



Course Specifications

| | |
|----------------------|---------------------------------------|
| Course Title: | Numerical Analysis |
| Course Code: | 2024103-3 |
| Program: | Bachelor in Mathematics. |
| Department: | Mathematics and Statistics Department |
| College: | Faculty of sciences |
| Institution: | Taif university |

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Numerical Analysis

A. Course Identification

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|--|
| 1. Credit hours: (3) |
| 2. Course type |
| a. University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/> |
| b. Required <input checked="" type="checkbox"/> Elective <input type="checkbox"/> |
| 3. Level/year at which this course is offered: 10th level / 4th year |
| 4. Pre-requisites for this course (if any): Ordinary differential equations (2022201-4) Linear Algebra (2022204-3) |
| 5. Co-requisites for this course (if any): None |

6. Mode of Instruction (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|----|-----------------------|---------------|------------|
| 1 | Traditional classroom | 5Hr/week | 100 |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

7. Contact Hours (based on academic semester)

| No | Activity | Contact Hours |
|----|-------------------|---------------|
| 1 | Lecture | 50 |
| 2 | Laboratory/Studio | |
| 3 | Tutorial | |
| 4 | Others (specify) | |
| | Total | 50 |

B. Course Objectives and Learning Outcomes

1. Course 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

2. Course Main Objective

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.

3. Course Learning Outcomes

| CLOs | | Aligned PLOs |
|------|--|--------------|
| 1 | Knowledge and Understanding: | |
| 1.1 | Define the fundamental concepts and basics knowledge of numerical analysis | K1 |
| 1.2 | Classify numerical errors. | K1 |
| 2 | Skills: | |
| 2.1 | Apply numerical methods and computer language packages for solving a problem. | S3 |
| 2.2 | Use computing knowledge, skills and mathematical packages in information analysis and suggestion of solutions. | S3 |
| 3 | Values: | |
| 3.1 | Work effectively within groups and independently. | V1 |
| 3.2 | Articulate ethical behavior associated with institutional Guidelines in classroom. | V3 |

C. Course Content

| No | List of Topics | Contact Hours |
|--------------|---|---------------|
| 1 | Preliminaries of Computing :Basic concepts: Round-off Errors, Floating Point Arithmetic, Error Estimation, Convergence. | 5 |
| 2 | Numerical Linear Algebra: Iterative methods: Jacobi's Iteration Methods, Gauss-Seidal Iteration Methods. | 5 |
| 3-4 | Numerical Solution of Nonlinear Equations: Bisection Method. Newton Raphson's Method. Successive Approximation Method (Fixed point iteration). Error Analysis for Iterative Methods. Numerical Solutions of Nonlinear Systems of Equations. | 10 |
| 5 | Midterm exam. Finite Differences and Interpolation: Finite Difference Operator. | 5 |
| 6 | Interpolation and Polynomial Approximation: Interpolation with Equal Intervals: Newton's Forward Interpolation- Newton's Backward Interpolation. Interpolation with Unequal Intervals: Lagrange Formula- Newton 's Divided Difference. | 5 |
| 7 | Numerical Differentiation and Integration 1) Numerical Differentiation: using Newton's forward interpolation- using Newton 's divided difference. 2) Numerical Integration: Trapezoidal rule- Simpson's rule- Simpson's 3/8 rule | 5 |
| 8-9 | Initial Value Problem for Ordinary Differential Equations: Picard Method-Euler's method- Modified Euler's method- Runge-Kutta methods. | 10 |
| 10 | Computer implementations of selected numerical algorithms | 5 |
| Total | | 50 |

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

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

2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|----------------------------------|--------------------------------------|
| 1 | Quizzes + Home works | Continues | 10 % |
| 2 | Midterm exam | 5 th -6 th | 30 % |
| 3 | Class Work (Homework- report- class test....) | 8 th | 10 % |
| 4 | Final exam | 11 th | 50 % |

*Assessment task (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:
 6 hours per week (as defined in the teaching schedule of the faculty member) for academic advice and consultations.
 Teaching staff is also available using Blackboard web site and Taif University “Edugate” System.

F. Learning Resources and Facilities

1. Learning Resources

| | |
|---------------------------------------|---|
| Required Textbooks | Richard L. Burden and J. Douglas Faires, Numerical Analysis (2011), 10th Edition. Student Edition: ISBN-10:0-534-39200-8. https://fac.ksu.edu.sa/sites/default/files/numerical_analysis_9th.pdf |
| Essential References Materials | 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. https://www.academia.edu/30721823/ Rao V. Dukkipati Numerical methods BookFi.org Store J. and Bulirsch R., Introduction to Numerical Analysis, (1993), Springer- Verlag, ISBN 0-387-90420 |
| Electronic Materials | <ul style="list-style-type: none"> • http://www.nd.edu/~zxu2/ACMS40390-F10.html • http://home.ku.edu.tr/~emengi/teaching/math304/mart304.html • http://home.ku.edu.tr/~emengi/teaching/math304/mart304/lectures.html |
| Other Learning Materials | Matlab tutorial |

2. Facilities Required

| Item | Resources |
|---|---|
| Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.) | Lecture halls, containing white boards, and electronic monitors - The seats fit the number of students - Laboratories equipped with suitable numbers of computers |
| Technology Resources (AV, data show, Smart Board, software, etc.) | Matlab software |
| Other Resources (Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | Wi-Fi internet connections |

G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|--|---------------------------|--------------------|
| Effectiveness of teaching and assessment | Students | Indirect |
| Quality of learning resources | Peer Reviewer Students | Direct Indirect |

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|--|---------------------------|--------------------|
| Extent of achieving the course learning outcomes | Peer Reviewer Students | Direct Indirect |

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

Assessment Methods (Direct, Indirect)

H. Specification Approval Data

| | |
|---------------------|--|
| Council / Committee | Department of Mathematics and Statistics |
| Reference No. | |
| Date | 12-7-1443 H |

قسم الرياضيات والإحصاء
Mathematics and Statistics
Department



Numerical Analysis