Course Specifications

Course Title:	**Differential Geometry**
Course Code:	**23042307-3**
Program:	**Bachelor of Mathematics**
Department:	**Mathematics Department**
College:	**Jamoum University College**
Institution:	**Umm Al-Qura University**

Table of Contents

A. Course Identification

1. Credit hours: 3 hours
2. Course type **a.** University ☐ College ☐ Department ■ Others ☐ **b.** Required ■ Elective ☐
3. Level/year at which this course is offered: Fourth Level / Second Year
4. Pre-requisites for this course (if any): Sets and Algebraic Structures (23042103-4)
5. Co-requisites for this course (if any)**:** Does not exist

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	3 Hours /Week	100%
2	**Blended**	0	0%
3	**E-learning**	0	0%
4	**Correspondence**	0	0%
5	**Other**	0	0%

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	(3 hours) x (15 weeks)
2	**Laboratory/Studio**	0
3	**Tutorial**	(1 hour) x (15 weeks)
4	**Others** (specify)	0
	Total	60 hours
Other Learning Hours *		
1	**Study**	(1 hour) x (15 weeks)
2	**Assignments**	(1 hour) x (15 weeks)
3	**Library**	(1 hour) x (15 weeks)
4	**Projects/Research Essays/Theses**	(1 hour) x (15 weeks)
5	**Others** (specify)	0
	Total	60 hours

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

Differential geometry is the study of geometric properties of curves, surfaces, and their higher dimensional analogues using the methods of calculus. It has a long and rich history, and, in addition to its intrinsic mathematical value and important connections with various other branches of mathematics, it has many applications in various physical sciences, e.g., solid mechanics, computer tomography, or general relativity. Differential geometry is a vast subject.

In this elementary introductory course we develop much of the language and many of the basic concepts of differential geometry in the simpler context of curves and surfaces in ordinary 3 dimensional Euclidean space.

2. Course Main Objective

The aim is to build both a solid mathematical understanding of the fundamental notions of differential geometry and sufficient visual and geometric intuition of the subject. We hope that this course is of interest to students from a variety of math, science and engineering backgrounds, and that after completing this course, the students will be in a position to (i) apply their knowledge and skills in this course to their related subjects, (ii) be ready to study more advanced topics such as global properties of curves and surfaces.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge:**	
1.1	Determine curvature of curves in different coordinate systems	
1.2	Parameterize curves	
1.3	Derive Frenet formulae	
1.4	Recall the local canonical form and corresponding curves	
1.5	Recognize first and second fundamental forms	
1.6	Examine Principal Gaussian and mean curvatures	
2	**Skills :**	
2.1	Describe regular surfaces and regular values	
2.2	Distinguish types of curvature and torsion	
2.3	Analyze geodesic lines and curves	
2.4	Classify Equations of Gauss and Godazzi-Mainardi	
3	**Competence:**	
3.1	Exemplify important concepts in specific cases	
3.2	Formulate important results and theorems covered by the course	
3.3	Relate the theory, methods and techniques of the course to solve mathematical problems	
3.4	Present arguments to others	

C. Course Content

No	List of Topics	Contact Hours
1	Skew and plane curves, arc length, tangent, osculating plane, normal plane	6
2	Curvature, Principal normal, circle of curvature, bi-normal, torsion, rectifying plane	9
3	Frennet-Serret formulas, cylindrical helix, involutes and, Bertrand curves	6
4	Parametric equations of a surface, tangent plane to a surface, linear	9

	element of a surface	
5	First and second fundamental quadratic forms of a surface	6
6	Normal curvature of a surface, lines of curvature of a surface, geodesics	9
Total		45

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	Determine curvature of curves in different coordinate systems	Lecture Tutorials	Exams (Quizzes, Midterm and Final). Written and possibly oral exam at the end of the course. In addition, compulsory work may be given during the course
1.2	Parameterize curves	Lecture Tutorials	
1.3	Derive Frenet formulae	Lecture Tutorials	
1.4	Use the local canonical form and corresponding curves	Lecture Tutorials	
1.5	Recognize first and second fundamental forms	Lecture Tutorials	
1.6	Examine Principal Gaussian and mean curvatures	Lecture Tutorials	
2.0	**Skills**		
2.1	Describe regular surfaces and regular values	Lecture Individual or group work	Exams (Quizzes, Midterm and Final). Homework
2.2	Distinguish types of curvature and torsion	Lecture Individual or group work	
2.3	Analyze geodesic lines and curves	Lecture Individual or group work	
2.4	Classify Equations of Gauss and Godazzi-Mainardi	Lecture Individual or group work	
3.0	**Competence**		
3.1	Exemplify and interpret important concepts in specific cases	Lecture Individual or group work	Exams (Quizzes, Midterm and Final). Research Essays
3.2	Formulate important results and theorems covered by the course	Lecture Individual or group work	
3.3	Use the theory, methods and techniques of the course to solve mathematical problems	Lecture Individual or group work	
3.4	Present mathematical arguments to others	Lecture Individual or group work	

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	6th week	20%
2	Midterm 2	12th week	20%
3	Homework + Reports + Quizzes	During semester	10%
4	Final exam	End of semester	50 %

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

All faculty members are required to be in their offices outside teaching hours. Each member allocates at least 4 hours per week to give academic advice to students and to better explain the concepts seen during the lectures.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Differential Geometry of Curves and Surfaces, Kristopher Tapp, 2016, Springer
Essential References Materials	- Elementary Differential Geometry, Barrett O'Neill, 1997, Academic Press - Differential Geometry of Curves and Surfaces, Manfredo P. do Carmo, 1976, Prentice Hall
Electronic Materials	None
Other Learning Materials	None

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Large classrooms that can accommodate more than 30 students
Technology Resources (AV, data show, Smart Board, software, etc.)	Data Show, Smart Board
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment	Students	Direct
Quality of learning resources	Students	Direct
Extent of achievement of course learning outcomes	Faculty Member	Direct

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Council of the Mathematics Department
Reference No.	
Date	