هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title:	**Introduction to Differential Equations**
Course Code:	**MAT 1231**
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 3 / Year 2					
4. Course general Description:					
This course introduces differential equations, covering first-order types such as separable, linear, exact, and Bernoulli equations. It explores second-order linear differential equations, including methods for solving homogeneous and non-homogeneous cases. Students will also learn about higher-order linear equations and Laplace transforms, focusing on their properties and applications in solving initial value problems. The course addresses linear systems of differential equations and incorporates the use of symbolic MATLAB software for practical problem-solving and examples.					
5. Pre-requirements for this course (if any):					
MAT 1102 Calculus (2) and MAT 1223 Linear Algebra					
6. Co-requisites for this course (if any):					
None.					
7. Course Main Objective(s):					
The Introduction to Differential Equations course equips students with essential tools for modeling and solving real-world problems in fields like engineering and physics. It develops critical analytical and problem-solving skills, serving as a foundation for advanced studies and applications in dynamic systems.					

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	Summarize the concept of ordinary differential equations, the meaning of the meaning of their solutions, and the methods to find them.	K1	4 lecture hours\week 2 tutorial hours\week Self-study	Regular Exams Assignments Short Quizzes
1.2	Classify differential equations with respect to their order and linearity to match the corresponding methods to solve them.	K2	4 lecture hours\week 2 tutorial hours\week Self-study	Regular Exams Assignments Short Quizzes
2.0	**Skills**			
2.1	Solve real-world problems involving Cauchy-Euler equations Bernoulli, Ricatti differential equations and other initial value problems in fields of such as economics, engineering, and the sciences.	S1, S2	Self-study Real-life problems	Participations Short Quizzes
2.2	Formulate, clearly and precisely, differential equations to solve various applied problems.,	S4	Self-study Real-life problems	Participations Short Quizzes
2.3	Using Symbolic MATLAB software and online CAS to find and visualize solutions of differentia equations.	S5	Self-study Real-life problems	Participations Short Quizzes

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.4	Solve first-order and second order and high-order ordinary differential equations using the appropriates methods including integration, the method of undetermined coefficients, the method of variations of parameters, Laplace transform.	S3	Self-study Real-life problems	Participations Short Quizzes
3.0	**Values, autonomy, and responsibility**			
3.1	Engage in group discussions and critical interactions	V1, V3	Class discussion and team work	Participation and homework report.
3.2	differentiate between valid and fallacious Mathematical arguments to model real problems involving differential equations.	V1, V2	Class discussion	Participation, mini-project and homework.

C. Course Content

No	List of Topics	Contact Hours
1.	**First order differential equations:** Separable equations, First order linear equations, Exact differential equations, Homogeneous differential equations, Bernoulli equations, Riccati equations.	**15**
2.	**Second order linear differential equations:** General solution of the homogeneous linear equation with constant coefficients, Particular solution of the non-homogeneous equation, Method of Undetermined Coefficients, Variation of Parameters Method.	**15**
3.	**Higher order linear differential equations:** General theory of linear differential equations, Homogeneous linear equations with constant coefficients, Undetermined Coefficients Method, Variation of Parameters Method.	**8**
4.	**Laplace Transforms:** Basic definitions and properties, First shifting theorem, Partial fractions, Differentiation and integration of Laplace transforms, Laplace transform of some discontinuous functions, the unit step function, Dirac function, shifting on the t- axes and second shifting	**20**

	theorem, Inverse of Laplace transform, Convolution, Solving Initial Value Problems Using Laplace Transforms.	
5.	**Linear systems of differential equations:** Superposition principle, Independence, Matrix exponential, Basic theory of systems of first order linear equations, Homogeneous linear systems with constant coefficients, non-homogeneous linear systems of differential equations.	**10**
6.	**Using Symbolic MATLAB software to solve differential equations.** Brief introduction to symbolic MATLAB software, solving some generic ODE with examples.	**9**
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 15-16	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	***Elementary Differential Equations and Boundary Value Problems,*** W. Boyce and R. DiPrima, 9th Edition, New York: John Wiley & Sons, 2010. (Main Reference)
Supportive References	***Advanced Engineering Mathematics,*** E. Kreyszig, John Wiley & Sons, INC 10th Edition, 2010. ***Fundamentals of Differential Equations,*** R. Nagle, E. Saff and A. Snider, Addison-Wisley, 6th Edition, 2011. ***A first course in differential equations with applications,*** Dennis G. Zill, 5th Edition, PWS Kent Publishing Company, 2000.
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 Ordinary differential equations and symbolic computation.
Technology equipment (projector, smart board, software)	• **Data Show Projectors:** For clear presentations in classrooms. • **Smart Boards:** To enhance interactivity during lessons. • **Mathematical Software:** Essential for solving ODE numerically and symbolically and finding Laplace-transform.
Other equipment (depending on the nature of the specialty)	• **Computers:** For mini-project and homework and practical applications in laboratories. • **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)**