Course Specification
(Bachelor)

Course Title:	**Calculus (2)**
Course Code:	**MAT 1102**
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 2 / Year 1					
4. Course general Description:					
This course focuses on advanced topics in integration and series, essential for applied mathematics. It covers anti-derivatives, the properties of indefinite and definite integrals, and key integration techniques such as substitution, integration by parts, and partial fractions. Students will apply these methods to real-world problems, calculating areas, volumes, and arc lengths. The course also introduces infinite series, exploring convergence tests, and Taylor and Maclaurin series. Additionally, it includes parametric equations and polar coordinates, with applications to conic sections, preparing students for further mathematical analysis.					
5. Pre-requirements for this course (if any):					
MAT 1101 Calculus (1)					
6. Co-requisites for this course (if any):					
None.					
7. Course Main Objective(s):					
• To master advanced techniques of integration and apply them to practical problems such as calculating areas, volumes, and arc lengths. • To gain a deep understanding of infinite series, including convergence tests and Taylor/Maclaurin series, and use them for function approximation. • To explore parametric and polar equations, focusing on their applications to plane curves and conic sections within calculus. • To strengthen mathematical skills and knowledge required for more advanced studies in applied mathematics and related disciplines.					

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%

No	Mode of Instruction	Contact Hours	Percentage
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	Explain the concepts of anti-derivatives, indefinite integrals, and the Fundamental Theorems of Calculus.	K1	Lectures and tutorials	Quizzes and written definitions
1.2	Summarize various techniques of integration, including substitution, integration by parts, and trigonometric techniques.	K2	Interactive workshops and collaborative learning	Homework assignments and in-class exercises
1.3	list appropriate series/ sequence test to decide the convergence or divergence of series/ sequences.	K1, K2	Lecture and class discussions	Exams and problem sets, participation
1.4	Describe the applications of parametric equations, including arc length and surface area calculations.	K2	Mini-Project-based learning and real-life applications	Mini-Projects and presentations
2.0	**Skills**			
2.1	Utilize appropriate integration techniques, including substitution	S1, S2	Problem-based learning,	Direct: Problem sets and

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	and integration by parts, to effectively solve complex problems involving definite and improper integrals.		workshops, tutorials, and hands-on practice.	project presentations; Indirect: Self-assessment surveys.
2.2	Construct graphical representations of functions and curves described by parametric equations, accurately determining arc lengths and surface areas using calculus methods.	S4	Hands-on workshops with graphing software, tutorials, and guided practice.	assignments; Class participation and feedback.
2.3	Evaluate the convergence of infinite series by applying various convergence tests, and effectively communicate the results through written explanations and presentations.	S5	Lectures on convergence tests, group discussions, tutorials, and presentations.	Exams and class feedback.
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate ethical responsibility by collaborating effectively with peers, fostering a respectful and inclusive learning environment during group activities and projects.	V1, V3	Group activities, peer review sessions, tutorials, and collaborative projects.	Direct: Group evaluations; peer feedback.
3.2	Cultivate self-directed learning by engaging in independent study and reflection, recognizing the importance of personal responsibility in mastering calculus concepts.	V1, V2	Independent study assignments, self-directed projects, tutorials, and reflective journaling.	Individual assignments; Indirect: Reflective journals and self-assessment.

C. Course Content

No	List of Topics	Contact Hours
1.	**Integration:** Anti-derivatives, Indefinite Integral and its properties, Sums and Sigma Notation, Partitions and Riemann sums, Area under	10

	curves and The Definite Integral, First and Second Fundamental Theorems of Calculus.	
2.	**Integration Techniques:** Integration by Substitution, Integration by Parts, Integration of Rational Functions Using Partial Fractions, Trigonometric Techniques of Integration, Integrals involving logarithmic, exponential, and hyperbolic functions, Improper Integrals.	15
3.	**Applications of Definite Integrals:** Area between curves, Volumes by slicing, Volumes using washers and Cylindrical Shells, Arc Length and Surface Area.	10
4.	Infinite Series: Sequences of Real Numbers, Convergence and Divergence of Infinite Sequences, Formal definition of a convergent sequence, Infinite Series, Basic Infinite Series (geometric series, p-series, alternating series, telescoping series), Convergence Tests for Positive Series (ratio test, root test, comparison and limit comparison test, integral test), Alternating Series, Absolute and Conditional Convergence, Power Series, Differentiation ad Integration of power series, Taylor and Maclaurin Series, Convergence of Taylor series, Applications of Taylor and Maclaurin Series.	25
5.	**Parametric equations:** Plane Curves and Parametric equations, Calculus with Parametric Equations, motion applications; Arc Length of Parametric Curves; Surface Area of Parametric Curves, Introduction to polar coordinates, Conversion between Cartesian and polar coordinates, Graphing polar equations,	15
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	***Calculus***, 4th Edition; R. T. Smith, R. B. Minton, McGraw-Hill, 2012. **(Main Reference)**
Supportive References	***Essential Calculus with Application***; Richard A. Silverman, Dover Publications, 1989. ***Calculus***; O. Swokowski, et al, PWS Pub. Co.; 6th Edition, 1994. ***Calculus: Early Transcendentals***, 7th Edition; C. Henry Edwards, David E. Penney, Pearson Prentice Hall, 2008. ***Schaum's Outline of Calculus***, 6th Edition; Frank Ayres, Elliott Mendelson, McGraw-Hill, 2013.
Electronic Materials	**None**
Other Learning Materials	**None**

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 integration,infinite series and parametric equations. • **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)