ISLAMIC UNIVERSITY OF TECHNOLOGY
Department of Computer Science and Engineering (CSE)
Course Outline and Course Plan

Name of the Teacher	**Md. Nazmul Haque**	**Position**	**Assistant Professor**
Department	**CSE**	**Programme**	**B.Sc. Eng. SWE**
Course Code	**Math 4341**	**Course Title**	**Linear Algebra**
Academic Year	**2020-21**	**Semester**	**Winter**
Contact Hours	**3.0**	**Credit Hours**	**3.0**
Text books and Reference books	**1. Introduction to Linear Algebra, Wellesley-Cambridge Press, 5th Edition, 2016. 2. Elementary Linear Algebra with Applications, Wiley, 11th Edition, 2014 3. Linear Algebra, Springer, 4th Edition, 2012**	**Authors of the books**	**1. Gilbert Strang 2. Howard Anton and Chris Rorres 3. Werner H. Greub**
Prerequisites (If any)	**1. Math 4241: Integral Calculus and Differential Equations**		
Course Homepage	**Google Classroom Code: f4nfnf7(Section 1), bq232px(Section 2)**		
Teaching Methods/ Approaches	☐ **Lecture√** ☐ **Demonstration√** ☐ **Problem solving√** ☐ **Others: Tutorial classes√**		
Teaching aids	**Multimedia√** **OHP√** **Board and Marker√** **Video Conferencing Tool and Tablet√**		

Course Assessment Method								
Attendance (10%)	**Quiz/Viva of Total Marks (Best 3 out of 4)**						**Mid Semester (25%)**	**Semester Final (35%)**
	1st Quiz	**2nd Quiz**	**3rd Quiz**	**4th Quiz**	**Others**		**Week/Date**	**Week/Date**
	Week/Date	**Week/Date**	**Week/Date**	**Week/Date**	**Assignment**	**Homework**		
	4th Week	**7th Week**	**12th Week**	**16th Week**	**5-6 Assignments**	**Will be given time to time**	**8-9th Week**	**15-16th Week**

Grading Policy					
Marks out of 100	**Letter Grade**	**Grade Point**	**Marks out of 100**	**Letter Grade**	**Grade Point**
80 - 100	A+	4.00	55 - 59	B-	2.75
75 - 79	A	3.75	50 - 54	C+	2.50
70 - 74	A-	3.50	45 - 49	C	2.25

65 - 69	B+	3.25	40 – 44	D	2.00
60 - 64	B	3.00	00 - 39	F	0.00

Course Contents
Linear Algebra: Solving $Ax = B$ for square systems by elimination (pivots, multipliers, back substitution, invertibility of A, and factorization into $A = LU$. Complete solution to $Ax = B$ (column space containing b, rank of A, nullspace of A and special solutions to $Ax = 0$ from row reduction). Basis and dimension (bases for the four fundamental subspaces). Least squares solutions (closest line by understanding projections). Orthogonalization by Gram-Schmidt (factorization into $A = QR$). Properties of determinants (leading to the cofactor formula and the sum over all $n!$ permutations, applications to inverse matrix calculation and volume). Eigenvalues and eigenvectors (diagonalizing A, computing powers A^k and matrix exponentials to solve difference and differential equations). Symmetric matrices and positive definite matrices (real eigenvalues and orthogonal eigenvectors, tests for $x'Ax > 0$, applications). Linear transformations and change of basis (connected to the Singular Value Decomposition - orthonormal bases that diagonalize A). Linear algebra in engineering (graphs and networks, Markov matrices, Fourier matrix, Fast Fourier Transform, linear programming). .

Course Objectives
The subject aims to equip the students such that they will be able to do the followings: 1. Use mathematically correct language and notation for Linear Algebra. 2. Develop computational proficiency involving procedures in Linear Algebra. 3. Understand the axiomatic structure of a modern mathematical subject and learn to construct simple proofs. 4. Solve problems that apply Linear Algebra to Chemistry, Economics and Engineering. 5. Determine and verify the accuracy of the solution.

