International Islamic University Chittagong

Department of Electrical and Electronic Engineering

B. Sc. Engineering in EEE

Midterm Examination, Spring 2024

Course Code: **MATH-2309** Course Title: **Mathematics-III**

Time: 1 hour 30 minutes Full Marks: 30

(i) Answer all the questions. The figures in the right-hand margin indicate full marks.

(ii) Course Outcomes (COs) and Bloom's Levels are mentioned in additional Columns.

Course Outcomes (COs), Program Outcomes (POs) and Bloom's Levels (BL) of the Questions		
CO	**CO Statements**	**PO**
CO1	This step demonstrates linear algebra's basic idea of vector spaces, subspaces, Linear dependence and independence of vectors, Linear mappings, and Inner product spaces.	**POa**
CO2	This effort applies the concept of matrix algebra to find the eigenvalues, eigenvectors, and different kinds of matrix decomposition for implementation in the engineering domain.	**POa**
CO3	Get a basic understanding of scalar and vectors, dot product, cross-product derivative of vectors, and vector integration. Analyze complex engineering problems, know the gradient, divergence, and curl and their physical significance, learn the Greens, Gauss & Stocks theorem and their applications, and be familiar with vector components in spherical and cylindrical systems.	**POa**

Bloom's Levels (BL) of the Questions						
Letter Symbols	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

1) a)	If $\mathcal{M} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is any 2×2 dimensional real matrix vector space, then $\mathcal{N} = \begin{bmatrix} 0 & b \\ c & 0 \end{bmatrix}$ is another 2×2 dimensional real matrix space such that $\mathcal{N} \subset \mathcal{M}$, therefore verify that $\mathcal{N}$ is a subspace of $\mathcal{M}$.	CO1	C3	5
1) b)	Let v=r^3. Show that W is not a subspace of V where $W = \{a, b, c : a \geq 0\}$ that is, W consists of those vectors whose first component is non-negative but W is a subspace of V where $W = \{(a, b, 0) : a, b \in R\}$ that is, W consists of those vectors whose third component is 0	CO1	C3	5
2) a)	Consider the following vectors $v_1 = (1,2,1), v_2 = (2,9,0), v_3 = (3,3,4)$ then the set $S = \{v_1, v_2, v_3\} \subset \mathcal{W}$, where $\mathcal{W} = R^3$ is a vector space, then prove that S is a basis of $\mathcal{W}$ and find its dimension.	CO1	C3	5
2) b)	Determine the value of μ such that the system has (i) a unique solution (ii) no solution (iii) more than one solution x+y-z=1, 2x+3y+μ z=3, x+μ y+3z=2	CO1	C3	5
3) a)	Using the Gram Schmidt orthogonalization process to construct the basis $\{u_1, u_2, u_3\}$into an orthogonal basis where u_1=(1,1,1), u_2=(0,1,1) and u_3=(0,0,1)	CO1	C3	5

3)	b)	Verify that the following is an inner product in R^2, $<u,v>= x_1y_1 - x_1y_2 - x_2y_1 + 3x_2y_2$, where $u=(x_1,x_2), v=(y_1,y_2)$	CO1	C3	5
		OR			
3)	a)	Consider the vectors $u = (1,1,1), v = (1,2,-3), w = (1,-4,3)$ in $\in R^3$ then verify the Cauchy Schwartz inequality.	CO1	C3	5
3)	b)	If $\mathcal{D} = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 2 \end{bmatrix}$, now apply Gram Schmidt orthogonalization process to find its Q *and* R decomposition.	CO1	C3	5