University of Asia Pacific (UAP)
Department of Computer Science and Engineering (CSE)

Course Outline

Program:	Computer Science and Engineering (CSE)
Course Title:	Numerical Methods
Course Code:	CSE 313
Semester:	Fall 2020
Level:	6th Semester (3rd Year 2nd Semester)
Credit Hour:	3.0
Name & Designation of Teacher:	Dr. Md. Rajibul Islam, Assistant Professor and Head
Office/Room:	7th Floor, Teachers' compound
Class Hours:	Tuesday: 11:00 AM − 12:20 PM (Sec A) Tuesday: 02:00 PM − 3:20 PM (Sec B) Thursday: 11:00 AM − 12:20 PM (Sec B) Thursday: 02:00 PM − 3:20 PM (Sec A)
Consultation Hours:	Sunday and Wednesday: 11:00 AM − 12:20 PM (Sec A) Tuesday and Wednesday: 3:30 PM − 4:50 PM (Sec B)
E-mail:	md.rajibul.islam@uap-bd.edu
Mobile:	**(**+88) 01835022398
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, Roundoff Errors, Truncation Errors, Bracketing Methods, Bisection Method, False Position Method, Open Methods, Simple Fixed-Point Iteration, Newton-Raphson Method, Secant Methods (Secant Method and Modified Secant Method), Matrix Algebra, Linear Algebraic Equation, Gauss Elimination, Pivoting, Tridiagonal Systems, Numerical Integration, Newton-

Cotes Formulas, Trapezoidal Rule, Simpson's Rules, Initial-Value Problems, Euler's Method, Improvements of Euler's Method, Runge-Kutta Method.

Course Objectives:

The objectives of this course are to:

1. **Provide** knowledge regarding principles of numerical methods and their terminologies.
2. **Enlighten** students on the derivation of several numerical methods and their formulas.
3. **Demonstrate** the numerical methods for obtaining an approximate solution from given equations and conditions.
4. **Enable** students to gain experience in analyzing and distinguishing between various numerical 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	**Remember** the knowledge regarding principles of numerical methods and their terminologies.	1	1/ Remember	Lecture, Group discussion	Quiz, Viva Assignment, Written exam
CO2	**Understand** several numerical methods and its formulas.	4	1/ Understand	Lecture, Problem Solving, Case study	Quiz, Viva, Assignment, Written exam
CO3	**Utilize** the numerical methods for obtaining approximate solution from given equations and conditions.	3	1/Apply	Lecture, Problem Solving, Group discussion	Quiz, Assignment, Written exam
CO4	**Analyze** various numerical methods.	2	1/Analyze	Lecture, Class presentation	Viva, Case study, Written exam

Weighting COs with Assessment methods:

Assessment Type	% weight	CO1	CO2	CO3	CO4
Final Exam (Written exam + Viva)	**50%**	8	8	24	10
Mid Term (Written exam)	**20%**	4	4	12	
Quizzes, Assignment, Case study.	**30%**			30	
Total	**100%**	12	12	66	10

Grading Policy: As per the approved grading policy of UAP (Appendix-3)

Course Content Outline and mapping with COs

Weeks	Topics / Content	Course Outcome	Delivery methods and activities	Reading Materials
1	*Introduction to Scientific Computing*: Introduction to numerical methods, Measuring errors, Sources of error, Binary representation of numbers, Floating point representation of numbers, Propagation of errors, Taylor series.	CO1	Lecture, Group discussion	Book- (Please see Required Reference) Chapter - 1
2	*Differentiation*: Continuous functions, Discrete functions, *Effect of step size on accuracy of numerical first derivative*: Forward Divided Difference, *Effect of step size on*	CO1, CO2	Lecture, Group discussion, Problem Solving, Case study	Book- (Please see Required Reference) Chapter - 2

