City University

Department of Computer Science and Engineering
Faculty of Science and Engineering

Course Outline

Course Code and Title, CSE – 231: Numerical Analysis
Credit Hours: 3
Prerequisites:

Program: B. Sc. in Computer Science & Engineering (CSE),
Semester: Fall 2018
Total Weeks: 13 **Hours/Week:** 3 **Total Hours:** 39^{+}

Instructor: Supta Richard Philip
Designation: Senior Lecturer
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Office Hrs: By appointment

Course Details
Rationale:
Numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern systems science. Such methods include techniques for simple optimization, interpolation from the known to the unknown, linear algebra underlying systems of equations, ordinary differential equations to simulate systems, and stochastic simulation under random influences. The primary objective of the course is to develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems on the computer and familiar with the ways of solving complicated mathematical problems numerically.

Course Objectives:

1. To understand the appropriate numerical methods to solve algebraic and transcendental equations and to approximate a function.
2. To calculate the differential equations, a definite integral and derivative at a value
3. To perform an error analysis for various numerical methods
4. Prove results for various numerical root finding methods
5. Design Code of various numerical methods in a modern computer language.

Intended learning outcomes (ILOs) of the Course:

Knowledge	**LO1:** Will be able to solve an algebraic or transcendental equation using an appropriate numerical method.
	LO2: Will be able to approximate a function and root findings methods using an appropriate numerical method.
	LO3: Will be able to solve a differential equation and definite integral using an appropriate numerical method.
	LO4: Will be able to evaluate a derivative at a value and an error analysis for a given numerical method using an appropriate numerical method.
Skills	Will develop skills on understanding the problems.
	Will gain skills on analysis the problem and selecting the solutions for the problem.
	Will help in achieving communication, demonstrate and presentation skill.
Attitude	Will develop attitude to group dynamics and team work.
	Will create attitude to tackle challenges related to computer and basic software.
	Will create positive attitude to listen ideas of classmates.

Mapping of Course ILO and PLO:

Learning Outcome (LO) of the Course	Program Learning Outcome (PLO)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
LO1	**MJ**	**MJ**	**MJ**	**MJ**	**MJ**			**MN**		**MJ**	**MN**	
LO2	**MJ**	**MJ**	**MJ**	**MJ**						**MJ**	**MN**	
LO3	**MJ**	**MJ**	**MJ**	**MN**	**MN**					**MJ**	**MN**	
LO4	**MJ**	**MJ**	**MN**		**MN**					**MJ**	**MN**	

Course Contents:

Sl . No.	**ILO**	**Topic**	**Teaching Strategy**	**Assessment Strategy**	**No. of Sessions**
1	1,4	Introduction and Errors: Introduction of Numerical Analysis, Requirements of Numerical Analysis, Different Types of Error, Calculation of truncation error.	Lecture, Exercise	Q/A	**2**
2	1	Solution of Algebraic and Transcendental Equations: Derivation and problem solution of Bisection method, False position method, Newton Raphson's Method	Lecture, Exercise	Q/A, Assignment	**3**
3	2	Interpolation with Equal Interval: Forward and Backward Differences, Derivations and problem solutions of Newton's Forward and Backward Interpolation	Lecture, Exercise	Q/A, Problem Solving Assignment	**4**
4	3	Interpolation with Unequal Interval: Introduction about interpolation of Unequal interval, Derivation and problem solution of Newton General divided difference, Lagrange's Interpolation	Lecture, Exercise	Q/A, Quiz	**3**
5	3	Numerical Integration: General Quadrature formula, Derivation of Trapezoidal, Simpson's 1/3 rule, Simpson's 3/8 rule using quadrature formula, problem solution of Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules for Numerical Integration	Lecture, Exercise	Q/A, Problem Solving	**3**
6	3	Numerical Solution of Ordinary Diff. Equation: Derivation and problem solutions of Taylor's series method, Euler's Method and Modified Euler's Method, Runge-Kutta method	Lecture, Exercise	Q/A, Group work	**4**
7	1,4	Solution of Linear Algebraic Equation: Solutions of linear equation s using the matrix inversion method, Gauss Jaccobi's method	Lecture, Exercise	Q/A, Assignment	**3**
8	2,4	Eigen Value and Eigen Vectors: Find the eigen value and eigen vectors from a equation.		Q/A, Presentation	**1**
				Total	**23**

