1. **Basic Information**

**Course Title**: Modern Topics in Numerical Analysis   **Code**: **EMM 701 Units: 3**

**Lecture**: 3 **Tutorial**: - **Practical**: - **Total:** 3

**Program on which the course is given:**  Doctor of Philosophy in Engineering Mathematics

**Major or minor element of program:** Major

**Department offering the program:** Department of Engineering Mathematics and Physics

**Department offering the course:** Department of Engineering Mathematics and Physics

**Academic year / level:** Academic year2014 / 2015 First Semester

**Date of specifications approval:**  December 2015

1. **Professional Information**
2. **Overall aims of course**

By the end of the course the students will be able to:

* Recognize Interpolation, Numerical differentiation and integration, Least squares method..
* Identify N. solutions to Ordinary and partial differential equations, Initial boundary value problems, Wave equation in spherical and cylindrical coordinates, System of linear equations.
* Deal with Numerical methods for solving of nonlinear equations, Review of Numerical methods in the last 10 years..

1. **Intended Learning outcomes of Course (ILOs)**
2. **Knowledge and Understanding:**

2.1.1 Identify theories, fundamentals of Numerical differentiation and integration.

2.1.3 Summarize the moral and legal principles of solutions to Ordinary and partial differential equations

2.1.4 List the principles and fundamentals of nonlinear equations.

1. **Intellectual Skills**

2.2.7 Make professional decisions in solving of nonlinear equations.

2.2.9 Interpret with discussion based on Numerical methods for solving of nonlinear equations

1. **Professional and Practical Skills**

2.3.3 Assess methods to detect the degree of accuracy.

1. **General and Transferable Skills**

2.4.1 Communicate effectively with continuous researches to the topics related with the subject

2.4.3 Teach and assess the estimating error.

2.4.4 Assess and identify the methods used for solving ordinary and partial differential equations.

1. **Contents**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No** | **Topic** | **No. of hours** | **Teaching / learning methods and strategies** | **Assessment method** |
| 1 | Introduction, Review to Errors. | 3 | Lectures | Assignments |
| 2 | Interpolation by using polynomials, differences and Lagrange's method | 3 | Lectures | Assignments |
| 3 | Review to Numerical differentiation | 3 | Lectures | Mid-term exam, Final exam |
| 4 | Review to Numerical integration. | 3 | Lectures | Quiz  Mid-term exam, Final exam |
| 5 | Review to Least squares method. | 3 | Class activity, Tutorial | Assignments  Mid-term exam, Final exam |
| 6 | Review to Least squares method. | 3 | Lectures, Tutorial | Mid-term exam, Final exam |
| 7 | Review to Wave equations in spherical and cylindrical coordinates. | 3 | Lectures | Assignments  Mid-term exam, Final exam |
| 8 | Mid-term Exam |  | -- | Mid-Term exam |
| 9 | Solution of equations of one variable. | 3 | Lectures | Quiz, Final exam |
| 10 | Solution of equations of one variable. | 3 | Lectures | Assignments, Final exam |
| 11 | Numerical methods for solving partial differential equations | 3 | Lectures | Quiz, Final exam |
| 12 | Numerical methods for solving partial differential equations | 3 | Lectures, Tutorial | Assignments, Final exam |
| 13 | Numerical methods for solving systems of nonlinear equations. | 3 | Lectures, Tutorial | Quiz, Final exam |
| 14 | Review of Numerical methods in the last 10 years. | 3 | Class activity, Tutorial | Assignments, Final exam |
| 15 | Final Exam |  |  |  |

1. **Teaching and Learning Methods**
   1. Lectures
   2. Class activity
   3. Self study
   4. Research assignments and the use of internet. 
2. **Student Assessment Methods**
   1. Homework assignments and others
   2. Quiz to assess student’s creativity and problem assessments.
   3. Final exam to assess understanding and scientific knowledge. 

Assignments to assess 2.1.1, 2.1.3, 2.1.4, 2.2.6, 2.2.7, 2.3.3, 2.4.1, 2.4.3, 2.4.4 Quiz to assess 2.1.1, 2.1.3, 2.1.4, 2.2.6, 2.2.7, 2.3.3, 2.4.1

Mid-Year exam to assess 2.1.1, 2.1.3, 2.1.4, 2.2.6, Final exam to assess 2.1.1, 2.1.3, 2.1.4

1. **Assessment schedule**

Assessment 1 All weeks 

Assessment 2 Quizzes

Assessment 3 Final exam on the 15thweek

1. **Weighting of Assessments**

Final- Term Examination 67 %

Oral Examination 00 %

Practical Examination 00 %

Year Work 33 %

Other 00 %

Total 100 %

1. **List of References**
   1. Course Notes

* Lecture material and training sheets
  1. Essential Books (Text Books)
* Calculus Of Finite Difference And Numerical Analysis By Gupta-Malik,
* Numerical analysis (7ed., Brooks Cole, 2001) By Burden R.L., Faires J.D.
* Numerical methods, software and analysis By Jhon R. Rice
* Schaum Outline Theory and Problems of Numerical Analysis McGraw-Hill\_1968R.
  1. Recommended Books
* Table of Integrals, Series, and Products, Seventh Edition BY I.S. Gradshteyn and I.M. Ryzhik.
  1. Periodicals Web sites, etc
* Mathematica 8, 9
* [www.MathematicsResearch.com](http://www.MathematicsResearch.com)
* [www.Google.com](http://www.Google.com)

1. **Facilities Required for Teaching and learning**

White board, prepared notes, Sheets and solving problems.

|  |  |
| --- | --- |
| **Course coordinator:** Prof. Dr. Mohamed Ismail Hessein |  |
| **Course instructor:** Prof. Dr. Mohamed Ismail Hessein |

**Head of department:**  **Prof. Dr.** Said Abdallah **Date: 28 / 7 / 2015**