Name of the Program	B.A. / B.Sc. (LIBERAL EDUCATION)			Year/ Semester:		3rd / 6th
Course Name	**Differential Geometry**	**Course Code:**	MT306	Type:		**Theory**
Credits	04			**Total Sessions Hours:**		**60 Hours**
Evaluation Spread	**Internal Continuous Assesment:**	**50 Marks**		**End Term Exam:**		**50 Marks**
Type of Course	○ Compulsory		⦿ Core		○ Creative	○ Life Skill
Course Objectives	Differential Geometry uses calculus to study geometry. It is a subject with a number of really beautiful results and many applications to pure mathematics, applied mathematics, and engineering. Our course will focus on the geometry of curves and surfaces in 3-dimensional Euclidean space. We'll learn about such things how to find the shortest distance between two points, how to measure curvature, and how to find and use the shortest paths on a surface.					
Course Outcomes (CO): *After the successful course completion, learners will develop following attributes:*						
Course Outcome (CO)	**Attributes**					
CO1	Students will learn the concept of Covariant, Contravariant and mixed tensor.					
CO2	Learn about Vector field, tangent vector and use to generate some base for the real life application.					
CO3	Use calculus with geometry and learn differential functions and surfaces .					
CO4	Gaussian curvature, First fundamental form and second fundamental form.					
Pedagogy	Interactive, discussion-bases, student-centered, presentation.					
Internal Evaluation Mode	Mid-term Examination: 20 Marks Activity: 10 Marks Class test: 05 Marks Online Test/Objective Test: 05 Marks Assignments/Presentation: 05 Marks Attendance: 05 Marks					

Session Details	Topic	Hours	Mapped CO
Unit 1	Coordinate transformation, Covariant, Contravariant and Mixed tensors, Tensors of higher rank, Symmetric and Skew-symmetric tensors, Tensor algebra, Contraction, Inner product, Riemannian metric tensor, Christoffel symbols, covariant derivatives of tensors. **Activity:** Assignment based activity.	15	CO1
Unit 2	Space curves, Examples, Differentiable curves and their parametric representations, Vector fields, Tangent vector, Principal normal, Binormal, Curvature and torsion, Serret-Frenet formula, Covariant differentiation, The structural	15	CO2

	equations. ==Involutes and Evolutes, Fundamental Theorem for space curves==. **Activity:** Assignment based activity.		
Unit 3	Surfaces, Differentiable functions on surfaces, Differential forms, Normal vector fields, First fundamental form, Normal curvature, Principal curvatures, Gaussian curvature, Second fundamental form ==on a surface.== **Activity:** Assignment based activity.	15	CO3
Unit 4	Gaussian equations, Weingarten equation, Codazzi-Mainardi equations, Totally umbilical surfaces, Minimal surfaces, Geodesic on surface, Index form of a geodesic. Riemannian manifolds, Riemannian connection, Geodesic in a Riemannian manifold, Riemannian curvature tensor, Submanifolds. **Activity:** Assignment based activity.	15	CO4

CO-PO and PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1								1					1
CO2	1			3		1				1	2	3		
CO3	1			1					1	1				1
CO4	1							1	1					

Strong contribution-3,   *Average contribution-2 ,*   *Low contribution-1,*

Suggested Readings:

Text- Books	1. Hicks, N. J., Van, D., Notes on Differential Geometry, Nostrand Company Inc. 2. Barret O' Neill, (2006). Elementary Differential Geometry. Academic Press. 3. A. Goetz: Differential Geometry, Springer Verlag.
Reference Books	1. De, U. C., Shaikh, (2007).. Differential Geometry of manifolds. Narosa Publishing House Pvt. Ltd. 2. Whilmore, T. J.,(1993). An Introduction to Differential Geometry. New Delhi: Oxford University Press. 3. Mishra, R. S.,(1984). Structures on a Differentiable manifold & their applications. Allahabad, Chandrama Prakashan. 4. Ahsan, Z. Tensor Calculus. New Delhi: Anamaya Publications.

Para Text	**Unit 1:**
	  1. https://www.youtube.com/watch?v=D5cDPYVQMkA
	  2. https://www.youtube.com/watch?v=5uWsroxq_cI
	  3. https://www.youtube.com/watch?v=3l1t5wkulT8
	
	Unit 2:
	  1. https://www.youtube.com/watch?v=3gbxDyivUx0
	  2. https://www.youtube.com/watch?v=IJKJdhF-IHM
	  3. https://www.youtube.com/watch?v=woUK5AWziiw
	
	Unit 3:
	  1. https://www.youtube.com/watch?v=3T63Idgkg8w
	  2. https://www.youtube.com/watch?v=QYyBac5HbGc
	  3. https://www.youtube.com/watch?v=g0lpV8EbC4Q
	Unit 4:
	  1. https://www.youtube.com/watch?v=7kfUMhMm9NY
	  2. https://www.youtube.com/watch?v=VH6GBeLi53Y
	  3. https://www.youtube.com/watch?v=UMAJtnP3i10
	  4. https://www.youtube.com/watch?v=fEn6njArpDw
	  5. https://www.youtube.com/watch?v=k-4FTPkNi1A

Recapitulation & Examination Pattern		
Internal Continuous Assesment:		
Component	**Marks**	**Pattern**
Mid Semester	20	**Section A:** Contains **10** MCQs/Fill in the blanks/One Word Answer/ True-False type of questions. Each question carries **0.5 mark.** **Section B:** Contains **07** descriptive questions out of which **05** questions are to be attempted. Each question carries **03 marks**.
Activity	10	Will be decided by subject teacher.
Class Test	05	Contains **05 descriptive questions.** Each question carries **01** mark.
Online Test/ Objective Test	05	Contains **10 multiple choice questions.** Each question carries **0.5** mark.
Assignment/ Presentation	05	Assignment to be made on topics and instruction given by subject teacher.
Attendance	05	As per policy.
Total Marks	**50**	

Course created by: **Dr. Sheeba Rizvi** **Dr. Toukeer Khan** **Signature:**	**Approved by: Prof. Nadeem Ur Rahman** **Signature:**