Program Content

Semester	V	
Course Code:	IT5506	
Course Name:	Mathematics for Computing II	
Credit Value:	3 (3L)	
Core/Optional	Optional	
Hourly Breakdown	Theory	Independent Learning
	45 Hrs	105 Hrs

Course Aim:

- To cover mathematical concepts required to understand and successfully complete the other courses in the degree program, and strengthen the mathematical foundation required in solving problems.

Intended Learning Outcomes:

After following this course, students should be able to

- apply mathematical concepts to solve problems in the areas of matrices, vector spaces, linear and integer programming.
- solve statistical problems involving discrete & continuous probability distributions.

Course Content: (Main Topics, Sub topics)

Topic		**Theory (Hrs.)**
1.	Theory of Matrices, Vector spaces and Linear Transformations	22
2.	Linear Programming and Integer Programming	12
3.	Basic Statistics	11
	Total	**45**

1. Theory of Matrices, Vector spaces and Linear Transformations (22 hours)

1.1 Different ways of looking at system of n linear equations in n unknowns (2 hours) [Ref 5: Pg. (1-5)] [Ref 6: Pg. (1-4)]

1.1.1 Geometric way (row picture)

1.1.2 linear combination of column vectors (Column picture)

1.1.3 Representing in matrix form

1.2 Matrices (2 hours) [Ref 3: Pg. (79-110, 115-123)] [Ref 5: Pg. (6-27)] [Ref 6: Pg. (91-132)]

1.2.1 Defining various types of matrices

1.2.2 Addition and scalar multiplication of matrices

1.2.3 Different ways of defining (or understanding) matrix multiplication

1.2.4 Special type of matrices and their properties.

1.2.5 Inverse of a square matrix (if it exists) and related results.

1.3 Solving systems of linear equations using elementary row operations (Gaussian Elimination) and backward substitution in matrix form considering different cases (2 hours) [Ref 3: Pg. (1-17, 41-72)] [Ref 5: Pg. (3-27)] [Ref 6: Pg. (1-46)]

1.3.1 existence of unique solution

1.3.2 existence of infinitely many solution

1.3.3 no solution

1.4 Elementary row operations and their corresponding matrices (2 hours) [Ref 3: Pg. (1-17, 41-72)] [Ref 5: Pg. (3-27)] [Ref 6: Pg. (1-46)]

1.4.1 Finding row-echelon form of a matrix (Gaussian Method)

1.4.2 Finding row reduced-echelon form of a matrix (Gauss - Jordan Method)

1.4.3 Defining row rank and column rank of a matrix

1.4.4 Computing the inverse of a square matrix (if it exists) using Gauss - Jordan Method.

1.5 The Determinant of a square matrix (2 hours) [Ref 3: Pg. (459-482)] [Ref 6: Pg. (163-184)]

1.5.1 Defining the determinant of a square matrix through its basic properties (through elementary operation).

1.5.2 Calculating the determinant of any square matrix using elementary operations

1.5.3 Properties of determinant.

1.5.4 The big formula for calculating the determinant and inverse of a square matrix (if it exists).

1.6 Vector spaces (6 hours) [Ref 3: Pg. (159-201)] [Ref 5: Pg. (28-66)] [Ref 6: Pg. (189-242)]

1.6.1 Axiomatic definition of a vector space and a subspace with suitable examples.

1.6.2 Identifying all possible subspaces of $\mathbb{R}^2$and R^3.

1.6.3 linear combination and linear span

1.6.4 Finite dimensional vector space, fundamental subspaces associated with a matrix

1.6.5 Linear independence and dependence, linear independence and the rank of a matrix.

1.6.6 Basis of a finite dimensional vector space and constructing basis.

1.7 Linear transformations (4 hours) [Ref 3: Pg. (238-245)] [Ref 5: Pg. (49-54, 67-73, 86-89)] [Ref 6: Pg. (62-77, 203-205)]

