

B.Sc.IT: Semester – I [Applied Mathematics – I]
Question Paper (Jan – 2017) [Revised Course]

- Kamal T.

Time: 3 Hours

Total Marks: 100

N.B.: (1) All Questions from are Compulsory.

(2) Attempt any three sub-questions from each Q.2 – Q.7.

Q.1 Attempt Any One The Question: (10 Marks)

- (A) If the matrix $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ is similar to a Diagonal Matrix. Find the Diagonal Matrix. (10)
- (B) If $u = \operatorname{cosec}^{-1} \sqrt{\frac{\frac{1}{x^2+y^2}}{\frac{1}{x^3+y^3}}}$. Show that $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \frac{\tan u}{12} \left(\frac{13}{12} + \frac{\tan^2 u}{12} \right)$. (10)

Q.2 Attempt Any Three From The Following: (15 Marks)

- (A) Under what condition the rank of the matrix $A = \begin{bmatrix} 2 & 4 & 2 \\ 2 & 1 & 2 \\ 1 & 0 & x \end{bmatrix}$ is 3? (5)
- (B) If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$ prove that $A^3 = A^{-1}$. (5)
- (C) Find the solution of system. $\begin{matrix} x_1 & x_2 & x_3 = 0 \\ x_1 & 2x_2 & x_3 = 0 \\ 2x_1 & x_2 & x_3 = 0 \end{matrix}$ (5)
- (D) Reduce the following matrix to the normal form and hence find its rank (5)
- $$\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$$

Q.3 Attempt Any Three From The Following: (15 Marks)

- (A) Show that the following vectors are linearly dependent and find the relation between them. $X_1 = (1, -1, 1), X_2 = (2, 1, 1), X_3 = (3, 0, 2)$. (5)
- (B) Verify Cayley-Hamilton Theorem for the Matrix $A = \begin{bmatrix} 2 & 4 & 3 \\ 0 & -1 & 1 \\ 2 & 2 & 1 \end{bmatrix}$. (5)
- (C) Express the matrix $A = \begin{bmatrix} 2+i & 1 & 3-3i \\ i & 1-i & 2+i \\ 1+i & -3 & 5 \end{bmatrix}$ as the sum of Hermitian Matrix and skew Hermitian Matrix. (5)
- (D) Find the minimal polynomial and show that it is Derogatory Matrix. (5)
- Where $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$.

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Q.4 Attempt Any Three From The Following: (15 Marks)

- (A) If $r = xi + yi + zk$ prove that $\text{grad} \left(\frac{1}{R} \right) = \frac{1}{R^3} r$ where $R = |r|$. (5)
- (B) Find the directional derivative of $f(x, y, z) = 3e^{2x-y+z}$ at the point $A = (1, 1, -1)$ in the direction $\overline{AB}$ when $B = (-3, 5, 6)$. (5)
- (C) If $F = x^2zi + 2y^3z^2j + xy^2zk$. Find $\text{div} F$ and $\text{curl} F$ at the point $(1, -1, 1)$. (5)
- (D) If $a = a_1i + a_2j + a_3k$ and $r = xi + yj + zk$, find $\text{curl} (r \times a)$. (5)

Q.5 Attempt Any Three From The Following: (15 Marks)

- (A) Solve: $\frac{dy}{dx} = \sin(x + y) + \cos(x + y)$. (5)
- (B) Solve: $\frac{dy}{dx} = \frac{y-x+1}{y+x-5}$. (5)
- (C) Solve: $(y^4 + 2y) dx + (xy^3 + 2y^4 - 4x) dy = c$. (5)
- (D) Solve: $(y \log x - 1) y dx = x dy$. (5)

Q.6 Attempt Any Three From The Following: (15 Marks)

- (A) Solve: $\frac{d^3y}{dx^3} + 4 \frac{d^2y}{dx^2} + \frac{dy}{dx} = 6y = 0$. (5)
- (B) Solve: $\frac{d^3y}{dx^3} - 7 \frac{dy}{dx} + 12y = e^{2x}$. (5)
- (C) Solve: $\frac{d^3y}{dx^3} - 2 \frac{dy}{dx} + 4y = 3x^2 - 5x + 2$. (5)
- (D) The differential equation of motion of a body is $\frac{d^2x}{dt^2} + n^2x = f \cos pt$. (5)
Solve this equation. What is the solution if $p = n$?

Q.7 Attempt Any Three From The Following: (15 Marks)

- (A) Find the n^{th} derivative of $x^3 \cdot \sin x$ by using Leibnitz Theorem. (5)
- (B) Verify Langrange's Mean Value Theorem for $f(x) = (x - 1)(x - 2)(x - 3)$ in $(0, 4)$. (5)
- (C) Verify Cauchy's Mean Value Theorem of the functions (5)
 $f(x) = \log x, g(x) = \frac{1}{x}$ on $[1, e]$
- (D) Find Maxima and Minima for $f(x, y) = x^3 + 3xy^2 - 15y^2 - 15x^2 + 72x$. (5)