Sana'a University
Faculty of Engineering
Mechanical Engineering Department
Mechanical Engineering Program

30. Course Specification of Engineering Mathematics

I. Course Identification and General Information:						
1.	Course Title:	Engineering Mathematics.				
2.	Course Code & Number:	BR231.				
3.	Credit Hours:	C.H.				TOTAL CR. HRS
		Th.	Seminar/Tu	Pr	Tr.	
		2	2	-	-	3
4.	Study level/ semester at which this course is offered:	Third Year - First Semester.				
5.	Pre –requisite (if any):	Differential Equations.				
6.	Co –requisite (if any):	None				
7.	Program (s) in which the course is offered:	Mechanical Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	Location of teaching the course:	Mechanical Engineering Department.				
10.	Prepared By:	Asst. Prof. Dr. Yasser ALhuri.				
11.	Date of Approval:					

II. Course Description:

This course deals with topics which provide students with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The focus of the course is the numerical methods using the following computational techniques, error analysis, numerical solutions to nonlinear equations, solution methods for linear system, interpolation, numerical differentiation, numerical integration, the numerical solutions of differential equations (ODEs and PDE) that arise in engineering and the physical sciences and Fourier transforms with it's applications in PDEs.

III.	Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
a1.	Recognize the concept of Numerical Analysis Methods and Error Analysis.	A1
a2.	Identify some Numerical Methods and appropriate techniques for solving Nonlinear Equations, Linear system and finding the Interpolation relevant to Mechanical engineering processes.	A1

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a3.	Establish Numerical Analysis to approximate Integration, Differentiation and Ordinary Differential Equations Problems.	A4
a4.	Define Fourier series, Complex and Integral and how use it to solve (PDEs) for Mechanical engineering problems.	A4
b1.	Examine different Numerical Methods to solve Applied engineering Problems.	B1
c1.	Apply various techniques of numerical methods to approximate the solution of some mathematics problems which haven't exact or analytical solution for mechanical Engineering practices.	C1
d1.	Co-operate with team members to share different knowledge.	D1
d2.	Assess to tasks with the support of the different resources.	D4

(A) Alignment Course Intended Learning Outcomes of Knowledge and UndeA1rstanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes		Teaching strategies	Assessment Strategies
a1.	Know the concept of Numerical Analysis Methods and Error Analysis.	• Active Lectures. • Tutorials. • The use of Computer and Web-Based Learning. • Design Work and Project. • Case Studies. • Independent Learning. • Directed Self Study. • Group Learning and Problem Based Learning.	Written Assessment. Final Exam
a2.	Identify some Numerical Methods and appropriate techniques for solving Nonlinear Equations, Linear system and finding the Interpolation relevant to Mechanical engineering processes.		Written Assessment. Final Exam.
a3.	Establish Numerical Analysis to approximate Integration, Differentiation and Ordinary Differential Equations Problems.		Written Assessment. Final Exam
a4.	Define Fourier series, Complex and Integral and how use it to solve (PDEs) to solve Mechanical engineering problems.		Written Assessment.

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies

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b1.	Examine different Numerical Methods to solve Applied Engineering Problems.	• Active Lectures. • Tutorials. • The use of Computer and Web-Based Learning. • Design Work and Project. • Case Studies. • Independent Learning. • Directed Self Study. • Group Learning and Problem Based Learning.	Written Assessment. Final Exam

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes		Teaching strategies	Assessment Strategies
c1.	Apply various techniques of numerical methods to approximate the solution of some mathematics problems which haven't exact or analytical solution for mechanical Engineering practices.	• Active Lectures. • Tutorials. • The use of Computer and Web-Based Learning. • Design Work and Project. • Case Studies. • Independent Learning. • Directed Self Study. • Group Learning and Problem Based Learning.	Written Assessment. Final Exam

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes		Teaching strategies	Assessment Strategies
d1.	Co-operate with team members to share different knowledge.	• Group Learning • Case Studies.	Written Assessment.
d2.	Assess to tasks with the support of the different resources.		Written Assessment.

