Code No: F-13603/N/AICTE

FACULTY OF ENGINEERING

B.E. (ECE/ETE/M/P/AE/CS/AI&DS/AI&ML/IoT/IT) I - Semester (AICTE) (Main & Backlog) (New) Examination, February/ March 2024

Subject: Physics

Time: 3 Hours **Max. Marks: 70**

Note: (i) First question is compulsory and answer any four questions from the remaining six questions. Each questions carries 14 Marks.
(ii) Answer to each question must be written at one place only and in the same order as they occur in the question paper.
(iii) Missing data, if any, may be suitably assumed.

1. a) Obtain the Miller Indeces of a plane whose intercepts on the crystallographic axis are 2, -6, ∞.
   b) In the intrinsic semiconductors, the carrier concentration varies as ________.
      a) $T^{3/2}$ b) T^2 c) $1/T$ d) T
   c) Calculate the electronic polarizability of an argon atom given $\varepsilon_r = 1.0024$ at NTP and $N = 2.7 \times 10^{35}$ atoms/m3. $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m.
   d) What are matter waves?
   e) Distinguish between hard and soft magnetic materials.
   f) What is population inversion? How it can be achieved?
   g) Explain the principle of propagation of light in an optical fibre.

2. a) Define packing fraction and coordination number. Derive the expression for the packing fraction of HCP structure.
   b) Derive the expression for calculating the density of the crystal in terms of lattice constant.

3. a) Explain Hall effect with figure and derive the expression for Hall coefficient.
   b) Explain the frequency and temperature dependence of dielectric polarization.

4. a) Derive the Schrodinger's time independent wave equation.
   b) Distinguish between conduction and displacement current.

5. a) Draw and explain B-H curve for a ferromagnetic material placed in a magnetic field.
   b) Explain the BCS theory of superconductivity.

6. a) Explain the construction and working of a semiconductor laser.
   b) Discuss the applications of optical fibre in medical field.

7. a) State the Poynting theorem and derive the relation for poynting vector.
   b) What is ferroelectricity and explain the ferroelectric nature for $BaTiO_3$ material with neat labelled diagram.

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B.E. I - Semester (AICTE) (Main & Backlog) (New) Examination, February/ March 2024

Subject: Mathematics-I

Time: 3 Hours **Max. Marks: 70**

Note: **(i) First question is compulsory and answer any four questions from the remaining six questions. Each questions carries 14 Marks.**
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1. a) Discuss the convergence of the series $\frac{1}{\log 2} - \frac{1}{\log 3} + \frac{1}{\log 4} - \frac{1}{\log 5} + \ldots\ldots$.

   b) Using Lagrange's mean value theorem show that $|\cos b - \cos a| \le |b - a|$.

   c) Show that the function $f(x,y) = \begin{cases} \frac{2x^4 + 3y^4}{x^2 + y^2}, (x,y) \neq 0 \\ 0, \ (x,y) = 0 \end{cases}$ is continuous at the point (0,0).

   d) Evaluate the integral $\int_0^1 \int_0^x e^{\frac{y}{x}} \, dy \, dx$

   e) If $\vec{A}$ and $\vec{B}$ are irrotational, prove that $\vec{A} \times \vec{B}$ is solenoidal.

   f) If $u = x \log xy$ where $x^3 + y^3 + 3xy = 1$, find $\frac{du}{dx}$.

   g) Find the directional derivative of $f(x,y,z) = xy^3 + yz^3$ at the point (2, -1, 1) in the direction of vector $i + 2j + 2k$.

2. a) Test for convergence of the series $\sum_{n=1}^{\infty} \frac{(n!)^2}{(2n!)} x^{2n}$

   b) Test for convergence of the series $\sum_{n=1}^{\infty} \left[\sqrt[3]{(n^3 + 1)} - n \right]$

3. a) The function $f(x) = \sin x$ is approximated by Taylor's polynomial of degree three about the point $x = 0$. Find c such that the error satisfies $|R_3(x)| \le 0.001$ for all x in the interval [0, c]

   b) Find the coordinates of the centre of curvature at any point of the parabola $y^2 = 4ax$ and hence find its evolute.

4. a) If $z = f(x, y)$, $x = r\cos\theta$, $y = r\sin\theta$, then show that $\left(\frac{\partial f}{\partial x}\right)^2 + \left(\frac{\partial f}{\partial y}\right)^2 = \left(\frac{\partial f}{\partial r}\right)^2 + \frac{1}{r^2}\left(\frac{\partial f}{\partial \theta}\right)^2$.

   b) Find the extreme values of $f(x, y, z) = 2x + 3y + z$ such that $x^2 + y^2 = 5$ and $x + z = 1$

5. a) Change the order of integration in $I = \int_0^1 \int_{x^2}^{2-x} xy \, dx dy$ and hence evaluate the same.

   b) Evaluate $\int_1^e \int_1^{\log y} \int_1^{e^x} \log z \, dz \, dx \, dy$.

6. a) Apply Green's theorem to prove that area enclosed by a plane curve C is $\frac{1}{2}\int_C (x dy - y dx)$. Hence, find the area of an ellipse whose semi-major and semi-minor axes are of length a and b.

   b) Verify Stoke's theorem for the vector field $F = (2x - y)i - yz^2 j - y^2 z k$ over the upper half surface of $x^2 + y^2 + z^2 = 1$, bounded by its projection on the xy - plane.

7. a) Show that $\nabla^2(r^n) = n(n+1)r^{n-2}$. Here $r = |\vec{r}|$

   b) If $x = a\cosh\xi \cos\eta, y = a\sinh\xi \sin\eta$, show that $\frac{\partial(x, y)}{\partial(\xi, \eta)} = \frac{1}{2}a^2(\cosh 2\xi - \cos 2\eta)$.

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