	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2018**
Department	**Mechanical Engineering**	Semester	**III**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
ME 203	**Engineering Thermodynamics**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To understand basic thermodynamic principles and laws	Course Outcomes	CO1	Able to understand the basic concept of thermodynamics such as system, surrounding, state, process, cycle, thermodynamic equilibrium, property diagrams and application of knowledge in the measurement of temperature and solving engineering problems.
			CO2	Able to identify the properties of pure substances using property table, p-v-t relations and apply the knowledge in formulation and solution of problem-related to energy transfer.
	To develop the skills to analyze and design thermodynamic systems		CO3	Able to apply the first law of thermodynamics to cyclic process and non-flow process undergone by closed systems.
			CO4	Able to apply the first law of thermodynamics to the open system using the control volume technique.
			CO5	Able to apply the second law of thermodynamics in analyzing the thermal efficiencies of heat engines and cop of refrigerator and heat pumps with reference to the reversible systems.
			CO6	Able to evaluate the entropy change in a wide range of processes and to determine the extent of irreversibility of process including the thermodynamic relations.

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**
2	CO2	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
3	CO3	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
4	CO4	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
5	CO5	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**
6	CO6	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SYLLABUS

No.	Content	Hours	COs
I	**Fundamental Concepts & Definitions**: Thermodynamic definition and scope, Microscopic and Macroscopic approaches, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe, Thermodynamic properties, Thermodynamic Process, Cycle, intensive & extensive properties, specific properties, Thermodynamic state, path and process, Thermodynamic Equilibrium, quasi- static process, cyclic and non-cyclic; processes, Property diagram, Point and Path function, Exact and inexact differential, Zeroth Lawof Thermodynamics, Measurement of Temperature, Thermometry, reference Points, Temperature Scales, Ideal gas temperature scale, Comparison of thermometers- Gas Thermometers, Thermocouple, Resistance thermometer	**06**	**CO1**
II	**Pure Substances:** Phase Transformations, T-v, P-v and P-T diagrams, Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapour and superheated vapour states of pure substance with water as example, triple point and critical points. .Enthalpy of change of phase (Latent heat), Dryness fraction (quality), Property and steam tables. Property calculations using steam tables, representation of various processes on T-v , P-v diagrams .Steam tables **Ideal and Real gases:** The ideal Gas Equation, Characteristic and Universal Gas constants, Mixtures of ideal Gases – Mole Fraction, Mass fraction,Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat's Laws of additive volumes, Deviations from idealGas Model: Equation of state of real substances, Vander Waals Equation of State, Law of corresponding states, compressibility factor, compressibility chart. Difference between Ideal and real gases. **Work and Heat:** Thermodynamic definition of work; examples, sign convention. Displacement work, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work, free expansion work, Heat; definition, units and sign convention	**09**	**CO2**
III	**The first law of Thermodynamics:** Joule's experiments, equivalence of heat and work. Statement of the First law of thermodynamics, PMM1, Application of the First law to non-flow processes, internal energy, enthalpy, Application of first law to control volume; steady flow energy equation(SFEE), Important applications (nozzles, diffuser, turbine, compressor, pump, heat exchanger). Transient flow –Filling and Emptying Process.	**07**	**CO3** **CO4**
IV	**Second Law of Thermodynamics:** Limitations of first law of thermodynamics, Necessity of 2nd law of thermodynamics, Thermal Reservoir, Heat Engine, Heat pump, Refrigerator ,schematic representation, Kelvin-Planck and Clausius Statements, Performance factors(efficiency , coefficients of performance),Reversible Process, Irreversible Process, Reversibility, Cause of irreversibility, internal and external irreversibility reversible/ Carnot heat engines/ refrigerators/heat pump, Corollaries of second law, PMM2,Absolute Thermodynamic Temperature scale.	**07**	**CO5**

V	**Entropy:** Clausius Inequality, Entropy- Causes of Entropy Change, Entropy changes in various thermodynamic processes, the principle of increase of entropy and its applications, Entropy generation in open and closed system, Entropy and Disorder, Reversible adiabatic process- isentropic process, T-s, H-s diagram of pure substance **General Thermodynamic Relations** Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations, Tds Equations. The Clapeyron equation, Equations for internal energy, enthalpy and entropy, specific heats, Throttling process, Joule Thomson Coefficient, inversion curve**.**	**07**	**CO6**
Total Hours		**38**	

Essential Readings

1. Y. Cengel and M. Boles, "Thermodynamics- An Engineering Approach", McGraw Hill Education; Eighth Edition, 2017

2. R. E. Sonntag and C. Borgnakke, "Introduction to Engineering Thermodynamics", John Wiley & Sons, Second Edition, 2006.

Supplementary Readings

1. Moran, Shapiro, Boettner and Bailey "Principles of Engineering Thermodynamics", Wiley, Eighth Edition, 2015.

Property Tables/ Databook

1. K K Ramalingam "Steam Tables & Mollier Diagram (SI units)" SciTech publications (India) Pvt.Ltd.(2013)

2. C.P. Kothandarman, "Refrigerant Tables and Charts including Air Conditioning Data" New Age International; Fifth edition (2018)