Indian Institute of Technology, Kanpur
Proposal for a New Course

1. Course No: SPA 632M

2. Course Title: Introduction to Mathematical Transforms and Applications in Space Sciences

3. Lectures per week: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional hours: (0-2): 0 (A), Credits (3*L+2*T+P+A): 6, Duration of Course: Full Semester

4. Proposing Department: Space Science & Astronomy

5. Proposing Instructor: Rohit Sharma

6. Course Description

   (A) Objectives: This course aims to teach basic and most used mathematical transforms in various astronomical fields.

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

   1. Introduction to Linear Transformation (2 lectures) Importance of transformations, unique ness and reversibility, brief revision of operations like rotation, translation, reflection etc.., Riemann integrability etc..
   2. Fourier Transforms & Applications (7 lectures)
      Basics and properties of Fourier transforms, Fast Fourier Transform & inverse FFT, Par seval's theorem, convolution, correlation, windowing, resolution vs sampling, interpolation, solving boundary value problems, diverse applications of FFTs in astronomy, signal and im age processing, spatial power spectrum, effects of quantisation, concept of matched-filtering (conjugate-filtering)
   3. Wavelet Transform and Applications (4 lectures) Motivation for wavelets, Concept of scales, Mother wavelet and utilities to different types of signals (e.g. Haar), Wavelet spectrum, and feature identification
   4. Laplace Transform (2 lectures) Definition and it's properties and connections with other transforms, inverse laplace transform, Hilbert transform, applications
   5. Radon & Hough Transforms (3 lectures) Theory and applications (e.g. pulsars / solar)

   (C) Pre-requisites, if any: N/A

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

7. Recommended Books:

   – Ronald Bracewell, The Fourier Transform & Its Applications, 3rd Edition, McGraw Hill – The Wavelet Transform, R. S. Pathak

8. Any other remarks:

Dated: Proposer:

Dated: DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: