**University of Asia Pacific (UAP)**

**Department of Computer Science and Engineering (CSE)**

**Course Outline**

**Program:** Computer Science and Engineering (CSE)

**Course Title:** Numerical Methods Lab

**Course Code:** CSE 314

**Semester:** Fall – 2020

**Level:** 6th Semester (3rd Year 2nd Semester)

**Credit Hour:** 0.75

**Name & Designation of Teacher:** Nadeem Ahmed, Assistant Professor

**Office/Room:** 7th Floor, Teachers’ compound

**Class Hours:** Thursday: 02:00 PM ̶ 04:50 PM (Sec B)

Saturday: 09:30 AM ̶ 12:50 PM (Sec A).

**Consultation Hours:** Saturday/Tuesday 7:00 pm – 9:00 pm.

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**Rationale:** The Numerical Methods course prepares students for connecting Mathematics knowledge to a broad variety of real life issues in Science and Engineering. It also prepares students for future endeavor as Data Scientists, Knowledge Workers, Decision Makers and numerous prospective professions to be named.

**Pre-requisite** (if any)**:** MTH 205 (Math IV), CSE 205 (Data Structures)

**Course Synopsis:** Errors, analytical and numerical solutions. Finite differences. Interpolation and extrapolation. Solution of linear and nonlinear algebraic equations. Numerical integration and differential. Matrices. Method of least squares. Initial-value problems and boundary-value problems for ordinary differential equations.

**Course Objectives:** The objectives of this course are to:

1. demonstrate how to code various numerical methods in a modern computer language environment such as MATLAB
2. teach how to develop appropriate numerical methods to solve algebraic and transcendental equations, differential equations, linear system of equations.
3. Teach how to perform an error analysis for various numerical methods and prove results for various numerical root finding methods.

**Course Outcomes (CO) and their mapping with Program outcomes (PO) and Teaching-Learning Assessment methods:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO**  **No.** | **CO Statements:**  Upon successful completion of the course, students should be able to: | **Corresponding**  **POs**  **(Appendix-1)** | **Bloom’s taxonomy domain/level**  **(Appendix-2)** | **Delivery methods and activities** | **Assessment**  **Tools** |
| CO1 | **Understand** how to find roots of polynomial equations through numerical analysis using MATLAB. | 1 | 1/Understand | Lecture, Problem Solving | Assignment, Lab final exam |
| CO2 | **Analyze** numerical integration and differentiation using MATLAB. | 2 | 1/Analyze | Lecture, Problem Solving | Online test, Offline test, Assignment, Lab final exam |
| CO3 | **Implement** numerical methods to solve engineering problems | 3 | 1/Apply | Lecture, Problem Solving | Online test, Offline test, Assignment, Lab final exam |

**Weighting COs with Assessment methods:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Assessment Type** | **% weight** | **CO1** | **CO2** | **CO3** |
| Lab Final Exam | 40% | 5 | 20 | 15 |
| Online and offline test | 25% |  | 10 | 15 |
| Class performance | 15% |  | 5 | 10 |
| Assignment | 20% | 5 | 5 | 10 |
| Total | 100% | 10 | 40 | 50 |

**Course Content Outline and mapping with COs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Weeks** | **Topics / Content** | **Course Outcome** | **Delivery methods and activities** | **Reading Materials** |
| 1-2 | Numerical methods used for problem solving. Steps in solving a problem with a computer. Mathematical modelling.  *Roots of equations*: graphical methods. *Bracketing methods*: Bisection and false-position methods. *Open methods*: Simple one-point iteration, Newton–Raphson, secant and modified Newton–Raphson methods. | CO1 | Lecture, Problem Solving | Book- (Please see Recommended Reference) |
| 3-4 | *Systems of linear algebraic equations:* introduction. Methods for solving systems of linear algebraic equations. Gauss elimination method. Matrix inversion method. Gauss-Seidel method. LU decomposition methods. | CO1, CO2, CO3 | Lecture, Problem Solving | Book- (Please see Recommended Reference) |
| 5-6 | *Curve fitting*: introduction. *Least square regression*: linear regression, polynomial regression and multiple linear regression. *Interpolation methods*: newton interpolation, Lagrange interpolation, quadratic spline interpolation. Cubic spline interpolation. Extrapolation. | CO1, CO2, CO3 | Lecture, Problem Solving | Book- (Please see Recommended Reference) |
| 7-8 | *Numerical integration*: introduction. *Numerical integration methods*: Newton–Cotes formulas, trapezoidal rule. *Simpson’s rules*: Simpson’s 1/3 rule, Simpson’s 3/8 rule. | CO1, CO2, CO3 | Lecture, Problem Solving | Book- (Please see Recommended Reference) |
| 9-10 | *Numerical differentiation*: introduction. *Finite difference approximations of the first and the second derivatives*: forward, backward and central diff. Derivatives of unequally spaced data. | CO1, CO2, CO3 | Lecture, Problem Solving | Book- (Please see Recommended Reference) |
| 11-12 | *Numerical solution of ordinary differential equations*: Euler’s method, Runge–Kutta methods. | CO1, CO2, CO3 | Lecture, Problem Solving | Book- (Please see Recommended Reference) |
| 13-14 | Numerical solution of partial differential equations | CO1, CO2, CO3 | Lecture, Problem Solving | Book- (Please see Recommended Reference) |

