Course Specification
(Bachelor)

Course Title:	**Calculus (3)**
Course Code:	**MAT 1207**
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**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:					
3 (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 4 / Year 2					
4. Course general Description:					
This module covers advanced topics in multivariable calculus and vector analysis, including vectors in space, dot and cross products, and equations of lines and planes. Students will explore vector-valued functions, partial derivatives, optimization techniques, and multiple integrals in various coordinate systems, and Vector Calculus. By the end, students will be able to analyze and solve complex problems in higher dimensions, with applications in physics and engineering.					
5. Pre-requirements for this course (if any):					
MAT 1116					
6. Co-requisites for this course (if any):					
None.					
7. Course Main Objective(s):					
This course plays a crucial role in the Applied Mathematics program by providing essential mathematical tools and techniques that underpin advanced studies and practical applications in various scientific and engineering 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	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	**Describe parametric and polar curves in plane and recognize regions and quadric surfaces in space.**	**K1, K2**	**lecture hours\week** **tutorial hours\week** **Self-study**	**Regular Exams** **Assignments** **Short Quizzes**
1.2	**Express double and triple integrals in different coordinate systems. in rectangular, polar, cylindrical, and spherical.**	**K1, K2**		
2.0	**Skills**			
2.1	**Apply the computational and conceptual principles of vector calculus, including partial derivatives and multiple integrals, to the solutions of various problems**	**S1, S2**	**Self-study** **Real-life problems**	**Participations** **Short Quizzes**
2.2	**Interpret, clearly and precisely both orally and in writing, calculus operations on vector-valued functions including limits, derivatives, integrals, curvature, and the description of motion in plane and space.**	**S4**	**Self-study**	**Participations**
2.3	**Illustrate figures in different coordinates using a CAS and some online solvers.**	**S5**	**Real-life problems**	**Short Quizzes**
2.4	**Calculate arc length /surface/volume of regions in 2 and 3 dimensions, in Cartesian, polar, cylindrical, and spherical coordinate systems, directional derivatives, equations of tangent planes, and gradient vectors.**	**S3**	**Self-study**	**Participations**

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.0	**Values, autonomy, and responsibility**			
3.1	**listen to the teacher's explanation of the Mathematics reasoning and illustration of 3D figures.**	**V1, V3**	**Class discussion**	**Participation**
3.2	**Show attitude of support the use of computers in learning/teaching mathematics**	**V1, V2**	**Problem solving, Class discussion**	**Homework and Mini-projects and presentation**

C. Course Content

No	List of Topics	Contact Hours
1.	**Vectors and Geometry of Space:** Vectors in Space, Dot Product, Cross Product, Equations of Lines and Planes in Space, Quadratic Surfaces in Space.	**10**
2.	**Vector-Valued Functions:** Vector-Valued Functions, Calculus of Vector Functions, Motion in Space, Curvature, Tangent and Normal Vectors.	**10**
3.	**Functions of several variables:** Functions of Several Variables, Limits and Continuity, Partial Derivatives, Differentiability, The Total Derivative, The Directional Derivatives and Gradient, Tangent Plane and Linear Approximation, Taylor's Theorem in Severable variables, Chain Rule, Maxima and Minima, Method of Lagrange Multipliers.	**20**
4.	**Multiple Integrals:** Double Integrals in Cartesian Coordinates, Areas and Volumes, Polar Coordinates, Double Integrals in Polar Coordinates, Surface Area, Triple Integrals in Cartesian Coordinates, Cylindrical and Spherical Coordinates, Triple Integrals in Cylindrical and Spherical Coordinates, Change of Variables in Multiple Integrals.	**15**
5.	**Vector Calculus:** Vector Field, Line and Surface Integrals, Curl and Divergence, Green's Theorem, Divergence Theorem, Stokes Theorem, and Physical Applications of Vector Calculus.	**20**
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	***Advanced Engineering Mathematics, 8th Edition, E. Kreyszig, John Wiley & Sons, INC, 1998.*** ***Calculus, 6th Edition, O. Swokowski, et al, PWS Pub. Co., 1994.*** ***Calculus Early Transcendentals, 7th Edition; C. Henry Edwards, David E. Penney, Prentice Hall, 2008.*** ***Calculus, 1st Edition, F. Ayres & E. Mendelson, Schaum's Outline McGraw-Hill, 1999.***
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 geometry in plane and space, area and volume. • **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)**