SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology

Bachelor of Technology

Mechanical Engineering
B. Tech. Semester IV

Course Name: **Thermodynamics and Heat Transfer** **Course Code: BTME19453**

Type of course: **MINOR – AES (Alternate Energy Systems) - 1**
Prerequisite: Basic Mechanical Engineering
Rational of course: This course is essential to understand the thermal engineering. Students will acquire the knowledge of fundamental of thermodynamics and heat transfer, application of laws for various practical engineering problems and analyze the gas, vapor and refrigeration cycles for evaluating the performance of the system.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
4	0	2	5	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Basic Concepts of Thermodynamics:** Thermodynamics and its importance, macroscopic, microscopic viewpoint, thermodynamic system, control volume, thermodynamics properties, processes, cycles, Homogeneous system, heterogeneous system, thermodynamic equilibrium, quasi-static process, pure substance, concept of continuum, zeroth law of thermodynamics, temperature and different scales, point function and path function, work transfer, heat transfer, , and processes like isobaric, isochoric, isothermal, polytropic process	6	13%
2.	**First and Second law of Thermodynamics:** **First law of Thermodynamics:** First law for a closed system undergoing a cycle and change of state, energy, PMM1, first law of thermodynamics for steady flow process, steady flow energy equation applied to nozzle, diffuser, boiler, turbine, compressor, pump, heat exchanger and throttling process, filling and emptying process limitations of first law of thermodynamics	9	20%

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	Second law of Thermodynamics: Kelvin- Planck and Clausius statements of second law and their equivalence, PMM2, reversibility, irreversibility, causes of irreversibility, Carnot theorem, corollary of Carnot theorem, absolute thermodynamic temperature scale		
3.	**Entropy and Exergy:** Clausius theorem, property of entropy, inequality of Clausius, entropy change in an irreversible process, entropy principle, entropy change for non-flow and flow processes, exergy of a heat input in a cycle, exergy destruction in heat transfer process, exergy of finite heat capacity body, irreversibility and Gouy-Stodola theorem and its applications, exergy of closed and steady flow system, second law efficiency	**9**	**20%**
4.	**Properties of gases and gas mixtures:** Avogadro's law, equation of state, ideal gas equation, Vander Waal's equation, reduced properties, law of corresponding states, compressibility chart, internal energy; enthalpy and specific heat of a gas mixtures	**6**	**13%**
5.	**Thermodynamics cycles:** Carnot cycle, Otto cycle, Diesel cycle, Brayton cycle, Rankine cycle, vapour compression refrigeration cycle	**6**	**14%**
6.	**Heat Transfer:** Introduction, conduction heat transfer, Fourier's law, thermal resistance, convection heat transfer, natural & force convection, Newton's law of cooling, radiation heat transfer, absorptivity, reflectivity, transmissivity, emissivity, Kirchhoff's law, Stefan-Boltzmann law, Planck's law, emissive power	**9**	**20%**

Percentage Distribution of Marks as per Bloom's Taxonomy (Theory/Practical):

Percentage Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**35**	**20**	**20**	**10**	**--**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary from above table.

Reference Books:

Sr. No.	Title of book /article	Author(s)	Publisher	Publication Year	Publication Edition
1.	Engineering Thermodynamics	P.K. Nag	McGraw-Hill Education, Noida	2017	6th
2.	Fundamentals of Thermodynamics	Borgnakke & Sonntag	Wiley India (P) Ltd., Noida	2020	--
3.	Thermodynamics – An Engineering Approach	Yunus Cengel & Boles	McGraw-Hill Education, Noida	2019	9th
4.	Engineering Thermodynamics: Work and Heat Transfer	Gordon Rogers and Yon Mayhew	Pearson Education Ltd., Noida	2002	4th
5.	CRC Handbook of Thermal Engineering	Frank Krieth	CRC Press	1999	1st

Course Outcomes (CO):

Sr. No.	CO Statements After learning this subject, students will be able to	Marks % weightage
CO-1	Describe the basic concepts of thermodynamics.	13
CO-2	Apply first and second law of thermodynamics for closed and open systems undergoing different thermodynamic processes.	20
CO-3	Apply the concept of entropy and exergy to different thermodynamic process.	20
CO-4	Explain the different properties of gas and gas mixture.	13
CO-5	Analyze and Evaluate the performance of thermodynamic cycles.	14
CO-6	Discuss the different mode of heat transfer.	20

Mapping of (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	2	2	2	2	2	1	0	1	0	0	1			
CO-2	3	3	3	3	2	2	2	0	1	1	1	1			
CO-3	3	3	3	3	2	2	2	0	1	1	1	1			
CO-4	3	3	3	3	2	2	2	0	1	0	0	1			
CO-5	3	3	3	3	2	2	3	1	1	1	2	1			
CO-6	3	3	3	3	2	2	2	0	1	1	1	1			
Rationale*	**15**	**14**	**14**	**14**	**10**	**10**	**10**	**1**	**5**	**3**	**4**	**5**			

*** Rationale - Mapping of CO's with PO's:** According to the above CO-PO mapping, this course will help to understand the fundamental of thermodynamics and heat transfer, applying the laws of thermodynamics, analyse and interpret the basic concept and different cycles. Students will able to design, analysis and interpret the different thermodynamic systems for the industries.

List of Practical:

1. To understand the various applications of steady flow energy equation (SFEE).
2. To verify First and Second Law using Internal Combustion Engine.
3. To verify First and Second Law using Mechanical Heat Pump.
4. To compare the Otto, Diesel and Dual cycles.
5. To study the effects of different variables on the performance of Rankine cycle.
6. To determine the thermal conductivity of given metal rod.
7. To determine heat transfer co-efficient by forced convection.
8. To determine heat transfer co-efficient by natural convection.

Major Equipment:

Mechanical heat pump and refrigeration unit, internal combustion engine, heat exchanger

List of Open Source/learning website:

1. https://onlinecourses.nptel.ac.in/noc20_me51/preview
2. https://onlinecourses.swayam2.ac.in/nou22_me01/preview