Mapping with CO, PO and Bloom's Taxonomy			
CO No.	**Course Outcomes (CO) Statement**	**Levels of Bloom's Taxonomy**	**Matching with Program Outcome (PO)**
CO1	Determine properties of vector spaces and subspaces by means of linear transformations.	C4	
CO2	Apply principles of matrix algebra to linear transformations.	C3	
CO3	Interpret the results of linear system of equations using vectors.	C3	
CO4	Use visualization, spatial reasoning, as well as geometric properties and strategies to model and solve problems, especially in R^2 and R^3, and conceptually extend these results to higher dimensions.	C3	
CO5	Use technology, where appropriate, to help solve problems, experiment, interpret results, and verify conclusions.	C3	

Weekly plan for course content and mapping with CO		
Weeks	**Topics**	**Tasks**
1	Introduction to Linear Algebra	
2	The Geometry of Linear Algebra	
3	Elimination with Matrices	

4	Factorization of A	Quiz 1- CO1,CO2
5	Columnspace and Nullspace	
6	Solution of Ax = B	Quiz 2- CO3, CO4 Assignment- CO5
7		
8	The Four Fundamental Subspace	
9		
10	Orthogonal Vectors and Subspaces	
11		
12	Projection Onto Subspaces	Quiz 3- CO1, CO4
13		
14	Determinants	
15		
16	Eigenvalues and Eigenvectors	Quiz 4- CO3

Program Outcomes	
PO 1	**Engineering Knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and system fundamentals, software development, networking & communication, and information assurance & security to the solution of complex engineering problems in computer science and engineering.
PO 2	**Problem Analysis:** Ability to **identify**, **formulate** and **analyze complex** Computer Science and Engineering problems in the areas of hardware, software, theoretical Computer Science and applications to reach significant conclusions by applying Mathematics, Natural sciences, Computer Science and Engineering principles.
PO 3	**Design/ Development of Solutions:** **Design solutions** for complex computer science and engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PO 4	**Investigation:** Ability to use **research-based knowledge** and **research methods** to perform literature survey, design experiments for complex problems in designing, developing and maintaining a computing system, collect data from the experimental outcome, analyze and interpret valid/interesting patterns and conclusions from the data points.
PO 5	**Modern Tool Usage:** Ability to create, select and apply **state of the art tools** and techniques in designing, developing and testing a computing system or its component.
PO 6	**The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to **professional engineering practice** in system development and solutions to **complex engineering problems** related to system fundamentals, software development, networking & communication, and information assurance & security.
PO 7	**Environment and Sustainability:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to **professional engineering**

	practice in system development and solutions to **complex engineering problems** related to system fundamentals, software development, networking & communication, and information assurance & security.
PO 8	**Ethics:** Apply **ethical principles** and commit to **professional ethics** and **responsibilities** and norms of computer science and engineering practice.
PO 9	**Individual Work and Teamwork:** Ability to function as an individual and as a team player or leader in multidisciplinary teams and strive towards **achieving a common goal.**
PO 10	**Communication:** **Communicate effectively** on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision making and apply these to one's own work, as a member and leader in a team, to **manage projects** and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to **engage in independent** and **lifelong learning** in the broadest context of technological change.

Mapping of COs and POs												
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2	✓	✓										
CO3		✓	✓									
CO4			✓									
CO5					✓							

K

Table: Knowledge Profile	
Attribute	
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline
K3	A systemic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5	Knowledge that supports engineering design in a practice area

K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability
K8	Engagement with selected knowledge in the research literature of the discipline

P

Table: Range of Complex Engineering Problem Solving	
Attribute	Complex Engineering Problems have characteristic P1 and some or all of P2 to P7
Depth of knowledge required	P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6, or K8 which allows a fundamentals-based, first principles analytical approach
Range of conflicting requirements	P2: Involve wide-ranging or conflicting technical, engineering and other issues
Depth of analysis required	P3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	P4: Involve infrequently encountered issues
Extent of applicable codes	P5: Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder involvement and conflicting requirements	P6: Involve diverse groups of stakeholders with widely varying needs.
Interdependence	P7: Are high-level problems including many component parts or sub-problems

A

Table: Range of Complex Engineering Activities	
Attribute	Complex activities means (engineering) activities or projects that have some or all of the following characteristics:

Range of resources	A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	A3: Involve creative use of engineering principles and research-based knowledge in novel ways
Consequences for society and the environment	A4: Involve creative use of engineering principles and research-based knowledge in novel ways
Familiarity	A5: Can extend beyond previous experiences by applying principles-based approaches

Class Schedule		
Day	**Section 1**	**Section 2**
Tuesday	9:40 a.m.	12:00 a.m.
Friday	12:00 p.m.	01:30 p.m.

Student Consulting Hour:

- Wednesday, 10 a.m. - 11 a.m.

Instruction Contact Details:

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