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Lesson Plan (CORE, Semester V, July, 2022 to November 2022)

Name of Teacher	Dr. Ankit Gupta	**Department**	Mathematics
Course	B.Sc (H) Mathematics	**Semester**	Five
Paper	Metric Spaces	**Academic Year**	2022-23

Learning Objectives

Up to this stage, students do study the concepts of analysis which evidently rely on the notion of distance. In this course, the objective is to develop the usual idea of distance into an abstract form on any set of objects, maintaining its inherent characteristics, and the resulting consequences.

Learning Outcomes

On completion of this course, the student will be able to:

- Learn various natural and abstract formulations of distance on the sets of usual or unusual entities. Become aware one such formulations leading to metric spaces.
- Analyse how a theory advances from a particular frame to a general frame.
- Appreciate the mathematical understanding of various geometrical concepts, viz. balls or connected sets etc. in an abstract setting.
- Know about Banach fixed point theorem, whose far-reaching consequences have resulted into an independent branch of study in analysis, known as fixed point theory.
- Learn about the two important topological properties, namely connectedness and compactness of metric spaces.

Lesson Plan

Week No.	Theme/ Curriculum	Any Additional Information

Week 1-4	• Definition of metric space, Illustration using the usual metric on $\mathbb{R}$, Euclidean and max metric on $\mathbb{R}^2$, Euclidean and max metric on $\mathbb{R}^n$, Discrete metric, Sup metric on $B(S)$ and $C[a,b]$, Integral metric on $C[a,b]$. • Sequences in metric space, Definition of limit of a sequence, Illustration through examples, Cauchy sequences. • Definition of complete metric spaces, Illustration through examples. • Open and closed balls, Neighborhood, Open sets, Examples and basic results.	Allocation of Assignment I
Week 5 – 8	• Interior point, Interior of a set, Limit point, Derived set, Examples and basic results. • Closed set, Closure of a set, Examples and basic results. • Bounded set, Diameter of a set, Cantor's theorem. • Relativisation and subspaces, Dense sets.	Test Scheduled (Syllabus upto Bounded set)
Week 9 - 11	• Continuous mappings, Sequential and other characterizations of continuity, Uniform continuity, Homeomorphism, Contraction mappings, Banach fixed point theorem.	
Week 12 - 14	• Connectedness and compactness, Definitions and properties of connected and compact spaces.	Allocation of Assignment II

References

1. Shirali, Satish & Vasudeva, H. L. (2009). Metric Spaces, Springer, First Indian Print

Additional Resources

1. Kumaresan, S. (2014). Topology of Metric Spaces (2nd ed.). Narosa Publishing House. New Delhi.
2. Simmons, George F. (2004). Introduction to Topology and Modern Analysis.