



# Course Specification

— (Bachelor)

**Course Title:** Numerical Analysis

**Course Code:** 2024103-3

**Program:** Bachelor in Mathematics

**Department:** Mathematics and Statistics Department

**College:** Faculty of Sciences

**Institution:** Taif University

**Version:** 1

**Last Revision Date:** 20/05/2023



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## A. General information about the course:

### 1. Course Identification

1. Credit hours: 3 (3,0,0) h

#### 2. Course type

A.  University  College  Department  Track  Others

B.  Required  Elective

3. Level/year at which this course is offered: Level 7 / 4th year

#### 4. Course general Description:

This course introduces the fundamental concepts of numerical methods and the relationship between numerical analysis and other branches of science. The course includes the classifications of numerical errors, numerical methods for solving nonlinear equations and linear system of equations, finite differences and interpolation, numerical differentiation, numerical integration, and numerical solution of ordinary differential equations.

#### 5. Pre-requirements for this course (if any):

Ordinary differential equations (2022201-4)

#### 6. Co-requirements for this course (if any):

None

#### 7. Course Main Objective(s):

The student will be taught as follows:

1. Developing and implementing numerically stable and accurate algorithms for all the basic tasks of computational science and engineering.
2. Finding acceptable approximate solutions when exact solutions are either impossible or so arduous and time-consuming as to be impractical.

### 2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	3Hr/week	100%
2	E-learning		
3	Hybrid <ul style="list-style-type: none"> <li>• Traditional classroom</li> <li>• E-learning</li> </ul>		
4	Distance learning		





### 3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	NA
3.	Field	NA
4.	Tutorial	NA
5.	Others (specify)	NA
<b>Total</b>		<b>45</b>

### B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
<b>1.0</b>	<b>Knowledge and understanding</b>			
1.1	<b>Define</b> the fundamental concepts and basics knowledge of numerical analysis.	K1	<ul style="list-style-type: none"> <li>Lectures</li> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Quizzes</li> <li>Assignments</li> </ul>
1.2	<b>Classify</b> numerical errors.	K1	<ul style="list-style-type: none"> <li>Lectures</li> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Exams</li> <li>Assignments</li> </ul>
<b>2.0</b>	<b>Skills</b>			
2.1	<b>Apply</b> numerical methods and computer language packages for solving a problem.	S3	<ul style="list-style-type: none"> <li>Interactive classes</li> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Quizzes</li> <li>Assignments</li> </ul>
2.2	<b>Use</b> computing knowledge, skills and mathematical packages in information analysis and suggestion of solutions.	S3	<ul style="list-style-type: none"> <li>Lectures</li> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Exams</li> <li>Quizzes</li> </ul>
<b>3.0</b>	<b>Values, autonomy, and responsibility</b>			
3.1	<b>Work</b> effectively within groups and independently.	V1	<ul style="list-style-type: none"> <li>Projects</li> </ul>	<ul style="list-style-type: none"> <li>Through the oral presentation of the projects.</li> </ul>
3.2	<b>Articulate</b> ethical behavior associated with institutional Guidelines in classroom.	V3	<ul style="list-style-type: none"> <li>Lectures</li> </ul>	<ul style="list-style-type: none"> <li>Assignments</li> </ul>





### C. Course Content

No	List of Topics	Contact Hours
1.	<b>Preliminaries of Computing</b> :Basic concepts: Round-off Errors, Floating Point Arithmetic, Error Estimation, Convergence.	3
2.	<b>Numerical Linear Algebra</b> : Iterative methods: Jacobi's Iteration methods.	3
3.	<b>Numerical Linear Algebra</b> : Gauss-Seidal Iteration Methods.	3
4.	<b>Numerical Solutions of nonlinear equations</b> : Bisection Method. Newton Raphson's Method.	3
5.	<b>Numerical Solutions of nonlinear equations</b> : Successive Approximation Method (Fixed point iteration). Error Analysis for Iterative Methods.	3
6.	<b>Numerical Solutions of nonlinear equations</b> : Numerical Solutions of Nonlinear Systems of Equations.	3
7.	<b>First Midterm exam</b>	3
8.	<b>Finite Differences and Interpolation</b> : Finite Difference Operator, <b>Interpolation with Equal Intervals</b> : Newton's Forward Interpolation- Newton's Backward Interpolation.	3
9.	<b>Interpolation with Unequal Intervals</b> : Lagrange Formula- Newton 's Divided Difference.	3
10.	<b>Numerical Differentiation</b> : Numerical Differentiation: using Newton's forward interpolation- using Newton 's divided difference.	3
11.	<b>Numerical Integration</b> : Trapezoidal rule- Simpson's rule- Simpson's 3/8 rule.	3
12.	<b>Numerical Integration</b> : Simpson's 3/8 rule and Error Analysis	3
13.	<b>Second Midterm exam</b>	3
14.	<b>Initial Value Problem for Ordinary Differential Equations</b> : Picard Method-Euler's method.	3
15.	<b>Initial Value Problem for Ordinary Differential Equations</b> : Modified Euler's method- Runge-Kutta methods.	3
Total		45

### D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	Continuous Evaluation	10 %
2.	Assignments, report	Continuous Evaluation	10 %
3.	Midterm 1 Exam	8-9	15%



No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
4.	Midterm 2 Exam	12-13	15%
5.	Final Exam	15-16	50%

\*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

<b>Essential References</b>	Richard L. Burden and J. Douglas Faires, Numerical Analysis (2011), 10th Edition. Student Edition: ISBN-10:0-534-39200-8.
<b>Supportive References</b>	Rao V. Dukkipati, (2010), Numerical Methods, 10th Edition, USA, New Age International (P) Ltd., Publishers Published by New Age International (P) Ltd., Publishers. ISBN (13): 978-81-224-2978-7.
<b>Electronic Materials</b>	Lectures available in Blackboard
<b>Other Learning Materials</b>	Matlab tutorial

### 2. Required Facilities and equipment

Items	Resources
<b>facilities</b> (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
<b>Technology equipment</b> (projector, smart board, software)	Data show, Blackboard
<b>Other equipment</b> (depending on the nature of the specialty)	None

## F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Program Leader	Direct & Indirect
Effectiveness of students' assessment	Faculty, Program Leader	Direct
Quality of learning resources	Students, Faculty	Indirect
The extent to which CLOs have been achieved	Faculty	Direct & Indirect
Other		

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify))

**Assessment Methods** (Direct, Indirect)





## G. Specification Approval

<b>COUNCIL /COMMITTEE</b>	Department Council
<b>REFERENCE NO.</b>	4
<b>DATE</b>	October 2023

