COURSE MODULE

Fluid Mechanics			III
Course Code	**BME403**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:2:0**	SEE Marks	50
Total Hours of Pedagogy	**40 hours Theory + 8-10 Lab slots**	Total Marks	100
Credits	**04**	Exam Hours	03
Examination nature (SEE)		**Theory**	

Course objectives:

- To have a working knowledge of the basic properties of fluids and understand the continuum approximation.
- To Calculate the forces exerted by a fluid at rest on submerged surfaces and understand the force of buoyancy.
- To understand the flow characteristic and dynamics of flow field for various Engineering applications.
- To know how velocity changes and energy transfers in fluid flows are related to forces and torques and to understand why designing for minimum loss of energy in fluid flows is so important.
- To discuss the main properties of laminar and turbulent pipe flow and appreciate their differences and the concept of boundary layer theory.
- Understand the concept of dynamic similarity and how to apply it to experimental modelling.
- To appreciate the consequences of compressibility in gas flow and understand the effects of friction and heat transfer on compressible flows

- Teaching-Learning Process (General Instructions) These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.
  1. Power-point Presentation,
  2. Video demonstration or Simulations
  3. Chalk and Talk are used for Problem Solving
  4. Laboratory Demonstrations and Practical Experiments

MODULE-1

Basics: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure, compressibility and bulk modulus. Concept of continuum, types of fluids etc, pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, Absolute, gauge, atmospheric and vacuum pressures pressure measurement by simple, differential manometers and mechanical gauges.

Fluid Statics: Total pressure and centre of pressure for horizontal plane, vertical plane surface and inclined plane surface submerged in static fluid

MODULE-2

Fluid Kinematics: Types of Flow-steady, unsteady, uniform, non-uniform, laminar, turbulent, one, two and three dimensional, compressible, incompressible, rotational, irrotational, streamlines, path lines, streak lines, velocity components, convective and local acceleration, velocity potential, stream function, continuity equation in Cartesian co-ordinates. Rotation, vorticity and circulation, Laplace equation in

velocity potential and Poisson equation in stream function, flow net, Problems. Laminar and Turbulent flow: Flow through circular pipe, between parallel plates, Power absorbed in viscous flow in bearings, Poiseuille equation.

MODULE-3

Fluid Dynamics: Momentum equation impacts of jets- force on fixed and moving vanes, flat and curved. Numericals.Euler's equation, Integration of Euler's equation to obtain Bernoulli's equation, 2 Bernoulli's theorem, Application of Bernoulli's theorem such as venture meter, orifice meter, rectangular and triangular notch, pitot tube, orifices etc., related numerical.

Loss of head due to friction in pipes, Major and minor losses, pipes in series and parallel

MODULE-4

Flow over bodies: Development of boundary layer, Lift and Drag, Flow around circular cylinders, spheres, aerofoils and flat plates, Streamlined and bluff bodies, boundary layer separation and its control.

Dimensional Analysis: Derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh method, Buckingham Pi-theorem, dimensionless numbers, similitude, types of similitude

MODULE-5

Compressible flows: Speed of sound, adiabatic and isentropic steady flow, Isentropic flow with area change stagnation and sonic properties, normal and oblique shocks, flow through nozzles.

Introduction to

CFD: Necessity, limitations, philosophy behind CFD, applications.

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Determine the viscosity of oil using Red wood viscometer and Say-bolt viscometer. **Can be Demo experiments for CIE**
2	Measurement of pressure using different Manometers for high and low pressure measurements (manometers using different manometric fluids).
3	Working principle of different flow meters and their calibration (orifice plate, venture meter, turbine, Rota meter, electromagnetic flow meter) **Can be Demo experiments for CIE**
4	Determination of head loss in pipes and pipe fittings having different diameters, different materials and different roughness
5	Reynolds apparatus to measure critical Reynolds number for pipe flows
6	Effect of change in cross section and application of the Bernoulli equation
7	Impact of jet on flat and curved plates
8	Measurement of coefficient of pressure distribution on a cylinder at different Reynolds Numbers
9	Effect of change in cross section and application of the Bernoulli equation
10	Working principle of different flow meters for open channel and their calibration
11	Determination of drag and lift co-efficients of standard objects using wind tunnel. **Can be Demo experiments for CIE**
12	Use any CFD package to study the flow over aerofoil/cylinder **Can be Demo experiments for CIE**

Course outcomes (Course Skill Set): At the end of the course, the student will be able to:

CO1: Identify and calculate the key fluid properties used in the analysis of fluid behaviour.

CO2: Understand and apply the principles of pressure, buoyancy and floatation and knowledge of fluid kinematics.

CO3: Apply the knowledge of fluid dynamics while addressing problems of mechanical and chemical engineering.

CO4: Understand the concept of boundary layer in fluid flow and apply dimensional analysis to form dimensionless numbers in terms of input output variables.

CO5: Understand the basic concept of compressible flow and CFD

CO 6: Conduct basic experiments of fluid mechanics and understand the experimental uncertainties.

Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

• IPCC means practical portion integrated with the theory of the course.

• CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.

• 25 marks for the theory component are split into 15 marks for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and 10 marks for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

• Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).

• The student must secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

• 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.

• On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.

• The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.

• The laboratory test (duration 02/03 hours) after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.

• Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.

• The student must secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC Theory SEE will be conducted by University as per the scheduled timetable, with

common question papers for the course (duration 03 hours
The question paper will have ten questions. Each question is set for 20 marks.
• There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
• The students must answer 5 full questions, selecting one full question from each module.
• Marks scored by the student shall be proportionally scaled down to 50 Marks
The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component

Suggested Learning Resources: Books •
Fox, R. W., Pitchard, P.J.,and McDonald, A. T., (2010), Introduction to Fluid Mechanics, 7thEdition, John Wiley & Sons Inc.
• Cimbala, J.M., Cengel, Y. A. (2010), Fluid Mechanics: Fundamentals and Applications, McGraw-Hill
• Frank M White., (2016), Fluid Mechanics, 8thEdition, McGraw-Hill Additional References:
• A textbook of Fluid Mechanics and Hydraulic Machines, Dr. R K Bansal, Laxmi publishers
• Fundamentals of Fluid Mechanics, Munson, Young, Okiishi&Hebsch, John Wiley Publications, 7th Edition
Web links and Video Lectures (e-Resources):
• Nptel.ac.in
• VTU, E- learning
• MOOCS
• Open courseware
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
• Industrial visits
• Course seminar
• Term project

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Subject Code: BME403	**TITLE; Fluid mechanics**	**Faculty Name: Dr. Srinivasa.K**

List of Course Outcomes	**Program Outcomes**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	
CO-1	3	3	-	-	-	-	-	-	-	-	-	-	
CO-2	3	3	-	2	-	-	-	-	-	-	-	-	
CO-3	3	3	2	-	-	-	-	-	-	-	-	-	
CO-4	3	3	2	-	2	-	-	-	-	-	-	-	
CO-5	3	3	-	2	2	-	-	-	-	-	-	-	
CO-6	3	3	2	2	-	-	-	2	-	-	-	1	
Program Specific Outcomes (PSOs)													
	PSO1						**PSO2**						

CO-1	**2**	**-**	
CO-2	**2**	**-**	
CO-3	**2**	**1**	
CO-4	**2**	**1**	
CO-5	**2**	**-**	
CO-6	**2**	**-**	

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution - = No Contribution