| Course Code | Course Name | Credits |
|---|---|---|
| **MTC403** | **Thermal and Fluid Engineering** | **03** |

**Prerequisite:**FEC102 Engineering Physics-I, FEC202 Engineering Physics-II, FEC104 Engineering Mechanics

**Objectives**

1. Study of basic concepts and laws of thermodynamics.
2. To study the properties of the fluids.
3. To study the transport of mass, momentum and energy.
4. Study of modes of heat transfer and governing laws.
5. Study and analysis of Boilers, turbines and heat exchangers

**Outcomes:** Learner will be able to…

1. Demonstrate understanding of basic concepts of thermodynamics.
2. Illustrate the physical properties and characteristic behavior of fluids.
3. Illustrate dimensional analysis for model and similitudes.
4. Identify & explain the three modes of heat transfer (conduction, convection and radiation) with mathematical model
5. Design and analyze different heat exchangers
6. Demonstrate basic understanding of turbines and IC engines.

| Module | Detailed Contents | Hrs. |
|---|---|---|
| 01 | **Thermodynamics:** Systems and control volumes, Properties of system, Continuum, State and equilibrium, Processes and cycles, Temperature and Zeroth law of thermodynamics, Heat and thermodynamic concept of work. The first & second laws of thermodynamics. Thermal energy reservoirs, concept of heat engine, refrigerator, heat pump and perpetual motion machines. Concept of entropy, Principle of Increase of entropy. | 6 |
| 02 | **Fluid Mechanics I:** Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Continuum models, characteristics of fluids. Fluid Statics, hydrostatic pressure, forces on submerged surfaces. Buoyancy and stability of floating bodies. Flow Kinematics, Types of flow, Flow field, velocity, acceleration, stream function, vorticity. Incompressible inviscid flow, Euler's and Bernoulli's equation. Flow in conduits and pipes | 6 |
| 03 | **Fluid Mechanics II:** Incompressible viscous flow, fully developed flow in pipes, head loss, major and minor losses, Flow measurement, pipeline networks. Boundary layers and flow over objects. Introduction to Compressible Flow - speed of sound, stagnation properties, Steady state-one-dimensional compressible flow - basic equations for isentropic flow, adiabatic flow with friction. Dimensional analysis and similitude. | 8 |
| **04** | **Heat Transfer I:**Introduction, Conduction: Fourier's Law, One dimensional heat transfer with and without heat generation, Transient conduction, Through Composite walls. Extended Surfaces: Heat transfer from finned surfaces, Fin Efficiency, Effectiveness. | 6 |

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| **05** | **Heat Transfer II :**Convection: Free and forced convection, Flow and thermal boundary layer equations, laminar flow through circular pipe, constant heat flux and constant wall temperature conditions, Overall heat transfer coefficient. Heat exchangers, Thermal Radiation: Radiation properties, Plank's Law, Kirchoff's law, Heat exchange between, two surfaces. | 7 |
| **06** | **Thermo-fluid Machines:**<br><br>Steam boilers and their classification, Mountings and accessories, Layout of a modern HP boiler, Boiler performance, Boiler efficiency Properties of steam like dryness fraction; enthalpy; internal energy and entropy, Steam table and Mollier Diagram, Steam turbines, Impulse turbines, Reaction turbines, velocity diagram, degree of reaction, compounding of steam turbines, IC engines, Air standard cycles, Carnot, Otto, diesel, dual cycles and their comparison, Two stroke and Four stroke engines, CI and SI engines. | 6 |
| **Self-study Topic** | Hydro turbines: Pelton wheel, Francis turbine and Kaplan turbine.<br>Gas Turbines Ideal and actual Brayton cycle. | **--** |

**Assessment:**

**Internal Assessment for 20 marks:** Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub- questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.( e.g. Suppose Q.2 has part (a) from module3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in thesyllabus.

**Text Books:**


1. Frank M. White, "Fluid Mechanics", MGH
2. Fox and McDonald, "Introduction to Fluid Mechanics", Wiley
3. F. P. Incropera and D.P. Dewitt, "Fundamentals of Heat and Mass Transfer", Wiley
4. M. N. Ozisik, "Heat Transfer: A Basic Approach", MGH


**References:**


1. Introduction to Thermodynamics and Heat Transfer, YunusCengel, 2 nded, McGraw-Hill
2. Fundamentals of Thermodynamics, Sonntag, Borgnakke, Van Wylen, Wiley India Pvt. Ltd.
3. Applied Thermodynamics, Onkar Singh, 3 rded, New Age International
4. Basic Engineering Thermodynamics, Rayner Joel, Longman Publishers
5. Basic Engineering Thermodynamics, Zemanski and Van ness, TMH