

## Indian Institute of Technology, Kanpur Proposal for a New Course

1. Course No: SPA\*\*\*A
  2. Course Title: Numerical Methods in Space Sciences & Engineering
  3. Lectures per week: L=2, Tutorial: T=0, Laboratory: P=1, Additional hours: (0-2) =0 (A), Credits  $(3*L+2*T+1*P+A)=5$   
Duration of Course: Half Semester
  4. Proposing Department: Space, Planetary and Astronomical Sciences and Engineering.
  5. Proposing Instructor: Pankaj Jain
  6. Other Instructors who may teach this course: Sharvari Nadkarni-Ghosh, Kartick Sarkar, Rohit Sharma, Ishan Sharma
  7. Course Description (A) Objectives: The course aims to introduce students to numerical techniques used in Space, Planetary and Astronomical Sciences and Engineering. (B) Contents (preferably in the form of 5 to 10 broad titles):
    1. **Numerical Integration** (2 lectures, 2 labs)  
Newton-Cotes formulae including trapezoidal rule and Simpson's rule, Gaussian quadrature, convergence and scaling of error, Monte Carlo Integration
    2. **Numerical Root finding** (1 lecture, 1 lab)  
Bisection method, Newton Raphson method for single and multi-dimensional systems.
    3. **Integration of Ordinary Differential Equations (ODE)** (3 lectures, 3 labs)  
Initial Value Problem Forward and backward Euler method, Runge-Kutta Method, Stiff system of equations, implicit vs. explicit schemes, shooting method for the Boundary Value Problem.
    4. **Numerical Interpolation of functions** (1 lecture, 1 lab) Numerical fitting with polynomials, Spline Interpolation
- (C) Pre-requisites, if any: N/A
- (D) Short summary for including in the Courses of Study Booklet: Numerical integration of functions, numerical root finding, Solving Ordinary differential Equations, Numerical Interpolation

7. Recommended Books:

- Numerical Recipes: The Art of Scientific Computing  
Authors: Vertterling, Flannery, Press and Teukolsky.

8. Any other remarks:

Dated:                      Proposer:

Dated:                      DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: