DEPARTMENT OF MECHANICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Course Title	Fluid Mechanics		
Course Code	MEPC18	**No. of Credits**	03
Course Code of Pre-requisite subject(s)	--		
Session	July 2019	**Section (if applicable)**	---
Faculty	Dr. S. Venkatachalapathy	**Department**	Mechanical Engineering
E-mail	svc@nitt.edu	**Tel. No.**	0431-2503415
Name of Course Coordinator (if applicable)	--		
Course Type	✓ **Core course** ☐ **Elective course** ☐ **Laboratory course**		

Syllabus (approved in BoS)

Introduction: Fluids and continuum, Physical properties of fluids, density, specific weight, vapour pressure, Newton's law of viscosity. Ideal and real fluids, Newtonian and non - Newtonian fluids. Fluid Statics-Pressure -density-height relationship, manometers, pressure on plane and curved surfaces, center of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to uniform accelerations, measurement of pressure.

Kinematics of fluid flow: Eulerian and Lagrangian approaches, classification of fluid flow, 1-D, 2-D and 3-D flow, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, stream lines, path lines, streak lines, stream tubes, velocity and acceleration in fluid, circulation and vorticity, stream function and potential function, Laplace equation, equipotential lines flow nets, uses and limitations.

Dynamics of Fluid flow: Fluid Dynamics: Energies in flowing fluid, head, pressure, dynamic, static and total head, Control volume analysis of mass, m and energy, RTT, Equations of fluid dynamics: Differential equations of mass, energy and momentum (Euler's equation), Navier-Stokes equations (without proof), Bernoulli's equation and its applications, Velocity measurements: Pitot tube and Pitot-static tube.

Pipe Flow: Viscous flow: Reynolds experiment to classify laminar and turbulent flows, significance of Reynolds number, critical Reynolds number, shear stress and velocity distribution in a pipe, law of fluid friction, head loss due to friction, Hagen Poiseuille Equation. Turbulent flow: Darcy - Weisbach equation, Chezy's equation Moody's chart, Major

and minor energy losses.

Concept of Boundary Layer: Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers, laminar sub layer, velocity profile, calculation of drag, boundary layer separation. Dimensional Analysis and Hydraulic similitude: Dimensional analysis, Buckingham's theorem, important dimensionless numbers and their significance, geometric, Kinematic and dynamic similarity, model studies. Froude, Reynolds, Weber, Cauchy and Mach numbers, Applications and limitations of model testing, simple problems only.

Essential Readings

1. Fox, R.W. and McDonald, A.T., Introduction to Fluid Mechanics, 6th ed., John Wiley, 2003.
2. White, F.M., Fluid Mechanics, 7th ed., McGraw Hill education (India) Pvt. Ltd., 2011.
3. Cengel, Y.A. and Cimbala, J.M., Fluid Mechanics : Fundamental and Applications, Tata McGraw-Hill Publishing Co. Ltd., 2006.
4. Som, S. K., Biswas, G. and Chakraborty, S., Introduction to Fluid Mechanics and Fluid Machines, 3rd ed., Tata McGraw-Hill Education Pvt. Ltd., 2012.
5. Munson, B.R., Young, D.F. and Okiishi, T.H., Fundamentals of Fluid Mechanics, 5th ed., John Wiley & Sons Inc., 2006.

COURSE OBJECTIVES

1. To familiarize with the fluid properties and their applications in fluid mechanics.
2. To formulate and analyze problems related to calculation of forces in fluid structure interaction.
3. To classify flows and to understand and apply the conservation principles for fluid flows.
4. To understand the principles of dimensional analysis.
5. To familiarize students with the relevance of fluid dynamics to many engineering systems

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
Upon completion of the course, the student will be able to	
1. Calculate pressure variations in accelerating fluids using Euler's and Bernoulli's equations	PO1, PO2
2. Become conversant with the concepts of flow measurements and flow through pipes	PO1, PO2, PO4
3. Apply the momentum and energy equations to fluid flow problems.	PO1, PO4

