SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology

Bachelor of Technology

Mechanical Engineering
B. Tech. Semester III

Course Name: Engineering Thermodynamics **Course Code: BTME13303**

Type of course: **Professional Core Courses (PCC)**
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, 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
3	0	2	4	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 and microscopic view point, concept of continuum, thermodynamic system, surrounding and boundary, control volume approach and systems approach, equilibrium pure substance, property – intensive and extensive, state, path, process and cycle. point function and path function, quasi static process and processes like isobaric, isochoric, isothermal, polytropic process, temperature and different scales, Zeroth law of thermodynamics	5	10%
2.	**First and Second 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, Kelvin- Planck and Clausius statements and their equivalence, PMM2, causes of irreversibility, Carnot theorem, corollary of Carnot theorem, thermodynamic temperature scale	9	20%

Sr. No.	Topics	Teaching Hrs.	Module Weightage
3.	**Entropy & Exergy:** Clausius theorem, property of entropy, inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, 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, exergy of closed and steady flow system, irreversibility and Gouy-Stodola theorem and its applications, 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, Gibbs-Dalton law, internal energy; enthalpy and specific heat of a gas mixtures	5	10%
5.	**Gas Power cycles:** Recapitulation of Carnot, Otto and Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, air standard efficiency, mean effective pressure, brake thermal efficiency, relative efficiency, Brayton cycle, effect of reheat, regeneration, intercooling and turbine and compressor efficiency on Brayton cycle	8	20%
6.	**Vapor Power cycles:** Carnot vapor cycle, Rankine cycle, comparison of Carnot and Rankine cycle, calculation of cycle efficiencies, variables affecting efficiency of Rankine cycle, reheat cycle, regenerative cycle, reheat-regenerative cycle, feed-water heaters **Refrigeration cycles:** Refrigeration by Non-Cyclic Processes, Reversed Heat Engine Cycle, Vapour Compression Refrigeration Cycle	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 (ISBNL: 978-9352606429)	2017	6th
2.	Fundamentals of Thermodynamics	Borgnakke & Sonntag	Wiley India (P) Ltd., Noida (ISBN: 978-8126598199)	2020	--
3.	Thermodynamics – An Engineering Approach	Yunus Cengel & Boles	McGraw-Hill Education, Noida (ISBN: 978-9353165741)	2019	9th
4.	Engineering Thermodynamics: Work and Heat Transfer	Gordon Rogers and Yon Mayhew	Pearson Education Ltd., Noida (ISBN: 978-8131702062)	2002	4th
5.	CRC Handbook of Thermal Engineering	Frank Krieth	CRC Press (ISBN: 978-0849395819)	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.	10
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.	10
CO-5	Analyze and Evaluate the performance of thermodynamic cycles.	40

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	3	2	1
CO-2	3	3	3	3	2	2	2	0	1	1	1	1	3	3	2
CO-3	3	3	3	3	2	2	2	0	1	1	1	1	3	3	2
CO-4	3	3	3	3	2	2	2	0	1	0	0	1	3	2	2
CO-5	3	3	3	3	2	2	3	1	1	1	2	1	3	3	2
Rationale*	**15**	**14**	**14**	**14**	**10**	**10**	**10**	**1**	**5**	**3**	**4**	**5**	**15**	**13**	**9**

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

analysis and interpret the different thermodynamic systems for the industries. Students will able to get research based knowledge to solve the various thermal systems.

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 determine the performance of the Vapor Compression Refrigeration (VCR) system and verify the first and second law of thermodynamics.
5. To understand the effect of various operating parameters on performance of the VCR cycle.
6. To determine the heat loss from pipe-in-pipe heat exchanger using SFEE, and verify the entropy principle for the heat exchanger.
7. To compare the Otto, Diesel and Dual cycles.
8. To study the effects of different variables on the performance of Rankine cycle.

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