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Error Analysis	a1,c1,d1,d2	- Accuracy, Precision and Error Definitions.	1	2

			-Round-Off Errors. -Truncation Errors.		
2.	Numerical Methods for Solving Nonlinear Equations of one Variable	a2 ,b1,c1,d1,d2	-Bisection Method. - False Position Method. - Fixed – Point iteration. - Newton – Raphson. - Secant Methods.	2	4
3.	The Interpolation	a2,b1,c1,d1, d2	- Direct Fit Polynomial. - Newton Interpolating Polynomials. - Lagrange Interpolating Polynomials. - Newton's Divided-Difference Interpolating Polynomials.	2	4
4.	Numerical Differentiation	a3,b1,c1,d1, d2	- Derivatives of Unequally Spaced Data. - Derivatives and Integrals for Data with Errors.	1	2
5.	Numerical Integration	a3,b1,c1,d1, d2	- The Trapezoidal Rule. - Simpson's Rules.	1	2
6.	Mid-Term Exam	a3,b1,c1, d2	- The First Sixth Chapters	1	2
7.	Numerical Methods to Solve (ODEs)	a3,b1,c1,d1, d2	-Euler's Method. - Runge-Kutta methods.	1	2
8.	Numerical Methods to Solve (PDEs)	a3,a4,b1,c1, d1,d2	Finite Difference Methods for Parabolic PDEs.	1	2
			Finite Difference Methods for Hyperbolic PDEs.	1	2
			Finite Difference Methods for Elliptic PDEs	1	2
9.	Fourier Series	a4,b1,c1,d1, d2	- Computation of Fourier Series. - Fourier Cosine and Sine Series.	1	2
10.	Complex Fourier and Integral	a4,b1,c1,d1, d2	-The Complex Form of Fourier Series.	1	2

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			-The Fourier Integral.		
11.	Applications of Fourier Series to Differential Equations	a4,b1,c1,d1, d2	Applications Fourier Series to Ordinary and Partial Differential Equations.	1	2
12.	Final Exam	a1, a2, a3, a4,b1,c1,d2	All Chapters	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

C- Tutorial Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours	Learning Outcomes
1.	Tutorial_1 Error Analysis	1	2	a1,c1,d1
2.	Tutorial_2+3 Numerical Methods for Solving Nonlinear Equations of one Variable	2	4	a2 ,b1,c1,d1,d2
3.	Tutorial_4+5 The Interpolation	2	4	a2,b1,c1,d1,d2
4.	Tutorial_6 Numerical Differentiation	1	2	a3,b1,c1,d1,d2
5.	Tutorial_7 Numerical Integration	1	2	a3,b1,c1,d1,d2
6.	Tutorial_8 Numerical Solutions of Ordinary Differential Equations	1	2	a3,b1,c1,d1,d2
7.	Tutorials_9+10+11 Numerical Solutions of PDEs	3	6	a3,a4,b1,c1,d1,d2
8.	Tutorials_12 Computation of Fourier Series, Fourier Cosine and Sine Series.	1	2	a4,b1,c1,d1,d2
9.	Tutorials_13 The Complex form of Fourier Series, The Fourier Integral. The Discrete and Fast Fourier Transforms.	1	2	a4,b1,c1,d1,d2
10.	Tutorials_14	1	2	a4,b1,c1,d1,d2

	Applications Fourier Series to Differential Equation.			
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- The use of Computer and Web-Based Learning.
- Design Work and Project.
- Case Studies.
- Independent Learning.
- Directed Self Study.
- Group Learning and Problem Based Learning.
- Case Studies.

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Tutorial_1 **Error Analysis**	a1,c1,d1	1st	1
2.	Tutorial_2+3 **Numerical Methods for solving Nonlinear Equations of one variable**	a2 ,b1,c1,d1,d2	2th & 3th	2
3.	Tutorial_4+5 **The Interpolation**	a2,b1,c1,d1,d2	4th & 5th	3
4.	Tutorial_6 **Numerical Differentiation**	a3,b1,c1,d1,d2	6th	1
5.	Tutorial_7 **Numerical Integration**	a3,b1,c1,d1,d2	7th	1
6.	Tutorial_8 **Numerical Solutions of Ordinary Differential Equations**	a3,b1,c1,d1,d2	8th	1
7.	Tutorials_9+10+11 **Numerical Solutions of PDEs**	a3,a4,b1,c1,d1,d2	9th -11th	3
8.	Tutorials_12 **Computation of Fourier Series, Fourier cosine and sine Series.**	a4,b1,c1,d1,d2	12th	1

