The equatorial plane is an equipotential plane. Justify

 (b) Why choke is preferred to a rheostat in controlling the current in an ac circuit?

 (c) Why does the spark occur across the air gap, during the breaking of a LR circuit?

 (d) What is the direction of gradient of a scalar field?

 (e) Displacement current is as real as conduction current. Explain.

 (f) Every electron has an intrinsic angular momentum. Justify.

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