**Required Reference: Numerical Methods with Applications**: Abridged (2nd Edition) – Autar Kaw, Egwu Kalu

<http://nm.mathforcollege.com/topics/textbook_index.html>

**Recommended Reference: 1. Numerical Methods using MATLAB (Apress; 1st ed. edition)** – Abhishek Gupta. 2014

**2. Numerical Methods Using MATLAB (Pearson: 4th Edition) –** John H. Mathews, and Kurtis K. Fink. 2004.

**3. Numerical Methods: Using MATLAB (Academic Press: 4th edition) –** George Lindfield, and John Penny. 2018.

**Minimum attendance:** 70% class attendance is mandatory for a student in order to appear at the final examination.

**Special Instructions:**

* **Late attendance:** Students who will enter the class after the attendance call will be marked as absent.
* **Assignment**: **Unfinished** work should be submitted as assignment. **Additional** assignments may be given as needed. Copied home work will be graded as zero. Late submission will result a 50% deduction in score.

**Student’s responsibilities:** Students must come to the class prepared for the course material covered in the previous class(es).

They must submit their assignments on time.

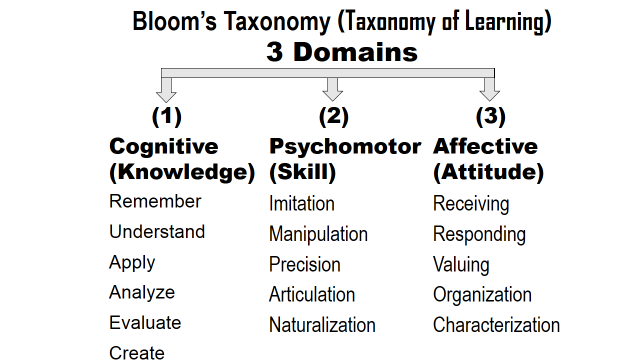
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| --- | --- | --- |
| **Prepared by** | **Checked by** | **Approved by** |
| Dr. Md. Rajibul Islam  (Course Teacher) | Chairman, PSAC committee | Head of the Department |

**Appendix-1:**

**Washington Accord Program Outcomes (PO) for engineering programs:**

|  |  |  |
| --- | --- | --- |
| **No.** | **PO** | **Differentiating Characteristic** |
| 1 | Engineering Knowledge | Breadth and depth of education and type of knowledge, both theoretical and practical |
| 2 | Problem Analysis | Complexity of analysis |
| 3 | Design/ development of solutions | Breadth and uniqueness of engineering problems i.e. the extent to which problems are original and to which solutions have previously been identified or codified |
| 4 | Investigation | Breadth and depth of investigation and experimentation |
| 5 | Modern Tool Usage | Level of understanding of the appropriateness of the tool |
| 6 | The Engineer and Society | Level of knowledge and responsibility |
| 7 | Environment and Sustainability | Type of solutions. |
| 8 | Ethics | Understanding and level of practice |
| 9 | Individual and Team work | Role in and diversity of team |
| 10 | Communication | Level of communication according to type of activities performed |
| 11 | Project Management and Finance | Level of management required  for differing types of activity |
| 12 | Lifelong learning | Preparation for and depth of Continuing learning. |

**Appendix-2**



**Appendix-3**

**UAP Grading Policy:**

|  |  |  |
| --- | --- | --- |
| **Numeric Grade** | **Letter Grade** | **Grade Point** |
| 80% and above | A+ | 4.00 |
| 75% to less than 80% | A | 3.75 |
| 70% to less than 75% | A- | 3.50 |
| 65% to less than 70% | B+ | 3.25 |
| 60% to less than 65% | B | 3.00 |
| 55% to less than 60% | B- | 2.75 |
| 50% to less than 55% | C+ | 2.50 |
| 45% to less than 50% | C | 2.25 |
| 40% to less than 45% | D | 2.00 |
| Less than 40% | F | 0.00 |
|  |  |  |