Teaching Learning Methods:

Analyze and solve knowledge-based problems for practical situation
Group discussion
Lecture slides, presentations, audio and video
Analytical and critical thinking approach to understand real life system and models

Assessment Schedule:

Assessment 1	Quizzes	Week 4, Week 10
Assessment 2	Assignments	Week 5, Week 11
Assessment 3	Presentation	Week 5, Week 11
Assessment 4	Mid-Term Exam	Week 6
Assessment 5	Final Exam	Week 12

Weights of Assessments:

Assessments	%
Mid-Term Exam	30
Final Exam	40
Quizzes	10
Assignments	10
Presentation	10
Total	**100**

Grading Policy:

Policy	Letter Grade	Grade Point	Assessments
80% and above	A+	4.00	Outstanding
75% to below 80%	A	3.75	Superlative
70% to below 75%	A-	3.50	Excellent
65% to below 70%	B+	3.25	Very Good
60% to below 65%	B	3.00	Good
55% to below 60%	B-	2.75	Average
50% to below 55%	C+	2.50	Below Average
45% to below 50%	C	2.25	Passing
40% to below 45%	D	2.00	Probationary
Below 40%	F	-----	Fail

List of References:

Course Notes: Follow Lecture notes.
Essential Books (Text Books): G. Shankar Rao : Numerical Analysis.
Recommended Reference Books:

1. E. Balagurusamy: Numerical Methods,
2. Gerald and C.F.: Applied Numerical Analysis

Online Recourses: Use Internet to get documents on specific topics.

Facilities Required for Teaching and Learning:

Projector, Whiteboard, Internet access from classroom computer, Audio/Visual equipment.

Course Policies and Procedures:

1. **Class attendance:** Regular attendances of classes are mandatory and students will be assigned F automatically if he/she misses 6 consecutive classes.
2. **Late submission of work:** Late submission will be followed by penalty, please maintain deadlines.
3. **Unfair means /plagiarism:** Plagiarism will be dealt with severe penalty. Original work is encouraged as they will carry value marks.

Appendix-1: Program Learning Outcome (PLO)

PLO No.	PLO
1.	Engineering Knowledge
2.	Problem Analysis
3.	Design/Development of Solutions
4.	Investigation
5.	Modern Tool Usage
6.	The Engineer and Society
7.	Environment and Sustainability
8.	Ethics
9.	Communication
10.	Individual and Team Work
11.	Life Long Learning
12.	Project Management and Finance

Professional/Generic Skills (Detailed):

1. **Engineering Knowledge (T)** -Apply knowledge of mathematics, sciences, engineering fundamentals and manufacturing engineering to the solution of complex engineering problems;
2. **Problem Analysis (T)** – Identify, formulate, research relevant literature and analyze complex engineering problems, and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;
3. **Design/Development of Solutions (A)** –Design solutions, exhibiting innovativeness, for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, economical, ethical, environmental and sustainability issues.
4. **Investigation (D)** Conduct investigation into complex problems, displaying creativeness, using research-based knowledge, and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;
5. **Modern Tool Usage (A & D)** -Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations;
6. **The Engineer and Society (ESSE)** -Apply reasoning based on contextual knowledge to assess societal, health, safety, legal, cultural, contemporary issues, and the consequent responsibilities relevant to professional engineering practices.
7. **Environment and Sustainability (ESSE)** -Understand the impact of professional engineering solutions in societal, global, and environmental contexts and demonstrate knowledge of and need for sustainable development.
8. **Ethics (ESSE)** –Apply professional ethics with moral values and commit to responsibilities and norms of professional engineering code of practices.
9. **Communication (S)** -Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
10. **Individual and Team Work (S)** -Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
11. **Life Long Learning (S)** -Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
12. **Project Management and Finance (S)** -Demonstrate knowledge and understanding of engineering management and financial principles and apply these to one's own work, as a member and/or leader in a team, to manage projects in multidisciplinary settings, and identify opportunities of entrepreneurship.

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Course Coordinator/ Teacher *Head of the Department*

Date: *Date:*