# NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

## *COURSE PLAN*

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|---|---|---|---|
| Course Title | THERMO DYNAMICS AND FLUID MECHANICS | | |
| Course Code | CE 283 | No. of Credits | 4 |
| Department | CHEMICAL ENGINEERING | Faculty | Dr.A.SUBATHIRA |
| Pre-requisites Course Code | ____ | | |
| Course Coordinator | Nil | | |
| Course Teacher-E-mail | asubathira@nitt.edu | Telephone No. | 9043169644 |
| Course Type | Core course | | |

### COURSE OVERVIEW

**Thermodynamics** is the branch of physics that deals with the relationships between heat and other forms of energy. In particular, it describes how thermal energy is converted to and from other forms of energy and how it affects matter. **Fluid mechanics** is the branch of physics which involves the study of fluids (liquids, gases, and plasmas) and the forces on them. Fluid mechanics can be divided into fluid statics, the study of fluids at rest; and fluid dynamics, the study of the effect of forces on fluid motion. In simpler words, fluid mechanics is the application of the laws of force and motion to fluids

### COURSE OBJECTIVES

1.To develop the understanding about the principles of work and energy,appreciation of the design principles in thermo-fluid systems,analysis of existing thermo-fluid systems and contribution of these concepts to new designs.

2.Explain the physical properties of a fluid and the consequenceof such properties on fluid flow.

3.State the conservation principles of mass,line of momentum and energy for fluid flow.

4.Determine the basic forces and moments acting on simple profiles and shapes in an inviscid,steady flow.

| Course Outcomes | Aligned Programme Outcomes (PO) |
|---|---|
| **1.** The ability to develop and understand thermodynamic behavior of continuum by applying conservation laws to fixed control volumes and use of empirical models is also performed. | PO1 |
| **2.** The ability to properly structure an analysis strategy and apply physical laws to various situations of interest in engineering | PO5, PO7 |
| **3.** The ability to understand how standard instrumentation, refrigeration and energy generation hardware functions. | PO6 |
| **4.** Construct solutions to fluid dynamics problems applicable to their research using methods from the fluids literature. | PO10, PO11 |
| **5.** List and explain the assumptions behind the classical equations of fluid dynamics and students will learn to Categorize solutions to fluids problems by their fundamental assumptions. | PO09, PO12 |

**COURSE TEACHING AND LEARNING ACTIVITIES**

| Sl. No | Week | Topic | Mode of Delivery |
|---|---|---|---|
| 1 | 1st week | Classification of fluids and their physical properties, Fluid statics | Chalk and board |
| 2 | 2nd week | Dimensional analysis – Rayleigh's method – Buckinghan Theorem and its applications. | Chalk and board<br>Analysing all real physical phenomena by this methods |
| 3 | 3rd week | Ideal fluid – velocity field – stream line, streak line and path line, continuity equation – Rotational and irrotational motion, stream function and potential function. | Chalk and board, Tutorial problems |
| 4 | 4th week | Euler's equations of motion, Bernoulli's equation and its application. Classification of open channel flows – measurement of discharge using | Chalk and board<br>Visit to FM lab |

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| | | rectangular and V notches. | |
| 5 | 5TH week | Laminar flow – Losses – Hagen-Poiseuille equation - Turbulent pipe flow | Chalk and board, Tutorial problems |
| 6 | 6TH WEEK | Centrifugal pumps, reciprocating pumps, Hydraulic ram, Impulse turbine, reaction turbine. | Lecture, Power point presentation and visit to labs having that facility |
| 7 | 7 TH WEEK | Thermodynamic equilibrium, quasi-static process, zeroth law, work and heat interactions, first law for a cycle and a process, steady flow processes | Lecture, Power point Presentation |
| 8 | 8TH WEEK | Second law statements, reversibility, Carnot theorem, Clausius inequality, entropy principle | Lecture, Power point Presentation, tutorial problems |
| 9 | 9TH WEEK | Availability and irreversibility, properties of pure substances, phase equilibrium diagrams | Lecture, Power point Presentation, tutorial problems |
| 10 | 10 TH WEEK | Rankine cycle, reheat and regenerative cycle, properties of ideal gas, Stirling and Ericson cycles. | Chalk and Talk, Small illustrations |
| 11 | 11 TH WEEK | Otto, diesel and dual cycles, Brayton cycle with regeneration, inter cooling and reheat, Joule-Thompson effect | Lecture and power point presentation |

**COURSE ASSESSMENT METHODS**

| Sl.No. | Mode of Assessment | Week/Date | Duration | % Weightage |
|---|---|---|---|---|
| 1 | Assignment - I | After 4th week | Two days | 5 |
| 2 | Cycle Test -I | After 4th week | 1 hr | 20 |
| 3 | Assignment - II | After 7th week | Two days | 5 |
| 4 | Cycle Test - II | After 8th week | 1 hr | 20 |
| 6 | End Semester | After 10th week | 3 hrs | 50 |

**ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc**

**Text Books:**

1. Zemansky, "*Heat and Thermodynamics*" 7th edition, McGraw Hill, New York, 1997.
2. Streeter V.L. and Wylie E.B., "*Fluid Mechanics*", 9th edition, McGraw Hill, New York, 1997 ISBN 0070625379.

**Reference Books:**

1. Van Wylen, G.A., et al, "*Fundamentals of classical Thermodynamics*", 4thEdition, John Wiley & Sons, 1994.
2. Cengal, Y.A., Bogles, M.A., Micheal Boles, "*Thermodynamics*", 2ndedition, McGraw Hill Book Company, 1994.
3. Nag P.K., "*Engineering Thermodynamics*", 2nd Edition, Tata McGraw Hill, 1995.
4. ShamesI.H, "*Mechanics of Fluids*", Third Edition, McGraw Hill, New York, 1992

**COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)**

First feedback collected from all the students in the middle of the course.

Second feedback collected at the end of the course

**COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)**

Test and assignments should not be copied one. Novelty and their uniqueness may be shown in the examinations and assignments.

If attendance shortage arises in between the semester due to genuine and valid reasons, the student can take up extra classes by convincing the faculty.

**ADDITIONAL COURSE INFORMATION**

Queries may also be emailed to the Course faculty directly at asubathira@nitt.edu

**FOR SENATE'S CONSIDERATION**

**Course Faculty** Subathra 28/8/15

**CC-Chairperson** Goldin R. Bennet 28.8.15. **HOD** 28/8/15