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9.	Tutorials_13 **The complex form of Fourier Series, The Fourier Integral. The Discrete and Fast Fourier Transforms.**	a4,b1,c1,d1,d2	13th	1
10.	Tutorials_14 **Applications Fourier Series to Differential Equation.**	a4,b1,c1,d1,d2	14th	1
Total				**15**

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VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Assessment (Work Sample such as Portfolios).	1-14	15	10 %	a1, a2, a3, a4, b1, c1, d1, d2
2	Quizzes	2,4,6,8,10	15	10 %	a1, a2, a3, a4, b1, c1, d1, d2
3	Mid-Term Exam	8	30	20 %	a1, a2, a3, a4, b1, c1, d2
4	Final Exam.	16	90	60 %	a1, a2, a3, a4, b1, c1, d2
Total			**150**	**100%**	

VIII. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

1- Xin-She Yang., 2007, Applied Engineering Mathematics. University of Cambridge, Cambridge, United Kingdom Pub.
2- Richard L.Burden and J.Doyglass Faires. 2011 Numerical Analysis, 9th Ed. Brooks /Col, Cengage Learning.

2- Essential References.

1- Sastry S.S., 2004, Engineering Mathematics V.2 Asoke Pub., India.
2- Coddington E. A., 1989, an Introduction to Ordinary Differential Equations, Dover Pub.
3- Chapra S. C. and Canale R. P. (2015) Numerical Methods For Engineers, 7th Ed. McGraw-Hill Education.

3- Electronic Materials and Web Sites *etc*.

- http://ocw.mit.edu/courses/
- http://depts.washington.edu/amath/
- http://www.esam.northwestern.edu/index.html
- http://www.seas.harvard.edu/academics/undergraduate/applied-math

I. Course Policies:

1	**Class Attendance:**

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	- The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and be considerd as an exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic.
2	**Tardy:** - For lateness in attending the class, the student will be initially notified. If he repeates late in attending class he will be considered absent.
3	**Exam Attendance/Punctuality:** - The student should attend the exam on time. He is permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in the exam.
4	**Assignments & Projects:** - In general one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment
5	**Cheating**: - For cheating in exam, the student is considered as failure. In case the cheating is repeated three times during study the student will be disengaged from the Faculty
6	**Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Affair Council of the university.
7	**Other policies:** - The mobile phone is not allowable to be used during class lecture. It must be switched off, otherwise the student will be ordered to leave the lecture room. - The mobile phone is not allowed to be taken during the examination time. - Lecture notes and assignments may be given directly to students using soft or hard copy.

Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi** **Name of Reviewer from the Department: Assoc.Prof. Dr.Riyad Muharam**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

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30. Course Plan of Engineering Mathematics

I. Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Asst. Prof. Dr. Yasser Alhuri	**Office Hours**					
Location& Telephone No.	Department of Basic Engineering Science 00967773038653	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	yasseralhuri@yahoo.com						

II. Course Identification and General Information:

1	Course Title:	Engineering Mathematics.				
2	Course Number & Code:	BR231.				
3	Credit Hours:	C.H				TOTAL CR. HRS
		Th.	Seminar/Tu.	Pr.	Tr.	
		2	2	-	-	3
4	Study level/year at which this course is offered:	Third Year - First Semester.				
5	Pre –requisite (if any):	Differential Equations (BR104).				
6	Co –requisite (if any):	None				
7	Program (s) in which the course is offered	Mechanical Engineering Program.				
8	Language of teaching the course:	English Language.				
9	System of Study:	Semesters.				
10	Mode of delivery:	Lectures and Tutorials.				
11	Location of teaching the course:	Mechanical Engineering Department.				

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III. Course Description:

This course deals with topics which provide students with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The focus of the course is the numerical methods using the following computational techniques: error analysis, numerical solutions to nonlinear equations, solution methods for linear system, interpolation, numerical differentiation, numerical integration, the numerical solutions of differential equations (ODEs and PDE) that arise in engineering and the physical sciences and Fourier transforms with it's applications in PDEs.

