International Islamic University Chittagong

Department of Electrical and Electronic Engineering

B. Sc. Engineering in EEE

Midterm Examination, Spring 2023

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) of the Questions	
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.
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.
CO3	Get a basic understanding of scalar and vectors, dot product, cross-product derivative of vectors, and vector integration. Analyse 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.

Bloom's Levels of the Questions						
Letter Symbols	**R**	**U**	**Ap**	**An**	**E**	**C**
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

1) a)	Define linearly dependent and independent of vectors. Determine whether or not the vectors in $\mathbf{R}^3$ are linearly dependent or independent: $(i)(2,-3,7),(0.0.0),(3,-1,-4)$ and (ii) (1,2,-3),(1,-3,2),(2,-1,5).	CO1	R,E	5
1) b)	(i) Define vector subspace. Let v=R^3.Show that W is not a subspace of V where W= $\{a,b,c : a,b,c \in \boldsymbol{Q}\}$ that is, W consists of those vectors whose components are rational number. (ii) Define linear combination. For which value of K will the vector $A=(1,-2,K)$ in R^3 be a linear combination of the vectors $B=(3,0,-2), C=(2,-1,5)$?	CO1	R,Ap	3+2
2) a)	Consider the following vectors $v_1=(1,2,1), v_2=(2,9,0), v_3=(3,3,4)$ then the set $S=\{v_1,v_2,v_3\}\subset V$, where $V=R^3$ is a vector space, then prove that S is a basis of V and find its dimension.	CO1	E	6

2)	b)	If $V = \{(x, y, z): x, y, z \in \mathcal{R}\} = \mathcal{R}^3 and\ W = \{(x, y, 0): x, y \in \mathcal{R}\}$ are two vector spaces over the field F. then prove that the transformation/mapping $L: V \to W$ is defined by $L(x, y, z) = (x, y, 0)$is linear transformation(Linear Mapping).	.CO1	An	4
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	Ap	6
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	Ap	4

OR

3)	a)	Apply the Gram Schmidt orthogonalization process for QR decomposition for the matrix $A = \begin{pmatrix} 1 & 3 \\ -1 & 4 \end{pmatrix}$.	CO1	Ap	6
3)	b)	Define the inner product space then, if $f(t) = 3t - 5,\ g(t) = t^2$ then find the inner product of $< f, g >$.	CO1	Ap	4