4. Evaluate head loss in pipes and conduits.	PO1, PO4
5. Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity	PO1, PO3

COURSE PLAN – PART II

COURSE OVERVIEW

The course provides a stuctured approach on the understanding of fluid properties and application of such properties into different practical scenarios and industrial applications. The design of the course includes the introduction to the fluid properties, understanding of different kinds of flow patterns, framing the governing equations for steady flows, incompressible flows, inviscid flows and so on. The course further extends the insight into Eulerian approach and hence analysis based on boundary layer and dimensions.

COURSE TEACHING AND LEARNING ACTIVITIES

Sl. No.	Week	Topic	Mode of Delivery
1	1st week	Basic concepts - Fluid properties - Basic hydrostatic equation	Chalk & Talk
2	2nd week	Pressure at a point - Hydrostatic equations for incompressible fluids - Manometers	Chalk & Talk
3	3rd week	Hydrostatic force on submerged plane and curved surfaces - Buoyancy and equilibrium of floating bodies	Chalk & Talk
4	4th week	Eulerian and Lagrangian approches	Chalk & Talk
5	5th week	Classification of flows	PPT
6	6th week	Laplace equation, equipotential lines, flow nets, uses and limitations.	Chalk & Talk
7	7th week	Control volume analysis of mass, momentum and energy	Chalk & Talk
8	8th week	Velocity measurements	Chalk & Talk
9	9th week	Reynolds experiment and Laminar flows	Chalk & Talk
10	10th week	Turbulent flows	PPT

11	11th week	Boundary layer concept - Prandtl's equation - Drag on flat plates	Chalk & Talk
12	12th week	Dimensional Analysis	Chalk & Talk
13	13th week	Buckingham π-theorem - Dimensionless numbers.	Chalk & Talk

COURSE ASSESSMENT METHODS (Shall range from 4 to 6)

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Cycle Test - I	5th Week	1hour	20%
2.	Cycle Test - II	10th Week	1 hour	20%
CPA	Compensation test (I & II Cycle Test Topics Combined)	12th Week	1 hour	20%
3.	Assignment	13th Week	---	10%
4.	End Semester Examination	14th Week	3 hours	50%

COURSE EXIT SURVEY

1. Students feedback through class committee meetings
2. Feedback questionnaire from students – twice during the semester
3. Feedback from students on the course outcomes shall be obtained at the end of the course

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

Mode of Correspondence

1. The Faculty is available for consultation during the time intimated to the students.
2. All correspondence will be sent to the webmail id of the students, if required.
3. The students will be communicated through the email id: svc@nitt.edu for any academic related issues (including sharing of study materials) with respect to this course.

Attendance

1. Attendance will be taken by the faculty in all contact hours.
2. The minimum attendance for appearing the end semester examination is 75%.
3. A maximum of 10% is allowed under On Duty (OD) category.
4. Students who are having attendance less than 65% will be prevented from writing the final assessment and shall be awarded 'V' Grade.

Compensation Assessment

1. Attending all the assessments is **MANDATORY** for every student.
2. If any student is not able to attend any of the continuous assessments (CTs: 1-2) due to genuine reason, a Compensation examination shall be conducted for 20 marks comprising the syllabus of both the cycle tests.

3. Students should submit the assignments before the last date of submission. In case if a student fails to submit the assignment within the last date of submission, she/he will be awarded zero marks.

Academic Honesty & Plagiarism

1. In case if any student found guilty, indulging in any malpractice, the student will be awarded ZERO marks in that particular assessment. If found using mobile phones or any other gadgets for any malpractice during the examination, the answer sheet of the student will not be evaluated and will be awarded ZERO marks for that assessment.

FOR APPROVAL

(Dr. S. Venkatachalapathy) Course Faculty	CC Chairperson Aug. 8, 2019	HoD (Dept. of ME)