Course Specification
(Bachelor)

Course Title:	**Mathematical Methods for Engineers**
Course Code:	**MAT 1236**
Program:	**Bachelor of Science in Engineering**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**08/10/2024**

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A. General information about the course:

1. Course Identification

1. Credit hours:					
3 (2 Lectures, 0 Lab, 2 Tutorial)					
2. Course type					
A.	☐University	☐ College	☒ Program	☐Track	☐Others
B.	☒ Required			☐Elective	
3. Level/year at which this course is offered: Level 5 / Year 3					
4. Course general Description:					
This course covers a broad spectrum of mathematical techniques essential to the solution of advanced problems. Topics include Series Solutions of ODES, Laplace Transforms and the fundamentals of partial differential equations (PDEs). Students will explore classical PDEs like the wave, heat, and Laplace equations, along with boundary-value problems and their conditions. The course also teaches analytic methods, including separation of variables Method, Fourier and Lplace transforms Transforms Methods.					
5. Pre-requirements for this course (if any)**:**					
MAT 1207, MAT 1228, GE 1100					
6. Co-requisites for this course (if any)**:**					
None.					
7. Course Main Objective(s):					
The main objective of the course is to provide students with essential theoretical and practical skills in understanding and solving partial differential equations, which are crucial for modeling complex phenomena in physics and engineering. This course serves as a bridge between mathematical theory and real-world applications.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	0	0%
4	Distance learning	0	0%

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	30
5.	**Others (specify)**	0
Total		60

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

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	To recognize BVPs and IVPs for classical second-order PDEs describing physical processes such as heat and wave diffusions.	K1	4 lecture hours\week	Regular Exams
1.2	To solve analytically PDEs via methods of separation of variables, of characteristics, and Fourier and Laplace transforms.	K2	2 tutorial hours\week Self-study	Assignments Short Quizzes
2.0	**Skills**			
2.1	To develop techniques of first and second-order PDEs.	S1, S2	Real-life problems	Short Quizzes
2.2	To present basic PDE's methods clearly and precisely both orally and in writing.	S4	Self-study	Participations
2.3	To use Internet in searching for different kinds of PDEs	S5	Real-life problems	Short Quizzes
2.4	To demonstrate some proofs of PDEs solving methods.	S3	Self-study	Participations
3.0	**Values, autonomy, and responsibility**			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.1	To defend the formulated conclusions individually.	V1, V3	Personal questions	Participation
3.2	To operate meaningfully and productively with others.	V1, V2	Team work	Homework and Mini-projects

C. Course Content

No	List of Topics	Contact Hours
1.	**Laplace Transforms:** Basic Definitions, Properties of Laplace Transforms, Inverse Laplace Transform, First shifting theorem, Unit-Step function, Second shifting theorem, Dirac Delta function, Solving Initial Values Problems using Laplace Transforms.	15
2.	**Series Solutions of Differential Equations:** Power Series, Series Solutions of Linear Equations aroud Ordinary Points, Euler-Cauchy equations, Solutions around singular points, Frobenius Method, Bessel's Equation, Legendre's Equation, Special Functions (Gamma and Beta functions).	15
3.	**Introduction to PDEs & Basic Concepts:** Definition of General PDEs, Order, Linear and nonlinear PDEs, solution of PDEs, Classification of PDEs as Parabolic, Hyperbolic, and Elliptic Equations, Initial conditions, Boundary Conditions (Dirichlet, Neumann, and Mixed conditions), Classical PDEs (Heat Equation, Wave Equation, and Laplace Equation), Boundary-Value Problems, The method of characteristics for solving First order partial differential equations.	15
4.	**Analytic Methods for Solving PDEs:** Fourier Series, Fourier Cosine and Sine Series, Separation of Variables Method, Solving PDEs using Fourier and Laplace transforms.	15
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HomeWorks, Quizzes, Mini-projects	During the term	10%
2.	First Midterm	Week 5-6	25%
3.	Second Midterm	Week 10-11	25%
4.	Final Exam	Week 15	40%

*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	***Introduction to Partial Differential Equations;*** Undergraduate Texts in Mathematics, P. Olver, Springer, 2013. **(Main Reference).**
Supportive References	• *Partial Differential Equations of Mathematical Physics,* **R.B. Guenther & J.W. Lee, Prentice Hall/Dover publication, Mineola, 1996. (Main Reference).** • *Partial Differential Equations Methods and Applications (2nd Edition),* **R. McOwen, Prentice Hall/Pearson Education, 2002.** • *Lectures on Partial Differential Equations,* **V. I. Arnold, Springer-Verlag, Berlin, 2004.**
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Classrooms:** Equipped with whiteboards, projectors, and Smart Boards for interactive lessons and group discussions. • **Laboratories:** Feature computers with internet access, enabling hands-on activities and exploration of algebraic and trigonometric concepts. • **Exhibition Rooms:** Spaces for showcasing projects and presentations to encourage collaborative learning.
Technology equipment (projector, smart board, software)	• **Data Show Projectors:** For clear presentations in classrooms and labs. • **Smart Boards:** To enhance interactivity during lessons. • **Mathematical Software:** Essential for graphing and analysis.
Other equipment (depending on the nature of the specialty)	• **Computers:** For mini-project and homework and practical applications in laboratories. • **Advanced Calculators:** For computations and problem-solving and supporting the study of limits, continuity, and differentiation.

Items	Resources
	• **Whiteboards and Markers:** To facilitate brainstorming and collaboration.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student and teaching staff	Surveys and Questionnaires
Effectiveness of Students assessment	Course Coordinator	Peer Reviews
Quality of learning resources	Students and teaching staff	Classroom Observations
The extent to which CLOs have been achieved	Student Representatives	Student Performance Evaluations (exams, projects) CLOs Excel sheet.
Other	**None**	

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL**
REFERENCE NO.	**8/1446**
DATE	**05/04/1446 (08/10/2024)**