1.7.1 Examples of linear transformation in finite dimensional spaces.

1.7.2 The matrix representation of a linear transformation

1.7.3 The rank-nullity theorem and its applications.

1.7.4 Ordered bases, matrix of a linear transformation and similarity of matrices.

1.8 Orthogonality (2 hours) [Ref 3: Pg. (269-299, 307-310, 429-439)] [Ref 5: Pg. (270-286)] [Ref 6: Pg. (329-382)]

1.8.1 Dot/Inner product in a vector space

1.8.2 Orthogonal Vectors and Subspaces

1.8.3 Projections onto Lines

1.8.4 Orthogonal Bases and Gram-Schmidt orthogonalization process and the QR- decomposition.

1.8.5 Least square solution of a non-consistent linear system and the orthogonal projections.

2. Linear Programming and Integer Programming (12 hours)

2.1 Introduction to Linear Programming (7 hours) [Ref 7: Pg. (24-308)]

2.1.1 Assumptions

2.1.2 Graphical method and Simplex algorithm with standard and general linear programming problems

2.1.3 Duality

2.2 Introduction to Integer Programming (5 hours) [Ref 7: Pg. (576-653)]

2.2.1 Assumptions

2.2.2 Graphical method

2.2.3 Cutting plane algorithm

2.2.4 Branch and bound algorithm

2.2.5 Knapsack problems

3. Basic Statistics (11 hours)

Prerequisite(s): Need the basic knowledge on integration.

3.1 Random variables (1 hour) [Ref 2: Pg. (34-39)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

3.1.1 Discrete random variables

3.1.2 Continuous random variables

3.2 Cumulative Distribution Function (1 hour) [Ref 2: Pg. (34-39)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

3.3 Probability distribution of a discrete random variable (1 hour) [Ref 2: Pg. (34-39, 75-78)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

3.3.1 Definition

3.3.2 Mean and Variance

3.4 The Binomial probability distribution (1 hour) [Ref 2: Pg. (108-150)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

3.5 The Poisson probability distribution (1 hour) [Ref 2: Pg. (108-150)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

3.6 Probability distribution of a continuous random variable (1 hour) [Ref 2: Pg. (34-39, 75-78)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

3.6.1 Definition

3.6.2 Mean and Variance

3.7 The Uniform probability distribution (1 hour) [Ref 2: Pg. (108-150)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

3.8 The Normal probability distribution (2 hours) [Ref 2: Pg. (108-150)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

3.9 The Exponential distribution (1 hour) [Ref 2: Pg. (108-150)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

3.10 Normal approximation of the Binomial distribution (1 hour) [Ref 2: Pg. (108-150)], [Ref 8: Pg. (45-73, 108-185)], [Ref 9: Pg. (97-140)]

Teaching /Learning Methods:

You can access all learning materials and this syllabus in the VLE: http://vle.bit.lk/, if you are a registered student of the BIT degree program.

Assessment Strategy:

Continuous Assessments/Assignments:
In the course, case studies/Lab sheets will be introduced, and students have to participate in the learning activities.

Final Exam:
The final exam of the course will be held at the end of the semester. This course is evaluated using a two-hour question paper consisting of 4 Structured Questions.

References/ Reading Materials:

- **Ref 1:** Business Mathematics by Qazi Zameeruddin,V.K Khanna and S.K Bhambri (vikas publishing house)
- **Ref 2:** Schaum's Outline Probability and Statistics, by Murray R. Spiegel, J. Schiller, R. A. Srinivasan, 2rd edition, 2000, Mc Graw Hill
- **Ref 3:** Meyer, C.D., 2000. Matrix analysis and applied linear algebra (Vol. 2). SIAM.
- **Ref 4:** Schuam's Outline Series, Theory and Problems of Matrices by Frank Ayres, JR, McGraw-Hill
- **Ref 5:** Linear Algebra (2nd edition) by Hoffman, K. and Kunze, R., 1971. Englewood Cliffs, New Jersey
- **Ref 6:** Linear Algebra and Its Applications (4th edition) by David C. Lay, 2012. Addison Wesley, Pearson
- **Ref 7:** Introduction to Operations Research (7th edition), F S Hillier and G L Liebermann, 2001, McGraw-Hill.
- **Ref 8:** Probability and mathematical statistics, Prasanna Sahoo.
- **Ref 9:** Applied statistics and probability for engineers, Douglas C. Montgomery and George C. Runger.