THERMODYNAMICS & FLUID MECHANICS		Semester	IV
Course Code	BAG401	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination nature (SEE)	Theory		

Course objectives:
The course will enable the students to

- Acquire a basic understanding of properties of fluids and the measurement of pressure and fluid kinematics.
- Acquire a basic understanding of fundamentals fluid dynamics, and Benoulli's equation and flow meters.
- Acquire the basic concepts of flow through pipes and losses in pipe flows.
- Understand the basic concepts of flow over bodies and usefulness of dimensionless analysis.
- Acquire the fundamentals of compressible flow and the basic knowledge of working of CFD packages.
- Acquire the knowledge of simple fluid mechanics experimental setups and carry out the necessary analysis
  of these experiments
- Acquire knowledge experimental errors and the ability to estimate the experimental uncertainties.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different type of teaching methods to develop the outcomes through Power-Point Presentation and Video demonstration or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information.
6. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module-1

Basic Concepts: Definitions of system, boundary, surrounding control volume. Types of thermodynamic systems, Properties of system, definitions for properties like pressure, volume, temperature, enthalpy, internal energy, density, with their units. State, Property, Process and Cycle, Quasi Static Process, Thermodynamic Equilibrium.
Work & Heat Transfer: Work transfer, Types of work transfers, Point and Path Functions, Heat transfer, Comparison of Work and Heat transfers.
Zeroth Law of Thermodynamics: Zeroth Law of Thermodynamics. Heat and temperature - concept of thermal equilibrium.

Module-2

First Law of Thermodynamics: First law of thermodynamics- simple problems on heat and work conversions in process and cycle. Limitations of First law of thermodynamics.
Second Law of Thermodynamics: Heat Engine, Refrigeration and Heat Pump. Statements of Second law and their equivalence, Reversibility and Irreversibility, availability and unavailability – concept of change in entropy.

Module-3

Introduction: Definition and properties, types of fluids, fluid pressure at a point in static fluid, variation of pressure, Pascals Law, (To be reviewed in class but not for examination)
Pressure- absolute, gauge, vacuum, pressure measurement by manometers and gauges, hydrostatic pressure on vertical plane surface submerged in liquid. Buoyance, centre of buoyancy and metacentre, Stability of

submerged body.

Fluid Kinematics: Introduction, methods of describing fluid motion, types of fluid flow. Continuity equation (simple problems), velocity and acceleration of fluid particle (simple problems), streamlines, pathlines and streaklines, strain rate, vorticity, velocity potencial function and stream function relation between stream function and velocity potential function and simple problems, Types of motion.

Module-4

Fluid Dynamics: Introduction, Forces acting on fluid in motion. The momentum equation, Moment of momentum equation, Euler's equation of motion along a streamline. Bernoulli's equation - assumptions and limitations (simple problems).

Fluid flow measurement: Venturimeters, orificemeters, pitot tube, rectangular and triangular notches and weirs (simple problems)

Viscous flow: Types of flow, Reynolds Experiments, Laminar flow through circular pipe, laminar flow between two parallel stationary plates, power absorbed in viscous flow in bearings (simple problems), Poiseuilli equcation for loss of head due to friction in pipes.

Module-5

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.

Compressible flows: Introduction, Thermodynamics realtions, Basic equcations of compressible flow, velocity sound or pressure wave in a fluid, match number

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. Understand the basic principles of fluid mechanics and fluid kinematics
2. Acquire the basic knowledge of fluid dynamics and flow measuring instruments
3. Understand the nature of flow and flow over bodies and the dimensionless analysis
4. Acquire the compressible flow fundamental and basics of CFD packages and the need for CFD analysis.
5. 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 total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. 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.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Fox, R. W., Pitchard,P. J.,and McDonald, A. T., (2010), Introduction to Fluid Mechanics, 7thEdition, John Wiley & Sons Inc.
2. Cimbala, J.M., Cengel, Y. A. (2010),Fluid Mechanics: Fundamentals and Applications, McGraw-Hill
3. Frank M White., (2016), Fluid Mechanics, 8thEdition , McGraw-Hill

Additional References:

1. A text book of Fluid Mechanics and Hydraulic Machines, Dr. R K Bansal, Laxmi publishers
2. Fundamentals of Fluid Mechanics, Munson, Young, Okiishi & Hebsch, John Wiley Publicationss, 7th Edition

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-me22/
2. https://ocw.mit.edu/search/ocwsearch.htm?q=fluid%20mechanics
3. https://directory.doabooks.org/discover?query=Fluid+Mechanics&locale-attribute=en
4. http://elearning.vtu.ac.in/econtent/courses/video/CV/10CV35.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars

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