	accuracy of numerical first derivative: Backward Divided Difference, Effect of step size on accuracy of numerical first derivative: Central Divided Difference, Quiz 1.			
3-4	*Nonlinear Equations*: Bisection Method, Newton-Raphson Method, Secant Method.	CO1, CO2, CO3	Lecture, Group discussion, Problem Solving, Case study	Book- (Please see Required Reference) Chapter - 3
4-5	*Simultaneous Linear Equations*: Gaussian Elimination, LU Decomposition method, Gauss-Seidel method, Quiz 2.	CO1, CO3	Lecture, Group discussion, Problem Solving	Book- (Please see Required Reference) Chapter - 4
6	*Interpolation*: Direct Method, Newton's Divided Difference Method, Lagrange Method, Spline Method.	CO1, CO2, CO3	Lecture, Group discussion, Problem Solving, Case study	Book- (Please see Required Reference) Chapter - 5
7-8	*Regression*: Linear Regression, Nonlinear regression. *Integration*: Trapezoidal Rule, Simpson's 1/3rd Rule, Romberg Rule, Gauss-Quadrature Rule, Quiz 3.	CO1, CO3, CO4	Lecture, Group discussion, Problem Solving, Class presentation	Book- (Please see Required Reference) Chapter – 6 & 7
9-10	*Ordinary Differential Equations*: Euler's Method, Runge-Kutta 2nd order Method, Runge-Kutta 4th order Method, Shooting Method, Finite Difference Method.	CO1, CO2, CO3	Lecture, Problem Solving, Case study, Group discussion	Book- (Please see Required Reference) Chapter - 8
11	*Optimization*: Golden Section Search Method, Newton's Method, Multidimensional Direct Search Method, Multidimensional Gradient Method.	CO1, CO2, CO3	Lecture, Problem Solving, Case study, Group discussion	Book- (Please see Required Reference) Chapter - 9
12-13	*Partial Differential Equations*: Introduction to Partial Differential	CO1, CO4	Lecture, Group discussion, Class presentation	Book- (Please see Required Reference) Chapter - 10

	Equations, Parabolic Partial Differential Equations, Elliptic Partial Differential Equations, Quiz 4.			
14	*Fast Fourier Transforms*: Introduction to Fourier Series, Continuous Fourier Series, Fourier Transform Pair, Discrete Fourier Transform, Informal Development of Fast Fourier Transform.	CO1, CO2, CO3, CO4	Lecture, Problem Solving, Case study, Group discussion, Class presentation	Book- (Please see Required Reference) Chapter - 11

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 with MATLAB: Implementations and Applications** (2nd Edition) – Gerald W. Recktenwald
2. **Introductory Methods of Numerical Analysis** – S. S. Sastry

Special Instructions:
- Minimum Required Attendance is 70% (60% for Online semester)
- No make-up for quizzes and mid-term exam
- Plagiarism policy: zero tolerance in case of plagiarism

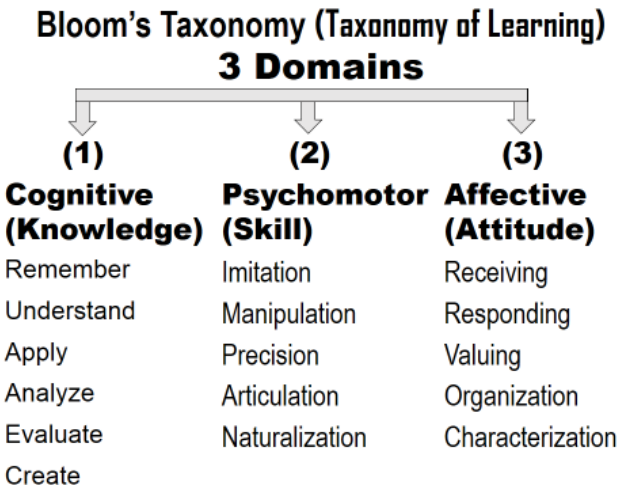
Prepared by	Checked by	Approved by
Dr. Md. Rajibul Islam (Course Teacher)	Chairman, PSAC committee	Head of the Department

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