**American International University- Bangladesh (AIUB)**

**Faculty of Science & Technology(FST)**

**Bachelor of Science**

**and**

**Bachelor of Engineering**

**Course Syllabus**

Course Title: **Complex Variables, Laplace and Z-transformations**

Course code: MAT 2101

Pre-requisite: MAT 1205 Integral Calculus and Ordinary Differential Equations

General/ Major course:

**Course Description:** This course will cover the topics **Laplace transform**, **inverse Laplace transform** (Cauchy Residue Theorem, partial fraction and convolution theorem) and **Application of Laplace transform**. It will also cover **Complex Variables** (complex number, conjugate, algebra of complex numbers, graphical representation of complex numbers**,** polar form, modulus and argument of complex number. De Moiver’s theorem and roots of complex number. Function of complex variables, analytic function, Cauchy-Riemann equations in Cartesian and polar forms, construction of analytic function, Laplace equation, Harmonic and conjugate Harmonic functions). Complex integrals (line integrals, Cauchy-Goursat’s theorem, Cauchy’s integral formula, Cauchy’s integral formula for higher order derivative, Taylor’s theorem and Laurents theorem). Singularity, poles, zeros and residue of complex valued function. Residue theorem, contour integration and mapping. Finally, the **Z-transform** will be discussed here and Z- transform includes properties of Z-transform and inverse Z-transform, methods of finding inverse Z-transform and application of Z-transform.

**Course Objective :**

**Knowledge:**

1. Students will be able to know the theory and application of Laplace Transform in solving differential equations, in control theory and in other engineering problems.

2. Students will also be able to know the theory of functions of complex variables and their properties and application in engineering, Z-transform and its application.

**Psychomotor Skills:**

1. . Learning the methods of solving the problems, students will be able to solve the physical problems.

2. To illustrate the methods in practical problems.

**Affective (Attitude, Behavior):** When & how to apply the idea for the practical problems.

Duration: 1 Semester, Class hour: 1.5 hours, Total number of classes: 24

Credit Hour: 3

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| **Unit no** | **Name of the Unit** | **Chapters/Topics covered in the Unit** |  |
| **1** | **Laplace transform** | Definition of Laplace transform, Laplace transform of elementary functions using definition, formulae and MATLAB command, properties of Laplace transforms, Laplace Transform of unit step function | **Mid term**  Number of classes-4  Quiz-1 |
| **2** | **Inverse Laplace transform** | Inverse Laplace transform, partial fraction method for finding inverse Laplace transform, MATLAB command for finding inverse Laplace transform |
| **3** | **Application of Laplace transform** | Solution of ordinary differential equations by using Laplace transform, | Number of classes-4  Quiz-2 |
| **4** | **Application of Laplace transform** | Solution of Simultaneous ordinary differential equations |
| **5** | **Complex Variable** | Definition of complex number, conjugate, algebra of complex numbers, graphical representation of complex numbers**,** polar form, modulus and argument of complex number.  De Moiver’s theorem and roots of complex number. | Number of classes-4  Quiz-3 |
| **6** | **Complex valued functions and their properties** | Function of complex variable, limit, continuity, differentiability. Analytic function, Cauchy-Riemann equations in Cartesian and polar forms, construction of analytic function, Laplace equation, Harmonic and conjugate Harmonic functions and mapping. |
| **7** | **Complex Integration** | Complex integrals, line integrals, Cauchy’s integral formula, Cauchy Residue Theorem, Taylor’s theorem and Laurents theorem. Singularity, poles, zeros and residue of complex valued function. | **Final Term**  Number of classes-4  Quiz-1 |
| **8** | **Application of residue theorem** | Contour integration and evaluation of improper integral by using residue theorem | Number of classes-4  Quiz-2 |
| **9** | **Z-Transform** | Definition of Z-transform, its physical meaning and applications, Z-transform of some simple sequences, properties of Z- transform. |
| **10** | **Inverse Z-Transform** | Definition and properties of inverse Z-transform, finding inverse Z-transform by the method of partial fraction and convolution theorem. | Number of classes-4  Quiz-3 |
| **11** | **Application of Z-Transform** | Solution of linear difference equations related to signal and related systems by Z-transformation. |

Text Book:

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| 1. Complex Variables and Applications – R.V. Churchill and J.W.Brown. 2. Laplace Transform – Murray R. Spiegel (Schaum’s Outline Series)**.** |

Reference Book/ Materials:

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| 1. Complex Variables and Applications – M.R.Spiegel (Schaum’s Outline Series).  2. Advanced Engineering Mathematics- E. Kreyszig. |