IV. Intended learning outcomes (ILOs) of the course:

Brief summary of the knowledge or skill the course is intended to develop**:**

1.	Recognize the concept of Numerical Analysis Methods and Error Analysis.
2.	Identify some Numerical Methods and appropriate techniques for solving Nonlinear Equations, Linear system and finding the Interpolation relevant to Mechanical engineering processes.
3.	Establish Numerical Analysis to approximate Integration, Differentiation and Ordinary Differential Equations Problems.
4.	Define Fourier series, Complex and Integral and how use it to solve (PDEs) for Mechanical engineering problems.
5.	Examine different Numerical Methods to solve Applied engineering Problems.
6.	Apply various techniques of numerical methods to approximate the solution of some mathematics problems which haven't exact or analytical solution for mechanical Engineering practices.
7.	Co-operate with team members to share different knowledge.
8.	Assess to tasks with the support of the different resources.

V. Course Content:

- Distribution of Semester Weekly Plan of Course Topics/Items and Activities.

A – Theoretical Aspect:

Order	Topics List	Sub Topics	Week Due	Contact Hours
1.	Error Analysis	- Accuracy, Precision and Error Definitions. -Round-Off Errors.	1st	2

		-Truncation Errors.		
2.	Numerical Methods for Solving Nonlinear Equations of one Variable	-Bisection Method. - False Position Method. - Fixed – Point iteration. - Newton – Raphson. - Secant Methods.	2th and 3th	4
3.	The Interpolation	- Direct Fit Polynomial. - Newton Interpolating Polynomials. - Lagrange Interpolating Polynomials. - Newton's Divided-Difference Interpolating Polynomials.	4th and 5th	4
4.	Numerical Differentiation	- Derivatives of Unequally Spaced Data. - Derivatives and Integrals for Data with Errors.	6th	2
5.	Numerical Integration	- The Trapezoidal Rule. - Simpson's Rules.	7th	2
6.	Mid-Term Exam	- The First Sixth Chapters	8th	2
7.	Numerical Methods to Solve (ODEs)	-Euler's Method. - Runge-Kutta methods.	9th	2
8.	Mid-Term Exam	The First Sixth Chapters	9th	2
9.	Numerical Methods to Solve (PDEs)	Finite Difference Methods for Parabolic PDEs.	10th	2
		Finite Difference Methods for Hyperbolic PDEs.	11th	2
		Finite Difference Methods for Elliptic PDEs	12th	2
10.	Fourier Series	- Computation of Fourier Series. - Fourier Cosine and Sine Series.	13th	2
11.	Complex Fourier and Integral	-The Complex Form of Fourier Series. -The Fourier Integral.	14th	2
12.	Applications of Fourier Series to Differential Equations	Applications Fourier Series to Ordinary and Partial Differential Equations.	15th	2

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13.	Final Exam	All Chapters	16th	2
Number of Weeks /and Units Per Semester			**16**	**32**

C – Tutorial Aspect:			
Order	**Topics List**	**Week Due**	**Contact Hours**
1.	Tutorial_1 **Error Analysis**	1st	2
2.	Tutorial_2+3 **Numerical Methods for solving Nonlinear Equations of one variable**	2nd, 3rd	4
3.	Tutorial_4+5 **The Interpolation**	4th, 5 th	4
4.	Tutorial_6 **Numerical Differentiation**	6 th	2
5.	Tutorial_7 **Numerical Integration**	7 th	2
6.	Tutorial_8 **Numerical Solutions of Ordinary Differential Equations**	8 th	2
7.	Tutorials_9+10+11 **Numerical Solutions of PDEs**	9 th, 10 th, 11 th	6
8.	Tutorials_12 **Computation of Fourier Series, Fourier cosine and sine Series.**	12 th	2
9.	Tutorials_13 **The complex form of Fourier Series, The Fourier Integral.** **The Discrete and Fast Fourier Transforms.**	13 th	2
10.	Tutorials_14 **Applications Fourier Series to Differential Equation.**	14 th	2
Number of Weeks /and Units Per Semester		**14**	**28**

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VI. Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- The use of Computer and Web-Based Learning.
- Design Work and Project.
- Case Studies.
- Independent Learning.
- Directed Self Study.
- Group Learning and Problem Based Learning.
- Case Studies.

