BMEE203L	Engineering Thermodynamics	L	T	P	C
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Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives

1. To apply the laws of thermodynamics and describe their significance.
2. To provide fundamental knowledge of ideal and real gases.
3. To analyse vapour, gas power cycles and determining properties of gas mixtures.
4. To establish the relationship between commonly measurable properties and the properties that cannot be measured directly.

Course Outcome

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

1. Demonstrate the understanding of basic thermodynamics concepts such as systems, forms of energy - work and heat, temperature.
2. Analyse the properties of pure substances, ideal and real gases.
3. Apply the first law of thermodynamics for closed and open systems.
4. Apply the second law of thermodynamics and entropy principles for engineering systems.
5. Analyse the performance of vapour and gas power cycles.
6. Evaluate the mixture properties using gas laws.
7. Assess the substance properties using thermodynamic relations.

Module:1	**Introduction and basic concepts of thermodynamics**	**4 hours**

Systems and control volume, properties of a system, state and equilibrium, quasi-static equilibrium, processes and cycles, forms of energy, pressure, work and heat transfer, temperature and the Zeroth law of thermodynamics.

Module:2	**Properties of pure substances**	**6 hours**

Phases of a pure substance, phase change process of pure substances, property diagrams for phase change processes, vapour property tables, Ideal gas equation of state, real gases-Van der Waals equation of state, compressibility factor, Benedict-Webb Rubin equation.

Module:3	**The first law of thermodynamics**	**8 hours**

Energy analysis of closed and open systems, energy analysis of steady flow devices-boiler, turbine, heat exchangers, pumps and nozzles, energy analysis of unsteady flow processes, limitations of the first law of thermodynamics.

Module:4	**The second law of thermodynamics**	**8 hours**

Thermal energy reservoirs, heat engines, heat pumps and refrigerators, Kelvin-Planck and Clausius statement and their equivalence, reversible and irreversible processes, Carnot cycle, Carnot principles, thermodynamic temperature scale, Entropy, Clausius-inequality, TdS equations, entropy change, entropy balance, the increase of entropy principles, Exergy-availability and irreversibility.

Module:5	**Vapour and gas power cycles**	**9 hours**

Carnot vapour power cycle, Ideal Rankine cycle, ideal re-heat Rankine cycle, ideal regenerative Rankine cycle, the effect of isentropic efficiencies, Air standard assumptions, Otto, Diesel cycle, Brayton, Stirling cycle and Ericsson cycles.

Module:6	**Gas mixtures**	**4 hours**

Composition of the gas mixture, mole and mass fractions, Dalton's law, Amagat's law, properties of gas mixtures.

Module:7	**Thermodynamic property relations**	**4 hours**

Maxwell relations, Clapeyron equation, General equations for du, dh, ds, Cv and Cp, Joule-Thomson coefficient.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Books

1.	Yunus A. Cengel, Michael A. Boles and Mehmet Kanoglu, Thermodynamics: An Engineering Approach, 2019, 9th Edition, McGraw Hill Education.		
Reference Books			
1.	Michael J Moran, Howard N Shapiro, Daisie D. Boettner and Margaret B. Bailey Fundamentals of Engineering Thermodynamics, 2015, 8th Edition, Wiley.		
2.	Nag P. K., Engineering Thermodynamics, 2017, 6th Edition, McGraw Hill Education.		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT.			
Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022