Course Specifications of: **Advanced Numerical Analysis MEP 601**

Program(s) on which the course is given: Post Graduate **M. Eng.** In Mechanical Power Engineering
Compulsory or Elective element of program: Compulsory
Department offering the program: Mechanical Engineering/ Power
Academic year / Level: **year/   2014/2015**
Date of specification approval: 2012

A. Basic Information

Title: Advanced Numerical analysis   **Code: MEP 601**
Credit Hours: 3   **Lecture: 3**
Tutorial: **Practical:**   **Total: 3**

B. Professional Information

1. **Overall aims of course**

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

   (a) Understand concepts and basic principles of numerical and graphics methods used in programming
   (b) Understand the use of numerical methods to solve matrices system
   (c) Solve problems on computational and advanced numerical techniques.

2. **Intended Learning outcomes of Course (ILOs)**

   By completion of the course, the student should be able to:

   2.1 **Knowledge and Understanding**
   a1. Define theories, fundamentals and specialized knowledge in the area of numerical analysis methods. (2.1.1)
   a2. Recognize the scientific developments in computational numerical methods. (2.1.3)
   a3. Explain the basic principles of ensuring higher levels of quality in computational numerical methods. (2.1.5).
   a4. Describe the current energy problems in a critically evaluated manner, (2.1.6).

   2.2 **Intellectual Skills**
   b1. Analyze and assess information in the field of numerical technique and draw analogies to solve problems.(2.2.1)
   b2. Evaluate the relative enhancement in the system or process performance due to the innovative part or procedure application, (2.2.2).

   2.3 **Professional and Practical Skills**
   c1. Write and evaluate professional reports in engineering numerical methods. (2.3.2)

c2. Assess methods and current tools in engineering numerical methods. (2.3.3)
c3. Use the various software programs for simulating the different mechanical systems. (2.3.6)

2.4 **General and Transferable Skills**
    d1. Use different sources for obtaining information and knowledge.(2.4.4)
    d2. Conduct self-learning and continuous education practices(2.4.8)

2 **Contents**

No	Topic	No. of weeks	Total no. of hours
1	Errors in numerical calculation - find roots of non-linear equations - solving a set of simultaneous equations - linear algebra - methods of optimal solutions	3	9
2	ordinary differential equations - application to cases of initial and boundary value problems - partial differential equations and applications to parabolic and elliptic equations	2	6
3	Best fitting curves for a set of readings - Numerical differentiation and numerical integration Solving linear systems by using iterative techniques, Finding the best polynomial representing a number of data points (or a function) by least squares method.	3	9
4	Understanding the difference between analogue and digital signals (images)	3	9
5	Understanding the Fourier Transform and its applications in image analysis - Applications and projects for the previous numerical methods in solving the issues in mechanical engineering.	3	9
6	Exam	1	3
	Total	15	45

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4- Course Matrix

ILO's code number	Teaching/learning methods and strategies	Assessment methods and strategies
2.1.1 2.1.3 2.1.5 2.1.6	Identify theories, fundamentals and specialized knowledge in the area of computational numerical methods. Outline the scientific developments in computational numerical methods.	Individual coursework assignments, quizzes, oral discussions and reports. Mid-year and /or final written examination is given.
2.2.1 2.2.2	Analyze and assess information in the field of numerical technique and	Analysis and problem-solving skills are assessed through oral and written

	draw analogies to solve problems.	examinations.
2.3.2 2.3.3 2.3.6	Write and evaluate professional reports in engineering numerical methods. Assess methods and current tools in engineering numerical methods.	Practical skills are assessed through computer lab, coursework exercises and reports, project reports and presentations.
2.4.4 2.4.8	Write and evaluate professional reports in engineering numerical methods. Assess methods and current tools in engineering numerical methods.	Presentations in monthly seminars Writing scientific reports

5 Assessment schedule

Assessment 1 Assignments   on weeks   1, 3, 6
Assessment 2 Quizzes   on weeks   2, 4, 9, 13
Assessment 3 Mid-term exam on weeks   8
Assessment 3 Oral exam   on week   14
Assessment 4 Final exam   on week   15

6 Weighting of Assessments

20% (60 marks) Home assignments, Quizzes, and reports
20% (60 marks) Mid-term examination and Oral examination
60% (180 marks) Final-term examination
100% (300 marks) Total

7 Lists of References

7.1 Essential books (Text books)

a. Course Notes
b. Introduction to Numerical Analysis (2nd Edition) (Dover Books on Advanced Mathematics) By F. B. Hildebrand, SBN-13 / EAN: 9780486653631

7.2 Recommended books; Periodicals & Websites.

- Numerical Methods by J. Douglas (Douglas Faires) Faires and Richard L. Burden (Jun 18, 2002)
- Numerical Methods for Engineers, Sixth Edition by Steven Chapra and Raymond Canale (Apr 20, 2009
- Numerical Methods with MATLAB by Amos Gilat and Vish Subramaniam (Mar 22, 2010)

8 Facilities Required for Teaching and learning

Lecture room equipped with overhead projector
Presentation board, computer and data show
Laboratory

Course coordinator: **Prof. G. A. Assasa, Prof. O. E. Abdellatif**
Course instructor: **Prof. O. E. Abdellatif, Prof. G. A. Assasa**
Head of department: **Prof. Dr. Osama Ezzat Abdellatif**

Matrix of course content and ILO's

Course Title: Advance Numerical Analysis   **Code**: **MEP 601**
Lecture: 3   Tutorials: 3   **Practical**: ----   **Total:** 3
Program on which the course is given: Post Graduate **M. Eng.** in Power Engineering.
Major or minor element of program: Compulsory
Department offering the program: Mechanical Engineering / Power
Department offering the course: Mechanical Engineering   / Power
Academic year / level: **2014/2015**. **Date of specifications approval: 2012**

Course content	ILO's A	ILO's B	ILO's C	ILO's D
1. Errors in numerical calculation - find roots of non-linear equations - solving a set of simultaneous equations - linear algebra - methods of optimal solutions	a1	b1	c3	d1
2. ordinary differential equations - application to cases of initial and boundary value problems - partial differential equations and applications to parabolic and elliptic equations	a1, a2		c1	d2
3. Best fitting curves for a set of readings - Numerical differentiation and numerical integration Solving linear systems by using iterative techniques, Finding the best polynomial representing a number of data points (or a function) by least squares method.	a1.a3		c2	d1
4. Understanding the difference between analogue and digital signals (images)	a1, a2		c1	d2
5. Understanding the Fourier Transform and its applications in image analysis - Applications and projects for the previous numerical methods in solving the issues in mechanical engineering.	a1,a4	b2	c2	d1

Matrix of course aims and ILO's

Course Title: **Advance Numerical Analysis**   **Code**: **MEP 601**
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Course aims	ILO's A	ILO's B	ILO's C	ILO's D
(a) Understand concepts and basic principles of numerical and graphics methods used in programming	a1,a3	b1	c1, c2	d1
(b) Understand the use of numerical methods to solve matrices system	a1, a2	b1,b2	c1,c3	d1
(c) Solve problems on computational and advanced numerical techniques	a2,a4	b1	c2	d2