

American International University-Bangladesh

Faculty of Science and Technology

Department of Mathematics

Matrices, Vectors and Fourier Analysis

Sample Question

Final Examination Spring: 2022-23

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**Part-A (Short Questions)**

1. Test linear dependency and independency of vectors.
2. Write Linear combination of vectors where scalar values are given.
3. Find the eigenvalue(s) of a matrix (2 by 2, 3 by 3).
4. Find inverse matrix (2 by 2) by using Cayley Hamilton theorem.
5. Point transformation from one coordinate system to other coordinate system (Cartesian to Cylindrical; Cylindrical to Spherical; Spherical to Cartesian and vice versa).
6. Find the eigenvalue(s) of a square matrix *A* if where matrix *A* and eigenvector (s) () are given.
7. Write the statement of Stokes’ Theorem.
8. Write the statement of Gauss’s Divergence Theorem.
9. Write the statement of Cayley-Hamilton Theorem.
10. Definition (i.e., eigen value, eigenvector, characteristic matrix, vector spaces, subspace, linear dependency and independency of vectors, linear combination etc).

**Part-B (Broad Questions)**

1. (a) Solve the system of ordinary first order differential equations by using eigenvalues & eigenvectors.

(b) State **Cayley-Hamilton theorem** and using **Cayley Hamilton Theorem** find the inverse of the matrix (3 by 3). Hence verify your result.

1. (a) Directional derivative of a scalar function along a direction (vector in Cartesian, Cylindrical and Spherical coordinate systems) at a point.
2. Find Gradient of a scalar function at the given point in Cartesian, Cylindrical and Spherical coordinate systems.
3. Find divergence of a vector field in three coordinate systems (Cartesian, Cylindrical and Spherical coordinate systems) at a given point.
4. Check whether the vector field in Cartesian, Cylindrical and Spherical coordinate systems is solenoidal or conservative(irrotational) in Cartesian, Cylindrical and Spherical coordinate systems.
5. Test whether the vector, is a conservative force field. If conservative, find the scalar potential such that. Hence find the work done in moving an object in this field from *A* to *B* in Cartesian/Cylindrical/Spherical coordinate systems.
6. Verify the Stokes Theorem (Cartesian/Cylindrical coordinate systems).
7. Verify the Gauss’s Divergence Theorem (Cartesian/Cylindrical coordinate systems).