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|  | **Daffodil International University**  **Department of Computer Science and Engineering**  **(CSE)**  **Course Outline** | | | | | | |
| **Course Code:** | | CSE 234 | | | | | |
| **Course Title:** | | Numerical Methods | | | | | |
| **Program:** | | B.Sc. in CSE | | | | | |
| **Faculty:** | | Faculty of Science and Information Technology (FSIT) | | | | | |
| **Semester:** | | Summer | | **Year:** | | 2020 | |
| **Credit:** | | 3.00 | | **Contact Hour:** | | 03 | |
| **Course Level:** | | L2T3 | | **Prerequisite:** | | MAT 121, MAT 211 | |
| **Course Category:** | | Core Engineering | | | | | |
| **Instructor Name(Initial):** | | **Ohidujjaman** | | | | | |
| **Designation:** | | Sr. Lecturer | | | | | |
| **Email:** | | jaman.cse@diu.edu.bd | | | | | |
| **Office Address:** | | Exam Building, AB04 509. | | | | | |
| **Class Hours:** | | **Sections** | **Day** | | **Time** | | **Room** |
| PC-A |  | |  | |  |
|  | |  | |  |
| PC-B |  | |  | |  |
|  | |  | |  |
| **Google Classroom Code:** | | th9w8f | | | | | |

**1.1 Course Rationale**

Numerical analysis, area of mathematics and computer science that creates, analyzes, and implements algorithms for obtaining numerical solutions to problems involving continuous variables. Such problems arise throughout the natural sciences, social sciences, engineering, medicine, and business. Since the mid 20th century, the growth in power and availability of digital computers has led to an increasing use of realistic mathematical models in science and engineering, and numerical analysis of increasing sophistication is needed to solve these more detailed models of the world. The formal academic area of numerical analysis ranges from quite theoretical mathematical studies to computer science issues. With the increasing availability of computers, the new discipline of scientific computing, or computational science, emerged during the 1980s and 1990s. The discipline combines numerical analysis, symbolic mathematical computations, computer graphics, and other areas of computer science to make it easier to set up, solve, and interpret complicated mathematical models of the real world.

**1.2. Course Objective**

The aim of this course is to teach the students’ different numerical methods which are essential in many areas of modern life. This course will develop their programming knowledge and analysis ability of the underlying mathematics in popular software packages. From this course, students’ will learn:

* Computing integrals and derivatives
* Solving differential equations
* Building models based on data, be it through interpolation, Least Square, or other methods
* Root finding and numerical optimization
* Estimating the solution to a set of linear and nonlinear equations
* Computational geometry

**1.3. Course Outcomes (CO’s)**

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| --- | --- |
| **CO1** | Solve differential equations that arises in the field of engineering and interpret the result. |
| **CO2** | Estimate errors in calculation of various methods |
| **CO3** | Develop codes and analyze its efficiency level |
| **CO4** | Explain numerical procedures that are used in developing different software packages |
| **CO5** | Apply knowledge and skills to optimize a problem |

**1.4. Program Outcomes (PO’s)**

**1.5. CO-PO Mapping**

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| **PO’s**  **CO’s** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **√** |  | **√** |  |  |  |  |  |  |  |  |  |
| **CO2** | **√** | **√** |  |  |  |  |  |  |  |  |  |  |
| **CO3** |  |  |  | **√** | **√** |  |  |  |  |  |  |  |
| **CO4** |  |  |  | **√** | **√** |  |  |  |  |  |  |  |
| **CO5** | **√** | **√** |  |  |  |  |  |  |  |  |  |  |

**2.1. Syllabus:**

**Solution to simultaneous linear equations:** tri-diagonal systems and Thomas’ method, Iteration method of Jacob and Gauss-Seidel;—**Non-linear equations:** Bisection method, Newton–Raphson method. **Matrices:** Norm, condition number with interpretation, LU decomposition, QR decomposition, SVD. **Interpolation:** Newton’s forward, backward and divided difference. Cubic spline method, **Curve fitting:** Least square method for linear and non-linear case, Bezier curves and B-spline curves, Function-approximation by Chebyshev polynomial. **IVP:** Range-Kutta method, Milne’s method; **BVP:** Finite difference method; **CVP:** Power method, QR method. **Numerical Integration:** Trapezoidal rule, Simpson’s 1/3 rule, Weddle rule, use of cubic spline.

**2.2. Course Delivery Plane**

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| **Class No** | **Topics** | **Expected Learning Outcome** | **Assessments (ASSN/ CT/Mid/Final)** |
| **01** | Introductory Class | * Overview of whole course * Importance of this course * Overview of lecture delivery plane |  |
| **02** | Error Analysis | * Perform an error analysis for a given numerical method |  |
| **03 to 05** | a. Bisection, Iteration and Newton Raphson method to solve algebraic and transcendental equations with algorithm | * Prove results for various numerical root finding methods * Perform an error analysis for a given numerical method * Code a numerical method in a modern computer language | 2/3 problems related  to discussion in the  class  **\*\* CLASS TEST 01 \*\*** |
| **06 to 08** | a. Background of matrix and solving systems of Linear Equations  b. Iterative methods (Jacobi & Gauss Seidel) | * Solve a linear system of equations using an appropriate numerical method * Able to find solution of linear system * Find the dominant Eigen -values | 2/3 problems related to  discussion in the class  **\*\* ASSIGNMENT \*\*** |
| **09 to 11** | a. Interpolation: Newton’s Backward Difference Method  b .Interpolation: Newton’s Forward difference Method.  c. Lagrange Interpolation Formula | * Approximate a function using an appropriate numerical method * Code a numerical method in a modern computer language * Approximate a function using an appropriate numerical method * Able to use in cryptography * Approximate a function using an | 2/3 problems related to  discussion in the class  **\*\* CLASS TEST 02 \*\*** |
| **\*\*\*\*\*\*\*\*\*\* MID TERM EXAM \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*** | | | |
| **12 to 13** | a. Curve fitting: Least square method  b. Applications of the methods for linear and non-linear case | * Construct a curve or mathematical function that has the best fit to a series of data points. |  |
| **14** | **\*\*\*\*\*\*\*\*\* PRESENTATION \*\*\*\*\*\*\*\*\*** | | |
| **15 to 19** | a. Numerical Differentiation.  b. Maximum and minimum value of a tabulated functions  c. Numerical solution of ordinary differential equations: Runge-kutta method of 2nd, 4thorder | * Able to forecast missing data * Able to find maximum and minimum value of a tabulated functions. * Solve a differential equation using an appropriate numerical method | **\*\* CLASS TEST 03 \*\*** |
| **20 to 22** | a. Derivation of General Formula Numerical Integration for Trapezoidal rule, Simpson’s 1/3 rule, Simpson’s 3/8 rule and Weddle’s rule | * Calculate a definite integral using an appropriate numerical method |  |
| **\*\*\*\*\*\*\*\*\*\* FINAL EXAM \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*** | | | |

**Text Book(s)**:

1. Numerical Analysis by Burden & Faires
2. Introductory Methods of Numerical Analysis, S.S Sastry