Indian Institute of Technology, Kanpur

Proposal for a New Course

1. Course No: ME6XX

2. Course Title: Computational Mathematics for Engineers

3. Per Week Lectures: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional Hours: 0 (A), Credits (3*L+2*T+P+A): 9 Duration of Course: Full Semester / ~~Modular~~

4. Proposing Department/IDP: Mechanical Engineering

   Other Departments/IDPs which may be interested in the proposed course: AE

   Other faculty members interested in teaching the proposed course:

5. Proposing Instructor(s): Malay K. Das, Abhishek Sarkar, Manjesh K. Singh, Anurag Gupta

6. Course Description:

A) Objectives:

The course covers mathematical theories and computer implementation of advanced numerical methods for solving mechanical engineering problems. Successful completion of this course will help the students solve problems in various areas, including computational mechanics and data-driven engineering.

B) Contents (*preferably in the form of 5 to 10 broad titles)*: 39 lectures

S. No	Broad Title	Topics	No. of Lectures
1.	Numerical Linear Algebra	Vector spaces, projections, least squares; LU, Cholesky, QR decompositions, sparse matrix solvers	9
2		Eigenvalue problems, Diagonalization, SVD	6
3	Numerical Optimization	Unconstrained optimization, gradient-descent methods, Newton and quasi-Newton methods; line search; constrained optimization	6
4	Probability	Random Variables and Probability Distributions; joint and conditional distributions; multivariate distribution	3
5	Fourier Analysis and Differential Equations	Fourier series, Fourier Transform, FFT	6
6		Canonical PDEs; Finite Difference Solution of ODEs and PDEs; Stability, Consistency, Convergence	9

C) Pre-requisites, if any (*examples: a- PSO201A,or b- PSO201A or equivalent*): NIL

D) Short summary for including in the Courses of Study Booklet

Vector space, projection, matrix decompositions, sparse matrix solvers, eigenvalue problems, SVD; numerical methods for constrained and unconstrained optimization problems; introductory concepts of probability; Fourier analysis, ODEs and PDEs

7. Recommended books:

   Textbooks E. Kreyszig, *Advanced Engineering Mathematics*, 10th ed., John Wiley & Sons, Inc

   Reference Books:

   1. Trefethen and Bau, Numerical Linear Algebra, SIAM
   2. Nocedal and Wright, *Numerical Optimization*, Springer
   3. Hogg et al., *Mathematical Statistics*, 8th ed., Pearson
   4. LeVeque, Finite Difference Methods for Ordinary and Partial Differential Equations, SIAM
   5. Chapra and Canale, *Numerical Methods for Engineers*, 8th ed., McGraw Hill ed.
   6. G. Strang, *Linear Algebra and Its Applications*, 4th ed., Cengage India Private Limited

8. Any other remarks: nil

Dated: 03.11.2026 Proposer: *Malay Das*

Dated: _____ DUGC/DPGC Convener: _____

The course is approved / not approved

Chairman, SUGC/SPGC

Dated: _____