IIT Mandi
Proposal for a New Course

Course number : MA 526
Course Name : An Introduction to Wavelets
Credit Distribution : 3-0-0-3
Intended for : UG/PG
Prerequisite : Basic Knowledge of Real Analysis and Linear Algebra
Mutual Exclusion : None

1. Preamble:

This is an introductory course on wavelet analysis. In this course we will introduce the basic notion of wavelets in different settings, namely for finite groups, discrete infinite groups and real line. This will provide the students an opportunity to know perspective applications of linear algebra and real analysis in mathematics and beyond. Wavelets have a wide range of applications for example signal processing, image processing etc.

2. Course Modules with quantitative lecture hours:

Unit/Topic 1: Review of Linear Algebra (5 hours)
Complex Series, Euler's Formula, Roots of Unity, Linear Transformations and Matrices, Change of Basis, diagonalization of Linear Transformations and Matrices, Inner Product, Orthogonal Bases, Unitary Matrices.

Unit/Topic 2: The Discrete Fourier Transform (7 Hours)
Definition and Basic Properties of Discrete Fourier Transform, Translation- Invariant Linear Transformations, The Fast Fourier Transform.

Unit/Topic 3: Wavelets on Finite Group $\square_N$ (6 Hours)
Convolution, Fourier Transform on $\square_N$, Definition of Wavelets and Basic Properties, Construction of Wavelets on $\square_N$.

Unit/Topic 4: Wavelets on Infinite Discrete Group $\square$ (8 Hours)
Definition and Basic Properties of Hilbert spaces, Complete orthonormal sets in Hilbert Spaces, The spaces $\ell^2(\square)$ and $L^2([-\pi, \pi))$, Basic Fourier Series, The Fourier Transform and Convolution on $\ell^2(\square)$ Wavelets on $\square$.

Unit/Topic 5: Wavelets on $\square$ (16 Hours)
Convolution and Approximate Identities, Fourier Transform on $\square$, Bases for The Space $L^2(\square)$, Belian-Low Theorem, Wavelets on $\square$, Multiresolution Analysis, Construction of Wavelets from multiresolution Analysis, Construction of Compactly supported Wavelets, Haar Wavelets, Band-Limited Wavelets, Applications.

Laboratory/practical/tutorial Modules: Nil

3. Text books:

1. Michael W. Frazier, An Introduction to Wavelets Through Linear Algebra, Springer-Verlag, New York, 1999.
2. Eugenio Hernandez, Guido Weiss, A First Course on Wavelets, CRC Press, 1996.

4. References:

1. Ingrid Daubechies, Ten Lectures on Wavelets, CBMS -NSF Regional Conference Series in Applied Mathematics, 61. Society for Indus trial and Applied Mathematics (SIAM), Philadelphia, PA, 1992.
2. George Bachman, Lawrence Narici, Edward Beckenstein, Fourier and Wavelet Analysis, Springer-Verlag New York, 2000.
3. Howard L. Resnikoff, Raymond O. Wells, Jr., Wavelet Analysis, Springer-Verlag New York, 1998.

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	Linear Algebra	MA512	5 hours	12%

6. Justification of new course proposal if cumulative similarity content is >30%: NA