NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ENERGY AND ENVIRONMENT

COURSE PLAN – PART I			
Name of the programme and specialization	**M.Tech. (Energy Engineering)**		
Course Title	**Computational Fluid Dynamics**		
Course Code	**EN604**	**No. of Credits**	**03**
Course Code of Pre-requisite subject(s)	**Nil**		
Session	**January 2021**	**Section (if, applicable)**	~~**A / B**~~
Name of Faculty	**Dr. Ruben Sudhakar D**	**Department**	**Energy and Environment**
Official Email	**rubensudhakar@nitt.edu**	**Telephone No.**	**0431-2503135**
Name of Course Coordinator(s) (if, applicable)	**Dr.M.Premalatha, HoD, DEE**		
Official E-mail	**-**	**Telephone No.**	
Course Type (please tick appropriately)	☑ **Core course**	☐ **Elective course**	

Syllabus (approved in BoS)

Governing Equations of Fluid Flow, Finite Difference, Finite Volume, Finite Element Methods, Laplace Equation, Diffusion Equation or Wave Equation

Application of Finite Volume Method to Fluid Flow problems - Pressure Correction Techniques Gauss Siedel - Gauss Jordan. Introduction to Multi grid Methods - Boundary Conditions

Structured and Unstructured Mesh- Introduction to CAD systems and Different Standards used for DATA Exchange. Governing Equations for Turbulent Flow, Rotating Machinery, Combusting Flow, Multiphase Flow.

Simple Internal Flows: T-Junction, Driven Cavity, Manifold, Valves, External Flows: Flow Over Ahmed Body, Car-Reacting Flow in a Gas Burner, Multiphase Flow in an Air Lift Reactor.

COURSE OBJECTIVES

To impart knowlegde on the basics of computational fluid dynamics and its application to thermo-fluid problems to obtain and analyse numerical solutions.

MAPPING OF COs with POs	
Course Outcomes	**Programme Outcomes (PO)** (Enter Numbers only)
1. Describe various flow features in terms of appropriate fluid mechanics principles.	**PO1, PO2, PO3, PO4, PO12**
2. Solve complex fluid mechanics equations using various discretization techniques available like FEM, FVM, and FDM.	**PO1, PO2, PO3, PO4, PO12**
3. Analyse a flow field to determine various quantities of interest, such as flow rates, heat fluxes, pressure drops, losses etc.	**PO1, PO2, PO3, PO4, PO12**
4. Simplify a real fluid-flow system into a simplified model problem, to select the proper governing equations for the physics involved in the system, to solve for the flow, to investigate the fluid-flow behavior, and to understand the results.	**PO1, PO2, PO3, PO4, PO12**
5. Recognize the type of fluid flow that is occurring in a particular physical system and to use the appropriate model equations to investigate the flow and will be able to communicate the results of this detailed fluid-flow study in a written format.	**PO1, PO2, PO3, PO4, PO12**

COURSE PLAN – PART II

COURSE OVERVIEW

This course will provide

(i) core knowledge of the fundamentals of CFD
(ii) introduction to the methods and analysis techniques used in CFD
(iii) introduction to the use of commercial CFD codes to analyse flow and heat transfer in problems of practical engineering interest

The emphasis of the course is on the use of CFD as a virtual fluid laboratory. By studying a variety of flow situations students will develop a better understanding of fluid mechanics more quickly than is possible with traditional analytical approaches.

COURSE TEACHING AND LEARNING ACTIVITIES (Add more rows)

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	1	Governing Equations of Fluid Flow, Finite Difference, Finite Volume	Online lecture/PPT
2	2	Finite Element Methods	Online lecture/PPT
3	3	Laplace Equation, Diffusion Equation or Wave Equation	Online lecture/PPT

4	4	Application of Finite Volume Method to Fluid Flow problems	Online lecture/PPT
5	5	Pressure Correction Techniques Gauss Siedel - Gauss Jordan	Online lecture/PPT
6	6	Introduction to Multi grid Methods - Boundary Conditions	Online lecture/PPT
7	7	Structured and Unstructured Mesh	Online lecture/PPT
8	8	Introduction to CAD systems and Different Standards used for DATA Exchange	Online lecture/PPT
9	9	Governing Equations for Turbulent Flow, Rotating Machinery	Online lecture/PPT
10	10	Governing Equations for Combusting Flow, Multiphase Flow	Online lecture/PPT
11	11	Simple Internal Flows: T-Junction, Driven Cavity	Online lecture/PPT
12	12	Simple Internal Flows Manifold, Valves	Online lecture/PPT
13	13	External Flows: Flow Over Ahmed Body, Car-Reacting Flow in a Gas Burner	Online lecture/PPT
14	14	Multiphase Flow in an Air Lift Reactor.	Online lecture/PPT

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date (tentative)	Duration (tentative)	% Weightage
1	Cycle test-1	22-26 Feb., 2021	60 minutes	30

2	Cycle test-2	22-26 Mar., 2021	60 minutes	30
3	Assignments	Throughout the semester	A week time for completion of each assignment	10
CPA	Compensation Assessment*	3-7 May, 2021	60 minutes	30
6	Final Assessment * (End-semester exam)	10-28 May, 2021	120 minutes	30

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

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

Feedback must be given through MIS portal, at the end of the semester. Feedback to the instructor can also be given anytime during the semester through email (rubensudhakar@nitt.edu).

COURSE POLICY (including compensation assessment to be specified**)**

MODE OF CORRESPONDENCE (email/ phone etc)

Students can email me at rubensudhakar@nitt.edu. From the time students are allowed to physically attend classes, they can meet me in my office (MN 103, DEE building)

Compensation Assessment will be conducted only for students who miss quiz-I or Quiz-II on valid/genuine grounds of medical or other emergencies.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the

Academic office.

- The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION, IF ANY

Suggested Readings/References

1. H.K. Versteeg& W. Malalasekera, "An Introduction to Computational Fluid Dynamics -The finite volume approach" Longman, 1995
2. Segerlind .L. J., "Applied finite Element Analysis", 2nd edition, John Wiley, 1984
3. Anderson, “Computational Fluid Dynamics: The Basics with Applications” McGraw Hill Company, 1995
4. D.A. Caughey and M.M.Hafez, "Frontiers of Computational Fluid Dynamics 1994" JohnWiley & Sons, 1994
5. Ferziger, J. H. and Peric, M., “Computational Methods for Fluid Dynamics” Springer-Verlag, Berlin, 2003.

FOR APPROVAL

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

Guidelines

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

b) Every theory 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. Only genuine cases of absence shall be considered.

d) The passing minimum shall be as per the regulations.

B.Tech. Admitted in				P.G.
2018	2017	2016	2015	
35% or (Class average/2) whichever is greater.		(Peak/3) or (Class Average/2) whichever is lower		40%

e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.

f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.

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