NIRMA UNIVERSITY
Institute of Technology
B. Tech. Computer Science and Engineering
Semester – VI
Department Elective-I

L	T	P	C
2	0	2	3

Course Code	2CSDE59
Course Title	Complexity Theory

Course Outcomes:

At the end of the course, students will be able to –

1. comprehend fundamental complexity classes with their complement classes
2. infer algorithmic relationship amongst various classes of problems through reductions and complexity analysis
3. analyse complexity of algorithms for intractable problems.

Syllabus:

Teaching Hours: 30

Unit I — **05**

Introduction of Complexity theory and fundamental complexity classes for algorithmic problems and design problems, randomization Vs non-determinism, space bounded complexity classes

Unit II — **08**

Reductions: Reduction between various variants of the problem, reductions between related problems and unrelated problems, polynomial reduction, Cook's theorem, NP Complete and NP equivalent problems

Unit III — **07**

Complexity Analysis: Pseudo polynomial and storey NP Completeness, complexity of Approximation algorithm, approximation preserving reduction, Black box complexity

Unit IV — **04**

Complexity classes within NP and Co-NP, Interactive proof systems, randomized verification of proofs

Unit V — **06**

Complexity of Non-uniform problems, non-uniform Turing machines and space bounds lower bounds for communication complexity, Non-deterministic Vs randomized communication protocols, complexity of Boolean functions with respect to circuit size and circuit depth

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory work will be based on the above syllabus with minimum 5 experiments to be incorporated.

Suggested Readings^:

1. Sanjeev Arora and Boaz Barak. Computational Complexity: A Modern Approach. Cambridge University Press
2. Steven Rudich and AviWigderson, Computational Complexity Theory, American Mathematical Soc.
3. Schoening and Pruim, Gems of Theoretical Computer Science, Springer-Verlag Berlin Heidelberg
4. Moore and Mertens, The Nature of Computation, Oxford
5. Hemaspaandra and Ogihara, The Complexity Theory Companion, An EATCS Series
6. Christos H. Papadimitriou, Computational Complexity, Pearson

L=Lecture, T=Tutorial, P=Practical, C=Credit

^this is not an exhaustive list