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Tutorial_1 **Error Analysis**	a1,c1,d1	1st	1
2.	Tutorial_2+3 **Numerical Methods for solving Nonlinear Equations of one variable**	a2 ,b1,c1,d1,d2	2th & 3th	2
3.	Tutorial_4+5 **The Interpolation**	a2,b1,c1,d1,d2	4th & 5th	3
4.	Tutorial_6 **Numerical Differentiation**	a3,b1,c1,d1,d2	6th	1
5.	Tutorial_7 **Numerical Integration**	a3,b1,c1,d1,d2	7th	1
6.	Tutorial_8 **Numerical Solutions of Ordinary Differential Equations**	a3,b1,c1,d1,d2	8th	1
7.	Tutorials_9+10+11 **Numerical Solutions of PDEs**	a3,a4,b1,c1,d1,d2	9th - 11th	3
8.	Tutorials_12 **Computation of Fourier Series, Fourier cosine and sine Series.**	a4,b1,c1,d1,d2	12th	1
9.	Tutorials_13 **The complex form of Fourier Series, The Fourier Integral.**	a4,b1,c1,d1,d2	13th	1

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	The Discrete and Fast Fourier Transforms.			
10.	Tutorials_14 **Applications Fourier Series to Differential Equation.**	a4,b1,c1,d1,d2	14th	1
	Total			**15**

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Assessment (Work Sample such as Portfolios).	1-14	15	10 %	a1, a2, a3, a4, b1, c1, d1, d2
2.	Quizzes	4,8,11	15	10 %	a1, a2, a3, a4, b1, c1, d2
3.	Mid-Term Exam	8	30	20 %	a1, a2, a3, a4, b1, c1, d2
4.	Final Exam.	16	90	60 %	a1, a2, a3, a4, b1, c1, d2
Total			**150**	**100%**	

IX. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

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- http://ocw.mit.edu/courses/
- http://depts.washington.edu/amath/
- http://www.esam.northwestern.edu/index.html
- http://www.seas.harvard.edu/academics/undergraduate/applied-math

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2	**Tardy:** - For lateness in attending the class, the student will be initially notified. If he repeates late in attending class he will be considered absent.
3	**Exam Attendance/Punctuality:** - The student should attend the exam on time. He is permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in the exam.
4	**Assignments & Projects:** - In general one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment
5	**Cheating**: - For cheating in exam, the student is considered as failure. In case the cheating is repeated three times during study the student will be disengaged from the Faculty
6	**Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Affair Council of the university.
7	**Other policies:** - The mobile phone is not allowable to be used during class lecture. It must be switched off, otherwise the student will be ordered to leave the lecture room. - The mobile phone is not allowed to be taken during the examination time. - Lecture notes and assignments may be given directly to students using soft or hard copy.

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Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad	Prof. Dr. Al-Qassim Mohammed Abbas

I. Course Identification and General Information:

1.	Course Title:	Engineering Mathematics.				
2.	Course Code & Number:	BR231.				
3.	Credit Hours:	C.H.				TOTAL CR. HRS
		Th.	Seminar/Tu	Pr	Tr.	
		2	2	-	-	3
4.	Study level/ semester at which this course is offered:	Third Year - First Semester.				
5.	Pre –requisite (if any):	Differential Equations.				
6.	Co –requisite (if any):	None				
7.	Program (s) in which the course is offered:	Mechanical Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	Location of teaching the course:	Mechanical Engineering Department.				
10.	Prepared By:	Asst. Prof. Dr. Yasser ALhuri.				
11.	Date of Approval:					

IX. Course Description:

This course deals with topics which provide students with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The focus of the course is the numerical methods using the following computational techniques, error analysis, numerical solutions to nonlinear equations, solution methods for linear system, interpolation, numerical differentiation, numerical integration, the numerical solutions of differential equations (ODEs and PDE) that arise in engineering and the physical sciences and Fourier transforms with it's applications in PDEs.

