

Indian Institute of Technology Kanpur  
Department of Mathematics & Statistics  
Proposal for New Modular Elective Course

Title: Iso-geometric Finite Element Analysis of Fluid Flows  
Course No: MTH 7XX  
Credits: 3-0-0-5 (L-T-P-C)  
Semester: Any, Duration: Half Semester  
Department: Mathematics & Statistics  
Proposer: B.V.R.Kumar  
Prerequisite: MTH-308, MTH-430, MTH-421, MTH 522, MTH523A, MTH738  
No. of Students: ~ 15  
Dept. to which course may be interesting: MATH/PHY/All Engineering Dept.

Course Objective: This course aims to provide a comprehensive understanding of isogeometric finite element analysis (IGA) for fluid flow problems. Students will learn how spline-based geometric representations such as NURBS and B-splines can be integrated with finite element formulations to achieve higher accuracy, smoothness, and geometric fidelity in computational fluid dynamics. The course covers mathematical foundations, weak formulations of incompressible flow equations, discretization strategies, stability considerations, mathematical convergence analysis and efficient numerical implementation. Through theoretical study and computational projects, participants will develop the ability to model complex fluid phenomena, handle curved geometries, and analyze advanced applications in engineering, biomechanics, and multiphysics fluid-structure interaction problems.

S.No.	Item	No. of Lectures
1	Recall of IGA Basics –Classical FEM, NURBS, IGFEA for Linear Problems, Fluid Mechanics	5
2	IGFEA in Linear Elasticity	2
3	Time Dependent Problems	2
4	Non-Linear Iso-geometric Analysis	4
5	Fluids	4
6	Fluid structure Interaction	3

Reference Books:

- J. Austrin Cotrell et al., Iso-geometric Analysis 2009, Wiley
- Annalis Bufa et al., Iso-Geometric Analysis for PDEs, 2011, Springer
- Cleas Johnson, Numerical Methods for PDEs, Cambridge
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Date: 23.03.26

*B. V. R. Kumar*

Signature of the Proposer:

Signature of DPGC Convener:

Course Approved/Not Approved

Signature of Chairman SUGC