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 2018	**Section (if applicable)**	B
Faculty	P Kaushik	**Department**	Mechanical Engineering
E-mail	pkaushik@nitt.edu	**Telephone No.**	+91 9632253573
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, momentum 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 Mc Donald, A.T., Introduction to Fluid Mechanics, 6th ed., John Wiley, 2003.
2. White, F.M., Fluid Mechanics, 5th ed., McGraw-Hill, 2003.
3. Yungus A. Cengel, John Cimbala, Fluid Mechanics Fundamental and applications, 3rd ed Tata McGraw-Hill Education.
4. S. K. Som, Gautam Biswas, Suman Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, 3rd ed. Tata McGraw-Hill Education.

COURSE OBJECTIVES

1. To familiarize with the properties of fluids and the applications of 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
2. Become conversant with the concepts of flow measurements and flow through pipes	PO1, PO2
3. Apply the momentum and energy equations to fluid flow problems.	PO4

4. Evaluate head loss in pipes and conduits.	PO1
5. Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity	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 aspects. The design of the course includes the introduction to the fluid properties, understanding on different kinds of flow patterns, framing the governing equations for steady, incompressible flow, inviscid flow and so on. The course further extends the insight into Eulerian approach and Lagrangian approach and hence analysis based on boundary layer and dimensions.

COURSE TEACHING AND LEARNING ACTIVITIES

S. No.	Week	Topic	Mode of Delivery
1	1st week	Introduction - Basic concepts - Fluid properties - Basic hydrostatic equation	PPT, 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	Euler and Lagrangian approches	Chalk & Talk
5	5th week	Classification of flows	Chalk & Talk
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	Chalk & Talk

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
14	14th week	Revision	Chalk & Talk

COURSE ASSESSMENT METHODS (Shall range from 4 to 6)

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Assignment	1st week of August	-	10%
2.	Mid exam (1st and 2nd units)	06 Sep 2018	1.5 hour	30%
3.	Quiz (Multiple Choice Questions) (3rd and 4th units)	4 Oct 2018	30 mins	10%
CPA	Compensation test (first four units)	5 – 9 Nov 2018	1.5 hour	30%
4.	End Semester Examination (Descriptive)	12 – 22 Nov 2018	2 hours	50%

COURSE EXIT SURVEY

1. Students feedback through class committee meetings
2. Feedback questionnaire from students – at the end of 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 then and there.
2. The students will be communicated through the email id: pkaushik@nitt.edu for any academic related issues (including sharing of study materials) with respect to this course.

Attendance

1. All the students are expected to attend all the contact hours. Students should maintain 75% minimum physical attendance by the end of the course to attend the end semester examination.
2. Students fall short of 75% attendance at the end of the course will have to appear the compensation assessment (CPA). Students with attendance in the range between 50% to 75% have to score at least 40% marks in the CPA to make themselves eligible for appearing the end semester exam. The students with attendance < 50% have to score 60% in the CPA to make themselves eligible for appearing the end semester exam.

3. Students not having 75 % minimum attendance at the end of the semester and also scores less than recommended marks in the CPA will be awarded 'V' Grade and have to REDO the course.
4. Marks obtained in the CPA will not be considered for cumulative marks for the students, who appeared due to attendance shortage.

Compensation Assessment

1. Attending all the assessments (2, 3, 4, 5) are mandatory for every student. Flexibility is given to the students to fix the date for each mode of evaluation convenient to majority of the students.
2. If any student fails to attend the cycle test 1 and 2 due to genuine reason like medical emergency, the student may be permitted to appear the compensation assessment (CPA) on submission of appropriate documents as proof. (Not valid for students having attendance lag).
3. Students not having 75 % minimum attendance at the end of the semester and also didn't the cycle test 1 and 2 will be awarded 'V' Grade and have to REDO the course.
4. In any case, compensation assessment (CPA) is not considered as an improvement test.
5. The minimum marks for passing this course and grading pattern will adhere to the regulations of the institute.

Academic Honesty & Plagiarism

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

FOR APPROVAL

[P Kaushik, AP/ME]	01/08/2018	
Course Faculty	**CC Chairperson**	**HoD (Dept. of ME)**