B. Sc. (Sem. III) (CBCS) Examination

July – 2022

Physics : 301

(Electricity, Magnetism & Semiconductor Electronics)

[New Course]

Faculty Code : 003
Subject Code : 2013002

Time : **2½** Hours]   [Total Marks : **70**

Instructions : (i)   Attempt any five questions.

               (ii)   Symbols have their usual meaning.

              (iii)   Figures on right hand side indicate full marks.

1   (a)   Answer the following questions :   **4**

         (1)   Fill up the blank : $\vec{a} \cdot (\vec{b} \times \vec{c}) = \vec{b} \cdot (\vec{c} \times \vec{a}) = $ _____.

         (2)   Fill up the balnk : $\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a} \cdot \vec{c}) \vec{b} - $ ____.

         (3)   "The vector triple product is not associative", express this sentence mathematically.

         (4)   Fill up the blank : A vector which satisfy condition $\vec{\nabla} \cdot \vec{V} = 0$, is called _____ vector.

   (b)   Find gradient of $f(x,y,z) = x^2 + y^2 + z^2$.   **2**

   (c)   Explain scalar triple product.   **3**

   (d)   Describe curl of a vector point function.   **5**

2   (a)   Answer the following questions :   **4**

         (1)   Fill up the blank : Curl of a vector function is a ____.

         (2)   What name is given to the sentence : "The line integral along some selected curve of the gradient is given by difference of the value of the function at the boundaries".

         (3)   Express this equation in words : $\iint (\nabla \times \vec{V}) da = \int \vec{V} \cdot \vec{dl}$.

         (4)   State the expression of gradient theorem.

(b) Calculate the divergence of $V = xy\hat{i} + yz\hat{j} + xz\hat{k}$.   2

(c) Prove that $\nabla \cdot (f\vec{A}) = f(\nabla \cdot \vec{A}) + \vec{A}(\nabla f)$.   3

(d) Explain the fundamental theorem of curl.   5

3 (a) Answer the following questions :   4

   (1) What is $\in_0$ in the expression of Coulomb's law ?

   (2) Fill up the blank : Several charges $q_1, q_2, q_2, \ldots, q_n$ are distributed at a distances $\vec{r_1}, \vec{r_2}, \vec{r_3}, \ldots, \vec{r_n}$, from Q. The total force on Q is calculated by _____ principle.

   (3) What is the unit of line charge density ?

   (4) Electric field lines start from _____. Complete the sentence.

(b) The potential due to an isolated point charge at a point 20 cm from the charge is 400 volt. Calculate the magnitude of the charge. $\in_0 = 8.85 \times 10^{-12} \, C^2 / Nm^2$.   2

(c) Explain electric field of plane charge sheet.   3

(d) Explain electric potential and comment on it.   5

4 (a) Answer the following questions :   4

   (1) Fill up the blank : If field lines are parallel to each other, such a field is called _____ field.

   (2) What name is given to the expression : $\nabla \cdot \vec{E} = \dfrac{\rho}{\in_0}$?

   (3) Fill up the blank : The electric field inside a spherical charged shell is ___.

   (4) Fill up the blank : The electric flux is _____ quantity.

(b) What is the electric field intensity on the surface of a uniform charged sphere with charge $300 \times 10^{-6} C$ and radius 8 cm ? $\in_0 = 8.85 \times 10^{-12} \, C^2 / Nm^2$.   2

(c) Describe divergence of electric field.   3

(d) Describe energy of a point charge distribution.   5

5 (a) Answer the following questions :   4

   (1) Fill up the blank : The formula $P = qBr$ is known as _____ formula.

   (2) What is volume current density ?

   (3) State equation of continuity.

   (4) Write expression of Biot-Savert's law.

(b) Calculate the magnetic field due to a long thin wire carrying current 15 Amp at distance 0.01 m from the wire. $\mu_0 = 4\pi \times 10^{-7} \, N/A^2$.   **2**

(c) Derive basic equation for stationary current.   **3**

(d) Explain magnetic field above a straight wire.   **5**

6 (a) Answer the following questions :   **4**

(1) What is the value of μ_0 ?

(2) What is the divergence of magnetic field B ?

(3) What is the relation between electric field E and potential V ?

(4) State the Ampere's line integral theorem.

(b) Find the magnetic field at a distance 5 m from a long straight wire carrying a steady current 5 Amp.   **2**

(c) Discuss : Lorentz force law.   **3**

(d) Discuss : Boundary condition in magnetostatics.   **5**

7 (a) Fill up the blank :   **4**

(1) In photo diode the reverse current depends only on the ____ of the light incident on the junction.

(2) In photo diode dark current flow due to the thermally generated ____ carriers.

(3) The varactor diode is also known as ____ capacitor.

(4) Solar cell is used for converting radiation energy into ____ energy.

(b) What is the resonance frequency of series $L-C$ circuit ?   **2**
$L = 200 \, \mu H$, $C = 200 \, pF$.

(c) Explain photo diode characteristics.   **3**

(d) Discuss : L-R ac circuit.   **5**

8 (a) Fill up the blank :   **4**

(1) The product of open circuit voltage and short circuit current gives the ____ of solar cell.

(2) In pure inductor, voltage leads the current by ____ degree.

(3) In series RC circuit, voltage ____ the current.

(4) In LCR circuit, resonance frequency is given as $f_0 =$ ____.

(b) At what frequency does a 1000 ohm resistance in series with a $2H$ coil offer an impedance of 1181 ohm ?   **2**

(c) Explain construction of solar cell.   **3**

(d) Explain LCR series ac circuit.   **5**

9   (a)   Answer the following questions :   **4**
            (1)   Fill up the blank : The ratio of change in collector current to the change in base current is known as _____ .
            (2)   Fill up the blank : The region between cut off and saturation point of transistor characteristics is known as _____ region.
            (3)   What is called faithful amplification ?
            (4)   The stability factor indicates the change in collector current due to the change in ..... Complete the sentence.

     (b)   In a transistor circuit collector load is 5000 ohm whereas   **2** zero signal collector current is 1 mA. What will be the operating point if $V_{CC} = 10V$?

     (c)   Why stabilization of operating point is necessary ?   **3**

     (d)   Discuss practical circuit of transistor amplifier and explain   **5** functions of biasing circuit, input capacitor, emitter bypass compacitor and coupling capacitor.

10   (a)   Answer the following questions :   **4**
            (1)   What is the general expression of stability factor ?
            (2)   What is smallest value of stability factor s ?
            (3)   The DC load line on the output characteristics of a transistor circuit is give the values of _____ , complete this sentence.
            (4)   What is frequency response ?

     (b)   In a *CE* pnp transistor circuit, $V_{CC} = 12V$ and   **2** $R_C = 6000$ ohm. Draw the dc load line.

     (c)   Explain thermal runaway.   **3**

     (d)   Explain voltage divider bias method for stabilization.   **5**

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