Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): **MATH 3670 DIFFERENTIAL GEOMETRY** (3,3,0)

Course Aims: This course teaches students the mathematical tools of classical differential geometry. Applications to curve and surface designs are also given.

Prerequisite: MATH 1120 Linear Algebra
MATH 2110 Differential Equations

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Learning Outcomes (LOs):

Upon successful completion of this course, students should be:

No.	Learning Outcomes (LOs)
	Knowledge
1	Able to understand the concept of a curve
2	Able to understand the theory of curves in E^3
3	Able to understand the theory of contact
4	Able to understand the background material in Euclidean spaces
5	Able to understand the concept of surface
6	Able to understand the theory of the non-intrinsic geometry of a surface
7	Able to understand the theory of global geometry of surface
8	Able to understand the basic theory of intrinsic geometry of surfaces in E^3
	Skill
9	Able to apply the fundamental concepts of the differential geometry of curves and surfaces in three-dimensional Euclidean space to many examples and solved problems

Assessment:

No.	Assessment Methods	Weighting	Remarks
1	Continuous Assessment	20%	Continuous assignments are designed to assess how well the students have learned the basic concepts and fundamental theory of the differential geometry of curves and surfaces in three-dimensional Euclidean space
2	Final Examination	80%	Final Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be understanding and skills based to assess the students' comprehension on the concepts of the differential geometry and their ability of applying those concepts to many examples and solved problems.

Learning Outcomes and Weighting:

Contents		LO No.	Teaching (in hours)
I	Concept of A Curve	1,9	6
II	Curvature and Torsion	1,2,9	6
III	The Theory of Curves	2,3,9	6
IV	Concept of a Surface	4,5,9	6
V	First and Second Fundamental Forms	6,7,9	9
VI	Intrinsic Geometry	8,9	9

References:

R.S. Millman and G.D. Parker, Elements of Differential Geometry, Prentice-Hall, 1977.

J. Oprea, Differential Geometry and its Applications, Prentice Hall, 1997.

Chuan-Chih Hsiung, A First Course in Differential Geometry, John Wiley and Sons, 1981.

A. Pressley, Elementary Differential Geometry, Springer Undergraduate Mathematics Series, 2001.

M. M. Lipschutz, Schaum's Outline of Differential Geometry, 1969.

Course Content in Outline:

	Topics	**Hours**
I.	Concept of A Curve	6
	A. Regular representations	
	B. Implicit representations of curves	
	C. Regular curves of class C^m	
	D. Arc length as a parameter	
II.	Curvature and Torsion	6
	A. Unit tangent vector	
	B. Principal normal unit vector	
	C. Principal normal line and osculating plane	
	D. Moving trihedron	
III.	The Theory of Curves	6
	A. Frenet equations	
	B. The fundamental existence and uniqueness theorem	
	C. Canonical representation of a curve	
	D. Involutes and Evolutes	
	E. Theory of contact	
IV.	Concept of a Surface	6
	A. Regular parametric representations	
	B. Coordinate patches	
	C. Definition of a simple surface	
	D. Topological properties of simple surfaces	
V.	First and Second Fundamental Forms	9
	A. First fundamental form and Second fundamental form	
	B. Normal curvature	
	C. Principal curvatures and directions	
	D. Gaussian and mean curvature	
	E. Rodrigues' formula	
	F. Conjugate families of curves	
	G. Gauss-Weingarten equations	
	H. The compatibility equations and the theorem of Gauss	
	I. The fundamental theorem of surfaces	
VI.	Intrinsic Geometry	9
	A. Mappings of surfaces	
	B. Isometric mappings	
	C. Geodesic curvature and coordinates	
	D. Arcs of minimum length	
	E. Surfaces with constant Gaussian curvature	
	F. Gauss-Bonnet theorem	