Course Specification

(Postgraduate Programs)

Course Title:	Advanced Engineering Mathematics
Course Code:	2202-502
Program:	Master in Electrical Engineering
Department:	Electrical Engineering
College:	College of Engineering
Institution:	King Faisal University
Version:	V2
Last Revision Date:	17 April 2025

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3)				
2. Course type				
A.	☐ University	☐ College	☒ Department	☐ Track
B.	☒ Required		☐ Elective	
3. Level/year at which this course is offered: Level 1/1st year				
4. Course General Description:				
This course presents mathematical methods for engineers including: Series Solutions of Linear Differential Equations, Matrices, Systems of Linear Differential Equations, Complex Analysis, Functions of a Complex Variable, Integration in the Complex Plane, Series and Residues, and Conformal Mappings.				
5. Pre-requirements for this course (if any)**:**				
MATH215: Math for EE or Graduate standing				
6. Co-requirements for this course (if any)**:**				
None				
7. Course Main Objective(s):				
To introduce a broad coverage of mathematical techniques, models and tools that is useful for early graduate engineers to analyze engineering systems and solve relevant problems.				

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lecture**	45
2.	**Laboratory/Studio**	
3.	**Seminars**	
4.	**Others** (specify) Introduction to Simulation Software	
	Total	45 Hours

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Explain solutions of linear differential equations in the form of power series and use matrices to solve linear systems.	K1	Lectures	Homework, Exams
1.2	Identify main aspects of matrix eigenvalue problems including, powers of matrices, orthogonal matrices, approximation of eigenvalues, diagonalization, LU-factorization and method of least squares.	K1	Lectures	Homework, Exams
1.3	Discuss appropriate scientific and mathematical theories in complex analysis and laws to model, analyze and solve engineering problems.	K1	Lectures	Homework, Exams
2.0	**Skills**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	Apply several mathematical techniques and methods to solve differential equations including matrices to solve systems of differential equations.	S1	Lectures	Homework, Exams
2.2	Utilize the concepts of eigenvalues and eigenvectors, diagonalization, and by means of a matrix exponential function with special emphasis on those types of matrices that are useful to solve systems of linear differential equations.	S1	Lectures	Homework, Exams
2.3	Solve complex integrals by Cauchy's integral formula and by residue integration.	S1	Lectures	Homework, Exams
2.4	Use mathematical software such as MATLAB or MAPLE to perform engineering computations and show the results in a presentation and/or a report.	S2	Lectures with Illustrative MATLAB Simulations	Project(s), Homework
3.0	**Values, autonomy, and responsibility**			
3.1	Use mathematical software such as MATLAB or MAPLE to perform engineering computations and show the results in a presentation and/or a report.	V1	Lectures with Illustrative MATLAB Simulation	Project(s), Homework

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.2	Read literature in Applied Engineering Mathematics and write a review article on a selected topic.	V2	Lectures	Project(s) and Presentation(s)

C. Course Content:

No	List of Topics	Contact Hours
1.	**Series Solutions of Linear Differential Equations** Solutions about Ordinary Points and Singular Points, Bessel Functions, Legendre Functions.	9
2.	**Matrices** The Eigenvalue Problem, Powers of Matrices, Orthogonal Matrices, Approximation of Eigenvalues, Diagonalization, LU-Factorization, Method of Least Squares.	9
3.	**Systems of Linear Differential Equations** Homogeneous Linear Systems, Solution by Diagonalization, Nonhomogeneous Linear Systems, Matrix Exponential.	6
4.	**Functions of a Complex Variable** Powers and Roots, Sets in the Complex Plane, Functions of a Complex Variable, Cauchy–Riemann Equations, Exponential and Logarithmic Functions, Trigonometric and Hyperbolic Functions and their Inverses.	9
5.	**Integration in the Complex Plane** Contour Integrals, Cauchy–Goursat Theorem, Cauchy's Integral Formulas.	6
6.	**Series and Residues** Sequences and Series, Taylor Series, Laurent Series, Zeros and Poles, Residues and Residue Theorem, Evaluation of Real Integrals.	6
	Total	**45**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Project(s) / Homework / Presentation(s)	Biweekly basis	35%
2.	Midterm Exam	Week 8	25%
3.	Final Exam	Week 16	40%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	1. Dennis G. Zill, Advanced Engineering Mathematics, 7th ed., Jones & Bartlett Learning, 2020. 2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th ed., Wiley, 2020.
Supportive References	1. Glyn James and Phil Dyke, Advanced Modern Engineering Mathematics, 5th ed., Pearson, 2018. 2. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 9th ed., McGraw Hill, 2014. 3. Murray Spiegel et al., Schaum's Outline of Complex Variables, 2nd ed., McGraw Hill, 2009.
Electronic Materials	KFU Blackboard: https://bblms.kfu.edu.sa/ KFU Electronic Library: https://www.kfu.edu.sa/en/Deans/Library/Pages/elibrary1.aspx American Mathematical Society: https://mathscinet.ams.org/mathscinet
Other Learning Materials	None

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Normal Class room accommodating 36 students
Technology equipment (Projector, smart board, software)	Overhead projector and multimedia interface
Other equipment (Depending on the nature of the specialty)	Computer LAB with Mathematical Software

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect- Online Survey
Effectiveness of students' assessment	Students and Faculty	Direct and Indirect Assessment
Quality of learning resources	Students and Faculty	Indirect- Online Survey
The extent to which CLOs have been achieved	Students and Faculty	Direct and Indirect Assessment
Other	None	None

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**EE DEPARTMENT QUALITY COMMITTEE**
REFERENCE NO.	**MEETING # 10**
DATE	**APRIL 19, 2025**