DEPARTMENT OF CHEMICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Course Title	**Computational Fluid Dynamics**		
Course Code	**CL622**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**NIL**		
Session	**January 2018**	**Section (if, applicable)**	**Not Applicable**
Name of Faculty	**Dr.M.Perumalsamy**	**Department**	**Chemical Engineering**
Email	**mpsamy@nitt.edu**	**Telephone No.**	**917010441790**
Name of Course Coordinator(s) (if, applicable)	**Dr.P.Sivashanmugam**		
E-mail	**psiva@nitt.edu**	**Telephone No.**	**04312503106**
Course Type	☐ **Core course**	☑ **Elective course**	

Syllabus (approved in BoS)

Conservation Laws of Fluid Motion and Boundary Conditions: Governing equations of fluid flow and heat transfer, Equations of state, Navier-Stokes equations for a Newtonian fluid, Classification of physical behaviour, Classification of fluid flow equations, Auxiliary conditions for viscous fluid flow equations

Turbulence and its Modelling: Transition from laminar to turbulent flow, Effect of turbulence on time-averaged Navier-Stokes equations, Characteristics of simple turbulent flows, Free turbulent flows, Flat plate boundary layer and pipe flow, Turbulence models, Mixing length model,The k-e model, Reynolds stress equation models, Algebraic stress equation models

The Finite Volume Method for Diffusion Problems: Introduction, one-dimensional steady state diffusion, two-dimensional diffusion problems, three-dimensional diffusion problems , discretised equations for diffusion problems

The Finite Volume Method for Convection-Diffusion Problems: Steady one-dimensional convection and diffusion, The central differencing scheme, Properties of discretisation schemes-Conservativeness, Boundedness, Transportiveness, Assessment of the central differencing scheme for convection-diffusion problems, The upwind differencing scheme, The hybrid differencing scheme, The power-law scheme, Higher order differencing schemes for convection-diffusion, Quadratic upwind differencing scheme

The Finite Volume Method for Unsteady Flows and Implementation of Boundary Conditions: One-dimensional unsteady heat conduction, Discretisation of transient

convection-diffusion equation, Solution procedures for unsteady flow calculations, Implementation of Inlet, outlet and wall boundary conditions, constant pressure boundary condition.

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 (CO)

Course Outcomes	**Aligned Programme Outcomes (PO)**
1. To impart knowledge on theory of governing equations representing fluid flow behavior	**1,2,6,9,10,11**
2. To understand the concept of turbulence and its modeling	**1,2,4,6,7,10,11**
3. Ability to solve steady state diffusion and convection fluid flow problems using Finite volume method	**1,2,3,4,5,8,10,11**
4. Ability to solve unsteady state fluid flow problems using finite volume method	**1,2,3,4,5,8,10,11**

COURSE PLAN – PART II

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 TEACHING AND LEARNING ACTIVITIES

S.No.	**Week/Contact Hours**	**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	Turbulence and its Modelling-Characteristics of simple turbulent flows, Free turbulent flows, Flat plate boundary layer and pipe flow,	Lectures and power point presentation
5.	5th week	Turbulence models, Mixing length model, The k-e model, Reynolds stress equation models, Algebraic stress equation models	Lectures and power point presentation
6.	6th 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
7.	7th week	The central differencing scheme, Properties of discretization schemes	Lectures and power point presentation
8.	8th week	The Finite Volume Method for Convection-Diffusion Problems - Steady one-dimensional convection and diffusion problems	Tutorial, Chalk and talk
9.	9th week	Assessment of the central differencing scheme for convection-diffusion problems, The central differencing scheme, The upwind differencing scheme	Lectures, Chalk and talk
10.	10th week	The hybrid differencing scheme, The power-law scheme,	Tutorial, Chalk and talk
11.	11th week	Higher order differencing schemes for convection-diffusion, Quadratic upwind differencing scheme	Tutorial, Chalk and talk

12.	12th week	The Finite Volume Method for Unsteady Flows -One-dimensional unsteady heat conduction, Discretization of transient convection-diffusion equation	Lectures, Chalk and talk
13.	13th week	Solution procedures for unsteady flow calculations,	Lectures, Chalk and talk
14.	14th week	Implementation of Inlet, outlet and wall boundary conditions, constant pressure boundary condition.	Lectures and power point presentation

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assignment-I	5th Week		5%
2	Cycle Test-I	6th Week	1Hr	20%
3	Assignment-II	10th week		5%
4	Cycle Test-II	12th week	1Hr	20%
CPA	Compensation Assessment*	13th Week	1Hr	20%
5	Final Assessment *	14th Week	3Hr	50%

***mandatory; refer to guidelines on page 4**

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

- Performance in the assessment methods will be assessed

  Questionnaire about the effectiveness of the delivery method, topics and the knowledge gained will be collected from students twice during the semester

COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, , academic honesty and plagiarism etc.)

MODE OF CORRESPONDENCE (email/ phone etc)

The teachers can be contacted in person for clarifications by the student on a mutually convenient time at room number **206** in the department of chemical engineering

ATTENDANCE

75 % attendance is mandatory

COMPENSATION ASSESSMENT

Those who are absent for any of the assessment tests on genuine grounds shall be given an opportunity only once for the compensation assessment 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.

ACADEMIC HONESTY & PLAGIARISM

Those who indulge in malpractice such as copying, plagiarism shall have to redo the course. 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 INFORMATION

The passing minima, **40%** mark will be followed as per the Institute norms.Those who failed in the course can appear for the supplementary exam.The total marks will be 100

FOR APPROVAL

Course Faculty _____ **CC-Chairperson** _____ (CA. ARUNAGIRI) **HOD** _____

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Guidelines:

a) The number of assessments for a course shall range from 4 to 6.

b) Every course shall have a final assessment on the entire syllabus with at least 30% weightage.

c) **One compensation assessment for absentees in assessments (other than final assessment) is mandatory. This is not applicable for project work/industrial lectures/internship**.

d) The policy for attendance for the course should be clearly specified.

e) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.