1. Course No.:

2. Course Title: **Great Ideas in Theoretical Computer Science**

3. Per Week Lectures: <u>03</u> (L), Tutorial: <u>00</u> (T), Laboratory: 00(P), Additional Hours [0-2]: (A)

   Credits (3*L + 2*T + P + A) = <u>09</u>   Duration of course: Full semester / ~~Modular~~

4. Proposing Department / ~~IDP~~: **CSE**

   Other departments which may be interested in the proposed course:

   Other faculty members interested in teaching the proposed course:

5. Proposed Instructor(s): **Anurag Pandey**

6. Course description:

   A. OBJECTIVES: The course is designed for PG students and interested 3rd and 4th year UG students, with the objective of discussing the most exciting and impactful ideas in theoretical computer science. These are

      a. Ideas that provide deep intuition and understanding of the theory of computing,

      b. Ideas that have had great impact on the world,

      c. Ideas that reveal connections of computer science to other areas of mathematics and natural sciences.

   The goal would be to allow the students to appreciate theoretical computer science from the perspective of an engineer, a mathematician, a scientist, as well as a visionary and an entrepreneur. This would inspire them to enrich or deploy the ideas presented in the course with their own unique viewpoints and enthusiasm.

   B. CONTENTS:

No.	Topic	# Lectures (75min each)
1	Introduction and overview of topics	1
2	Turing Machine, Time-Space, Computability	2
3	Tractability: P, NP-completeness, P vs NP	2
4	Graph Algorithms	2
5	Randomness in Computation, Hardness vs Randomness	3
6	Fast Fourier Transform & Fast Matrix Multiplication	2
7	Error Correcting Codes	2
8	Approximation Algorithms	2
9	Data Streaming Algorithms	2
10	Linear Programming	2

11	Learning Algorithms, PAC learning	2
12	Public-Key Cryptography	2
13	Interactive Protocols, Zero Knowledge Proofs	2
14	Quantum Computing and Algorithms	3
15	Other computational paradigms & Future Outlook	1

     C. PRE-REQUISITES: Mathematics for Computer Science, Design and Analysis of Algorithms

7. Recommended textbooks:

     There is no textbook for the course, as it covers a wide range of topics that cannot be fully addressed by a single book. Instead, materials and references will be provided for each topic.

Dated: April 03, 2025   Proposer: Anurag Pandey

Dated: DUGC/DPGC convenor:

The course is approved / not approved.

Chairman, SUGC/SPGC Dated: