Course Specification
(Bachelor)

Course Title:	**Introduction to Partial Differential Equations**
Course Code:	**MAT 1334**
Program:	**Bachelor of Science in Applied Mathematics**
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:					
4 (3 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 6 / Year 3					
4. Course general Description:					
The course covers the fundamentals of partial differential equations (PDEs), including definitions, classifications (parabolic, hyperbolic, and elliptic), and methods for solving first-order and second-order equations. 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, Fourier series, and transforms.					
5. Pre-requirements for this course (if any):					
MAT 1332 Mathematical Methods					
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 applied mathematics as well as in related fields such as physics, engineering, and applied mathematics. This course serves as a bridge between mathematical theory and real-world applications, preparing students for advanced studies and research in areas that rely on PDEs for analysis and problem-solving.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	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**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	30
5.	**Others (specify)**	0
Total		75

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.	**Introduction to PDEs:** Definition of a PDE; Degree, linearity; homogeneous and inhomogeneous equations; First order partial differential equations; The method of characteristics.	**20**
2.	**Second-order equation:** Classification as Parabolic, Hyperbolic, and Elliptic equations.	**5**
3.	**Classical PDEs of mathematical physics and Boundary-Value Problems:** Wave equation, Heat equation, Laplace equation; Boundary Conditions; Definition of a Boundary-Value Problem. Dirichlet, Neumann, and Mixed BVP.	**25**
4.	**Analytic methods for solving PDEs:** Separation of variables method; Solution of PDEs by Fourier series; review of Fourier and Laplace transforms; Solving PDEs using Fourier and Laplace transforms.	**25**
Total		**75**

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	1. *Partial Differential Equations: Theory and Completely Solved Problems,* T. Hillen, I. E. Leonard, H. Van Roessel, Wiley 2012. **(Main Reference)** 2. *Linear Partial Differential Equations for Scientists and Engineers,* Myint U. Debnath, North Holland, 2007. **(Main Reference).**
Supportive References	• *Introduction to Partial Differential Equations;* P. Olver, Springer, 2013. • *Partial Differential Equations Methods and Applications (2nd Edition),* R. McOwen, Prentice Hall/Pearson Education, 2002. • *Partial Differential Equations of Mathematical Physics,* R.B. Guenther & J.W. Lee, Prentice Hall/Dover publication, Mineola, 1996.
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. • **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)**