X.	Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
a1.	Recognize the concept of Numerical Analysis Methods and Error Analysis.	A1
a2.	Identify some Numerical Methods and appropriate techniques for solving Nonlinear Equations, Linear system and finding the Interpolation relevant to Mechanical engineering processes.	A1
a3.	Establish Numerical Analysis to approximate Integration, Differentiation and Ordinary Differential Equations Problems.	A4

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a4.	Define Fourier series, Complex and Integral and how use it to solve (PDEs) for Mechanical engineering problems.	A4
b1.	Examine different Numerical Methods to solve Applied engineering Problems.	B1
c1.	Apply various techniques of numerical methods to approximate the solution of some mathematics problems which haven't exact or analytical solution for mechanical Engineering practices.	C1
d1.	Co-operate with team members to share different knowledge.	D1
d2.	Assess to tasks with the support of the different resources.	D4

(A) Alignment Course Intended Learning Outcomes of Knowledge and UndeA1rstanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes		Teaching strategies	Assessment Strategies
a1.	Know the concept of Numerical Analysis Methods and Error Analysis.	• Active Lectures. • Tutorials. • The use of Computer and Web-Based Learning. • Design Work and Project. • Case Studies. • Independent Learning. • Directed Self Study. • Group Learning and Problem Based Learning.	Written Assessment. Final Exam
a2.	Identify some Numerical Methods and appropriate techniques for solving Nonlinear Equations, Linear system and finding the Interpolation relevant to Mechanical engineering processes.		Written Assessment. Final Exam.
a3.	Establish Numerical Analysis to approximate Integration, Differentiation and Ordinary Differential Equations Problems.		Written Assessment. Final Exam
a4.	Define Fourier series, Complex and Integral and how use it to solve (PDEs) to solve Mechanical engineering problems.		Written Assessment.

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes		Teaching strategies	Assessment Strategies
b1.	Examine different Numerical Methods to solve Applied	• Active Lectures. • Tutorials. • The use of Computer and Web-Based Learning.	Written Assessment. Final Exam

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Engineering Problems.	• Design Work and Project. • Case Studies. • Independent Learning. • Directed Self Study. • Group Learning and Problem Based Learning.	

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1. Apply various techniques of numerical methods to approximate the solution of some mathematics problems which haven't exact or analytical solution for mechanical Engineering practices.	• Active Lectures. • Tutorials. • The use of Computer and Web-Based Learning. • Design Work and Project. • Case Studies. • Independent Learning. • Directed Self Study. • Group Learning and Problem Based Learning.	Written Assessment. Final Exam

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Co-operate with team members to share different knowledge.	• Group Learning • Case Studies.	Written Assessment.
d2. Assess to tasks with the support of the different resources.		Written Assessment.

XI. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
13.	Error Analysis	a1,c1,d1,d2	- Accuracy, Precision and Error Definitions. -Round-Off Errors. -Truncation Errors.	1	2
14.	Numerical	a2 ,b1,c1,d1,d2	-Bisection Method. - False Position Method.	2	4

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	Methods for Solving Nonlinear Equations of one Variable		- Fixed – Point iteration. - Newton – Raphson. - Secant Methods.		
15.	The Interpolation	a2,b1,c1,d1, d2	- Direct Fit Polynomial. - Newton Interpolating Polynomials. - Lagrange Interpolating Polynomials. - Newton's Divided-Difference Interpolating Polynomials.	2	4
16.	Numerical Differentiation	a3,b1,c1,d1, d2	- Derivatives of Unequally Spaced Data. - Derivatives and Integrals for Data with Errors.	1	2
17.	Numerical Integration	a3,b1,c1,d1, d2	- The Trapezoidal Rule. - Simpson's Rules.	1	2
18.	Mid-Term Exam	a3,b1,c1, d2	- The First Sixth Chapters	1	2
19.	Numerical Methods to Solve (ODEs)	a3,b1,c1,d1, d2	-Euler's Method. - Runge-Kutta methods.	1	2
20.	Numerical Methods to Solve (PDEs)	a3,a4,b1,c1, d1,d2	Finite Difference Methods for Parabolic PDEs.	1	2
			Finite Difference Methods for Hyperbolic PDEs.	1	2
			Finite Difference Methods for Elliptic PDEs	1	2