BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 18.01.2021

In addition to part I (General Handout for all courses appended to the Time table) this portion gives further specific details regarding the course.

Course No : **MATH F342**

Course Title : DIFFERENTIAL GEOMETRY
Instructor-in-Charge : PRADIPKUMAR H. KESKAR
Instructor(s) : PRADIPKUMAR H. KESKAR
Tutorial/Practical Instructors: PRADIPKUMAR H. KESKAR

1. Course Description:

The course studies geometric objects like curves and surfaces in the 3- dimensional space. Topics include plane and space curves, Serret-Frenet frame and curvature and torsion of curves, global properties of curves, first and second fundamental forms of surfaces, normal, principal and Gaussian curvatures of surfaces, Gauss' Theorema Egregium and geodesics on surfaces.

2. Scope and Objective of the Course:

The objective of this course is to provide a systematic exposition of the essential concepts of modern differential geometry, and an understanding and appreciation for the intrinsic beauty of these concepts, as well as their deep relationships to computer and physical Sciences. The under current is to generalize and reinforce the classical subject in a modern way.

3. Text Books:

Somasundaram, D – Differential Geometry A First Course, Narosa Publishing House (2005)

4. Reference Books:

1. Pressley, A – Elementary Differential Geometry, 2nd Edition(Corrected Print), Springer (2012)
2. Gray A, Abbena E, Salamon S – Modern differential geometry of curves and surfaces with MATHEMATICA, 3rd Edition, CRC Press (2006)
3. Oprea, J – Differential Geometry and Its Applications, Mathematical Association of America(2007)
4. Bär, Christian - Elementary Differential Geometry, 1st South Asian edition, Cambridge University Press (2011)

5. Course Plan:

Module Number	Lecture session	Reference	Learning Outcome
1. Theory of Space Curves	L 1-3 Space curve, Parametrization, Arc Length, Tangent & Osculating Plane, Normal, Binormal. L 4-5 Curvature, Torsion, Behavior of curve at a point L 6-8 Contact between curve and surfaces, Osculating circle and sphere, Spherical curvatures, Involutes and Evolutes.	1.1-1.6 Sec. 2.1, 2.3 of R1. 1.10-1.13	Examining the curves in space and surface along with tangent, normal, curvature, asymptotes.

2. First Fundamental Form	L 9-11 Representation of surface, Curves, Tangent plane and surface normal L 12-13: General Surfaces of Revolution, Helicoid, First Fundamental Form L 14-17: Direction Coefficients, Families of Curves, Orthogonal Trajectories, Isometric Correspondence	2.1-2.6 2.7-2.9 2.10-2.14	Parameterization of curves and the properties of surfaces.
3. Geodesics on a Surface	L18-19: Geodesics and their differential equation, Canonical geodesic equations L20-22: Geodesics and its normal properties, Existence Theorem L23-24: Geodesics Parallel. Geodesics Polar Coordinates and curvatures. L25-27: Gauss-Bonnet Theorem, Gaussian Curvatures, Surface of constant curvature	3.1-3.3 3.4-3.7 3.8-3.10 3.11-3.13	Canonical geodesic equations and its normal properties
4. Second Fundamental Form	L28-29: Second Fundamental Form, Classification of points, Principle curvatures. L30-31: Lines of curvature, Dupin indicatrix, Developable surfaces L32-33: Developable with space curves, Minimal surfaces, L34-35: Ruled Surfaces, Three Fundamental Form	4.1-4.4 4.5-4.7 4.8-4.10 4.11-4.12	Maximum and minimum curvatures along a given direction.
5. Fundamental Equation of Surface Theory	L36-37: Tensor equation, Gauss Equations L38-39: Weingarten Matrix, Mainardi-Coddazzi equation L40-41: Parallel surfaces, Fundamental Existence theorem	5.1-5.3 5.4-5.5 5.6-5.7	Fundamental Equation of surface, Gauss equations.

6. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of component (Close Book/ Open Book)
Mid-Semester Test		30	TBA	
Comprehensive Examination	2 hrs	40	To be announced	
In Class quizzes	20 min each	20	The best of 2 quizzes	
Assignment	To be informed	10	To be announced (refer NALANDA)	

7. Chamber Consultation Hour: To be announced in class

8. Notices: NALANDA website

9. Make-up Policy: No make ups for in class quizzes, buffer quizzes will be given instead. For mid-semester and comprehensive examinations, make up will be provided only in genuine cases when permission is granted in advance.

10. Note (if any): Practice Problems will be assigned periodically. They must be worked out to understand the subject. Students are expected to consult the Reference books as advised in the class room.

Instructor-in-charge
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