Sana'a University
Faculty of Engineering
Department: Electrical Engineering
Title of the Program: Communication Engineering and Networks

25. Course Specification of Engineering Mathematics

I. Course Identification and General Information:						
1.	Course Title:	Engineering Mathematics.				
2.	Course Code & Number:	BR223.				
3.	Credit hours:	C.H.				Total C.R.
		Th.	Tu.	Pr	Tr.	
		2	-	-	2	3
4.	Study level/ semester at which this course is offered:	Therd Level (First Semester).				
5.	Pre –requisite (if any):	Mathematics 1 (FR001), Mathematics 2 (FR003), Linear Algebra (BR121), Differential Equations (BR122).				
6.	Co –requisite (if any):	None				
7.	Program (s) in which the course is offered:	Electrical Engineering Departments.				
8.	Language of teaching the course:	English /Arabic.				
9.	Location of teaching the course:	Faculty of Engineering,				
10.	Prepared By:	Associate Prof. Dr. Yasser ALhuri.				
11.	Date of Approval:					

II. Course Description:

This course deals with topics which provide students with 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 transforming with it's applications in PDEs.

III. Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Know the concepts of Numerical Analysis Methods and Error Analysis.	A1, A3

Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance	Rector of Sana'a University
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

a2.	Identify some Numerical Methods and appropriate techniques for solving Nonlinear Equations, Linear system and finding the Interpolation relevant to Electrical engineering processes.	A1, A3
a3.	Establish Numerical Analysis to approximate Integration, Differentiation and Ordinary Differential Equations Problems.	A1
a4.	Define Fourier series, Complex and Integral and how use it to solve (PDEs) for Electrical engineering problems.	A1
b1.	Examine different Numerical Methods to solve Applied engineering Problems.	B1,B3
c1.	Apply various techniques of numerical methods to approximate the solution of some mathematics problems which haven't exact or analytical solution for Electrical Engineering practices.	C1,C4
d1.	Co-operate with team members to share different knowledges.	D1
d2.	Assess to tasks with the support of the different resources.	D2

(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 concepts of Numerical Analysis Methods and Error Analysis.	-Active Lectures. -Tutorials.	-Written Assessmen. -Final exam
a2. Identify some Numerical Methods and appropriate techniques for solving Nonlinear Equations, Linear system and finding the Interpolation relevant to Electrical engineering processes.	-Active Lectures. -Tutorials.	-Written Assessment. -Final exam.
a3. Establish Numerical Analysis to approximate Integration, Differentiation and Ordinary Differential Equations Problems.	-Active Lectures. -Tutorials.	-Written Assessment. -Final exam
a4. Define Fourier series, Complex and Integral and how use it to solve (PDEs) for Electrical engineering problems.	-Active Lectures. -Tutorials.	-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 engineering Problems.	-Active Lectures. -Tutorials.	-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 Electrical Engineering practices.	-Active Lectures. -Tutorials.	-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 skills and knowledge.	- Case Studies.	-Written Assessment.
d2. Assess to tasks with the support of the different resources.	- Case Studies.	-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. -Round-Off Errors. -Truncation Errors.	1	2
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.	Numerical Methods to solve (ODEs)	a3,b1,c1,d1, d2	-Euler's Method. - Runge-Kutta methods.	1	2
7.	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
8.	Fourier Series	a4,b1,c1,d1, d2	-Computation of Fourier Series. -Fourier cosine and sine Series.	1	2
9.	Complex Fourier and Integral	a4,b1,c1,d1, d2	-The complex form of Fourier Series. -The Fourier Integral.	1	2
10.	Applications of Fourier series to Differential Equations	a4,b1,c1,d1, d2	-Applications Fourier series to Ordinary and Partial Differential Equations.	1	2
Number of Weeks /and Units Per Semester				**14**	**28**

B - Practical 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 Applications Fourier Series to Differential Equation.	1	2	a4,b1,c1,d1,d2
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.

Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance	Rector of Sana'a University
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

- Design Work and Project.
- Case Studies.
- Independent Learning.
- Directed Self Study.
- Group Learning and Problem Based Learning.

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Tutorial_1 **Error Analysis**	a1,c1,d1	1st	2
2.	Tutorial_2+3 **Numerical Methods for solving Nonlinear Equations of one variable**	a2 ,b1,c1,d1,d2	2th & 3th	4
3.	Tutorial_4+5 **The Interpolation**	a2,b1,c1,d1,d2	4th & 5th	6
4.	Tutorial_6 **Numerical Differentiation**	a3,b1,c1,d1,d2	6th	2
5.	Tutorial_7 **Numerical Integration**	a3,b1,c1,d1,d2	7th	2
6.	Tutorial_8 **Numerical Solutions of Ordinary Differential Equations**	a3,b1,c1,d1,d2	8th	2
7.	Tutorials_9+10+11 **Numerical Solutions of PDEs**	a3,a4,b1,c1,d1,d2	9th -11th	6
8.	Tutorials_12 **Computation of Fourier Series, Fourier cosine and sine Series.**	a4,b1,c1,d1,d2	12th	2
9.	Tutorials_13 **The complex form of Fourier Series, The Fourier Integral.** **The Discrete and Fast Fourier Transforms.**	a4,b1,c1,d1,d2	13th	2
10.	Tutorials_14 **Applications Fourier Series to Differential Equation.**	a4,b1,c1,d1,d2	14th	2
	Total			**30**

Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance	Rector of Sana'a University
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

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	45	30 %	all
2.	Final Exam.	16	105	70 %	all
	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.
3- 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*.

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

IX. Course Policies:

1. **Class Attendance:**
A student should attend not less than 75 % of total hours of the subject; otherwise he will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic

Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance	Rector of Sana'a University
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

2.	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class he will be considered as absent.
3.	**Exam Attendance/Punctuality:** A student should attend the exam on time. He is Permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam-
4.	**Assignments & Projects:** The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time-
5.	**Cheating:** For cheating in exam, a student will be considered as failure. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty-
6.	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another 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 Council Affair of the university.
7.	**Other policies:** - Mobile phones are not allowed to use during a class lecture. It must be closed, otherwise the student will be asked to leave the lecture room - Mobile phones are not allowed in class during the examination. Lecture notes and assignments my 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 A. Muharram.**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

Head of Department Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Algorafi	Dean of the Faculty Prof. Dr. Mohammed AL-Bukhaiti	Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al-Emad	Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas

Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance	Rector of Sana'a University
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