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Question Paper Code : 90337

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Third Semester
Medical Electronics
MA8352 – LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS
(Common to : Biomedical Engineering/Computer and Communication Engineering/
Electronics and Communication Engineering/Electronics and Telecommunication
Engineering)
(Regulations 2017)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A

(10×2=20 Marks)

1. If $V = \mathbb{R}^3$, then verify whether $W = \{(a_1, a_2, a_3)/2a_1 - 7a_2 + a_3 = 0\}$ is a subspace or not.
2. Find the dimension of W , where $W = \{(x_1, x_2, x_3)/x_1 + x_2 + x_3 = 0\}$.
3. Let $T : P_3(\mathbb{R}) \rightarrow P_2(\mathbb{R})$ be a linear transformation defined by $T(f(x)) = f'(x)$. Let B_1 and B_2 be the standard bases for $P_3(\mathbb{R})$ and $P_2(\mathbb{R})$ respectively. Then find $[T]$.
4. Test the matrix $A = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix} \in M_{2 \times 2}(\mathbb{R})$ for diagonalizable.
5. Let $V = \mathbb{R}^2$ and $S = \{(1,0), (0, 1)\}$. Check whether S is orthonormal basis or not.
6. Find the conjugate transpose of $A = \begin{pmatrix} i & 1+2i \\ 2 & 3+4i \end{pmatrix}$.
7. Form the partial differential equation by eliminating the arbitrary function from $z = e^{x-y} \cdot f(x+y)$.
8. Find the complete integral of the partial differential equation $z = px + qy + p^2 - q^2$.
9. State Dirichlet's conditions for Fourier series of $f(x)$ defined in the interval $c \leq x \leq c + 2l$.
10. Write all three possible solutions of one dimensional heat equation.

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PART - B

(5×16=80 Marks)

11. a) i) Determine the given set in $P_4(\mathbb{R})$ is linearly dependent or linearly independent for $x^4 - x^3 + 5x^2 - 8x + 6$, $-x^4 + x^3 - 5x^2 + 5x - 3$, $x^4 + 3x^2 - 3x + 5$ and $2x^4 + x^3 + 4x^2 + 8x$. (8)
- ii) Let $S = \{v_1, v_2, v_3\}$ where $v_1 = (1, -3, -2)$, $v_2 = (-3, 1, 3)$, $v_3 = (-2, -10, -2)$. Verify whether S forms a basis or not. (8)
- (OR)
- b) i) Verify whether the first polynomial can be expressed as a linear combination of the other two in $P_3(\mathbb{R})$ for the given $x^3 - 8x^2 + 4x$, $x^3 - 2x^2 + 3x - 1$ and $x^3 - 2x + 3$. (8)
- ii) Let W_1 and W_2 be subspaces of V . Prove that $W_1 \cup W_2$ is a subspace of V if and only if $W_1 \subseteq W_2$ (or) $W_2 \subseteq W_1$. (8)
12. a) i) Let $T : \mathbb{R}^3 \rightarrow \mathbb{R}^2$ be defined by $T(x, y, z) = (2x, -y, 3z)$. Verify whether T is linear or not. Find $N(T)$ and $R(T)$ and hence verify the dimension theorem. (8)
- ii) Let $T : P_2(\mathbb{R}) \rightarrow P_2(\mathbb{R})$ be defined as $T[f(x)] = f(x) + (x+1)f'(x)$. Find eigenvalues and corresponding eigenvectors of T with respect to standard basis of $P_2(\mathbb{R})$. (8)
- (OR)
- b) i) Test for diagonalizability of the matrix $A = \begin{bmatrix} 7 & -4 & 0 \\ 8 & -5 & 0 \\ 6 & -6 & 0 \end{bmatrix}$ and if A is diagonalizable, find the invertible matrix Q such that $Q^{-1}A Q = D$. (8)
- ii) Let T be the linear operator on \mathbb{R}^3 defined by $T \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix} = \begin{bmatrix} 4a_1 + a_3 \\ 2a_1 + 3a_2 + 2a_3 \\ a_1 + 4a_3 \end{bmatrix}$. Determine the eigenspace of T corresponding to each eigenvalue. Let B be the standard ordered basis for \mathbb{R}^3 . (8)
13. a) i) Let \mathbb{R}^3 have the Euclidean inner product. Use Gram-Schmidt process to transform the basis $\{u_1, u_2, u_3\}$ into an orthonormal basis, where $u_1 = (1, 1, 1)$, $u_2 = (0, 1, 1)$ and $u_3 = (0, 0, 1)$. (10)
- ii) Let $S = \{(1, 1, 0), (1, -1, 1), (-1, 1, 2)\}$ be an orthogonal set then orthonormal set is $\left\{ \frac{1}{\sqrt{2}}(1, 1, 0), \frac{1}{\sqrt{3}}(1, -1, 1), \frac{1}{\sqrt{6}}(-1, 1, 2) \right\}$ both are basis of \mathbb{R}^3 . Let $x = (2, 1, 3) \in \mathbb{R}^3$. Express x as a linear combination of orthogonal set S and orthonormal set. (6)
- (OR)



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- b) i) Use the least square approximation to find the best fit with a linear function and hence compute the error for the following data $(-3, 9)$, $(-2, 6)$, $(0, 2)$ and $(1, 1)$. (10)
- ii) Compute the orthogonal complement of $S = \{(1, 0, i), (1, 2, 1)\}$ in C^3 . (6)
14. a) i) Solve $z = p^2 + q^2$. (8)
- ii) Find the complete integral of $p^2y(1 + x^2) = qx^2$. (8)
- (OR)
- b) i) Solve $p\sqrt{x} + q\sqrt{y} = \sqrt{z}$. (8)
- ii) Solve $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x \partial y} - 6 \frac{\partial^2 z}{\partial y^2} = x + y$. (8)
15. a) i) Find the cosine series for $f(x) = x - x^2$ in the interval $0 < x < 1$. (8)
- ii) Obtain the sine series for $f(x) = x$ in $0 < x < \pi$ and hence deduce that $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$. (8)
- (OR)
- b) i) An finitely long uniform plate is bounded by two parallel edges and an end at right angles to them. The breadth is π . This end is maintained at a temperature u_0 at all points and other edges are kept at zero temperature. Determine the temperature at any point of the plate in the steady state. (8)
- ii) A tightly stretched string with fixed end points $x = 0$ and $x = l$ is initially in a position given by $y(x, 0) = y_0 \sin^3\left(\frac{\pi x}{l}\right)$. If it is released from rest from this position, find the displacement y at any time and at any distance from the end $x = 0$. (8)