



J.S. University, Shikohabad  
Faculty of Mechanical engineering

Value Added Course

AY: 2022-23

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## **Value Added Courses**

### **Faculty of Mechanical Engineering**



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# COMPUTATIONAL FLUID DYNAMICS

## Learning Objective:

This Course will provide knowledge of computational fluid dynamics

**Duration:** 30 Hours. (Theory and Practical)

## Course Outcomes: -

After completion of the course the student shall be able to:-

1. Students should be able to model fluid / heat transfer problems and apply fundamental conservation principles.
2. Students should be able to discretize the governing equations by Finite Difference Method and Finite volume Method.
3. Students should be able to develop programming skills by in-house code development for conduction, convection and fluid dynamics problems.
4. Students should be able to solve basic convection and diffusion equations and understand their role in fluid flow and heat transfer.
5. To prepare the students for research leading to higher studies.
6. To prepare the students for career in CAE industry using software tools.



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## Syllabus

### Module I: Introduction to CFD

Introduction to Computational Fluid Dynamics, Derivation and physical interpretation of governing equations (conservation of mass, momentum and energy) in differential form, Concept of substantial derivative, divergence and curl of velocity, Mathematical behavior of Governing Equations and boundary conditions.

### Module 2 : Solution to Conduction Equation

Introduction to FEA, FDM and FVM, Solution of two dimensional steady and unsteady heat conduction equation using finite volume method (Implicit and Explicit) with Dirichlet, Neumann, Robin boundary conditions, Stability Criteria.

### Module 3 : Solution to Advection Equation

Solution of two dimensional steady and unsteady heat advection equation using finite volume method (Implicit and Explicit) with Dirichlet BC, Stability Criteria, Introduction to first order upwind, CD, second order upwind and QUICK convection schemes.

### Module 4: Solution to Convection-Diffusion Equation

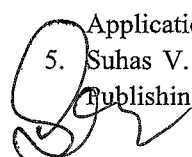
Solution of two dimensional steady and unsteady heat convection-diffusion equation for slug flow using finite volume method (Implicit and Explicit), Stability Criteria, 1-D transient convection-diffusion system, Peclet Number


### Module 5: Solution to Navier – Stokes Equation

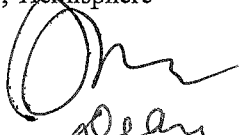
Solution of Navier-Stokes equation for incompressible flow using SIMPLE algorithms for lid driven cavity flow problem, Introduction to external flow simulation.

### References:-

1. H. Tennekes and J. L. Lumley, A First Course in Turbulence, MIT Press.
2. David C. Wilcox, Turbulence Modeling for CFD, DCW Industries
3. John D Anderson: Computational Fluid Dynamics- The Basics with Applications, McGraw-Hill
4. Atul Sharma, Introduction to Computational Fluid Dynamics: Development, Application and Analysis, Wiley
5. Suhas V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation

  
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