NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

Department of Chemical Engineering

COURSE OUTLINE			
Course Title	**Computational Fluid Dynamics**		
Course Code	**CL622**	**No. of Credits**	**3**
Session	**January2022**		
Department	**Chemical Engineering**	**Faculty**	**Dr.M.Perumalsamy**
Pre-requisites	**Fluid Mechanics and Numerical Methods**		
Course Type	**Elective Course**		

COURSE OVERVIEW

The Computational Fluid Dynamics subject is offered for M.Tech (Chemical Engineering) students in the second semester to acquire the knowledge on basic concepts of Computational fluid dynamics and its applications in chemical engineering. The course content includes governing equations representing fluid dynamics, Introduction to fluid flow behaviour and formulation of problem then solving the problems using Finite volume method. Both steady state and unsteady state fluid flow and heat transfer problems will be discussed.

COURSE OBJECTIVES

1. To understand the theory of governing equations representing fluid flow behavior
2. To impart knowledge on the concept of turbulence and its modeling
3. To solve fluid flow problems involving diffusion and convection phenomena using Finite volume method

COURSE OUTCOMES (COs)

1. To impart knowledge on theory of governing equations representing fluid flow behavior
2. To understand the concept of turbulence and its modeling
3. Ability to solve steady state diffusion and convection fluid flow problems using Finite volume method
4. Ability to solve unsteady state fluid flow problems using finite volume method

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1.	1st week	Introduction Computational Fluid dynamics and its significance. Governing equations of fluid flow and heat transfer, Equations of state	Lectures and power point presentation.
2.	2nd week	Continuity equation and Navier-Stokes equations for a Newtonian fluid	Chalk and talk
3.	3rd week	Classification of physical behavior, of fluid flow equations, Auxiliary conditions for viscous fluid flow equations	Lectures and power point presentation
4.	4th week	Transition from laminar to turbulent flow, Effect of turbulence on time-averaged Navier-Stokes equations,	Lectures and power point presentation
5.	5th week	Turbulence and its Modelling-Characteristics of simple turbulent flows, Free turbulent flows, Flat plate boundary layer and pipe flow,	Lectures and power point presentation
6.	6th week	Turbulence models, Mixing length model, The k-e model, Reynolds stress equation models, Algebraic stress equation models	Lectures and power point presentation
7.	7th week	The Finite Volume Method for Diffusion Problems -one-dimensional steady state diffusion, two-dimensional diffusion problems, three-dimensional diffusion problems	Tutorial, Chalk and talk
8.	8th week	Discretized equations for diffusion problems	Tutorial, Chalk and talk
9.	9th week	The central differencing scheme, Properties of discretization schemes	Lectures and power point presentation
10.	10th week	The Finite Volume Method for Convection-Diffusion Problems -Steady one-dimensional convection and diffusion problems	Tutorial, Chalk and talk

11.	11th week	Properties of discretization schemes- Conservativeness, Conservativeness, Boundedness, Transportiveness,	Lectures and power point presentation
12.	12th week	Assessment of the central differencing scheme for convection-diffusion problems, The central differencing scheme, The upwind differencing scheme	Lectures, Chalk and talk
13.	13th week	The hybrid differencing scheme, The power-law scheme,	Tutorial, Chalk and talk
14.	14th week	Higher order differencing schemes for convection-diffusion, Quadratic upwind differencing scheme	Tutorial, Chalk and talk
15.	15th week	The Finite Volume Method for Unsteady Flows -One-dimensional unsteady heat conduction, Discretisation of transient convection-diffusion equation	Lectures, Chalk and talk
16.	16th week	Solution procedures for unsteady flow calculations,	Lectures, Chalk and talk
17.	17th week	Implementation of Inlet, outlet and wall boundary conditions, constant pressure boundary condition.	Lectures and power point presentation

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assignment-I	On completion of first Unit		10%
2	Cycle Test- I	On completion of first two Units	1Hr	25%
3	Assignment-II	On completion of third Unit		10%
4	Cycle Test- II	On completion of 3rd and 4th units	1 Hr	25%
5	End Semester exam	After completing the syllabus	2Hrs	30 %

ESSENTIAL READINGS : Textbooks, reference books etc

1. H. K. Versteeg and W. Malalasekera, An introduction to computational fluid dynamics: the finite volume method , Longman scientific & technical publishers, 1995
2. John D. Anderson, Computational fluid dynamics: The Basics with Applications McGraw-Hill, Inc.New York, 1995.
3. Vivek V. Ranade, Computational flow modeling for chemical reactor engineering Academic Press, San Diego, 2002

COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)

- Performance in the assessment methods
- Questionnaire about the effectiveness of the delivery method, topics and the knowledge gained

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

- 75 % attendance is mandatory. Those who indulge in malpractice such as copying, plagiarism shall have to redo the course.
- Those who are absent for any of the assessment tests on genuine grounds shall be given an opportunity only once for the retest with the prior permission of the concerned faculty member. The retest shall be conducted before the end semester exam and the portions will be both I and II cycle test portions.
- The passing minima is as per the Institute norms.Those who failed in the course can appear for the supplementary exam.The total marks will be 100
- Any misbehavior, indiscipline in the classroom/exam hall will be dealt with seriously. In the worst case, the departmental disciplinary committee is empowered to debar the student from the course.

ADDITIONAL COURSE INFORMATION

The lecture materials such as notes, video lectures shall be displayed in MS-TEAMS. The teachers can be contacted in person for clarifications by the student on a mutually convenient time.

FOR SENATE'S CONSIDERATION

Course Faculty _____ **CC-Chairperson** _____ **HOD** _____

Dr.M.Perumalsamy Dr.M.Perumalsamy Dr.P.Kalaichelvi