The LNM Institute of Information Technology, Jaipur Department of Mathematics	LNMIIT The LNM Institute of Information Technology

Programme: **Ph.D. (Mathematics)**	**Course Title:** **Introduction to Knot theory**			**Course Code:** **----------**
Type of Course: **Program Elective**	**Prerequisites:** **Topology**			**Total Contact Hours:** **60**
Year/Semester: **4/Odd**	**Lecture Hrs/Week:** **4**	**Tutorial Hrs/Week:** **0**	**Practical Hrs/Week:** **0**	**Credits:** **4**

Learning Objective:

After finishing this course, students will be able to define fundamental knot theoretic concepts. Students will be able to apply proof techniques from multiple disciplines (topology, abstract algebra and analysis) to derive fundamental theorems about knots, to produce examples of knots with certain properties, and to produce counterexamples to knot-theoretic statements. Students will gain skills in writing mathematical proof in a highly interdisciplinary and current field.

Prerequisites of the course: Topology

Course outcomes (COs):

On completion of this course, the students will have the ability to:		**Bloom's Level**
CO-1	Understand fundamental concepts in knot theory.	**2**
CO-2	Analyze the knots for various properties and to distinguish knots	**4**
CO-3	Produce counterexamples and examples to knot-theoretic statements.	**6**

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CO-4	Interpret knot theoretic concepts.	**6**

Course Topics	
Topics	**Lecture Hours**
UNIT – I	
Knots, wild knots, tame knots, equivalence of two knots, knot diagram	10
UNIT – II	
Reidemeister moves, invariants, and numerical invariants: crossing number, bridge number, unknotting number, 3-colourability, p-colourability; Alexander Polynomial.	20
UNIT – III	
Seifert surfaces, Seifert Graph, Seifert Matrices, Invariants from the Seifert Matrices, Alexander-Conway Polynomial & its properties, signature of a knot, Torus knots & its properties, Tangles & 2-bridge knots, theory of braids, knots and braids, Markov moves, Alexander theorem.	20
UNIT – IV	
Kauffman Bracket Polynomial, Kauffman Polynomial, Jones Polynomial, HOMFLY polynomial. Gauss diagrams, Introduction to virtual knot theory.	10

Textbook References:

1. **Text Book: The Knot Book: An Elementary Introduction to the Mathematical Theory of Knots**, Colin C Adams, American Mathematical Society.

Reference books:

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1. **An Introduction to Knot Theory, Lickorish**, W.B.Raymond, Graduate text in Mathematics, Springer.
2. **Knot Theory and its Applications**, Kunio Murasugi, Birkauser.

Evaluation Method	
Item	**Weightage (%)**
Paper Presentations	50
End-Term	50

*Please note, as per the existing institute's attendance policy the student should have a minimum of 75% attendance. Students who fail to attend a minimum of 75% lectures will be debarred from the End Term/Final/Comprehensive examination.

Last Updated On: August 10, 2022

Updated By: Pratibha Garg

Approved By: