GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code : BE03000201

Subject Name : Engineering Thermodynamics

w. e. f. Academic Year:	2024-25
Semester:	3
Category of the Course:	PCC

Prerequisite:	Nil
Rationale:	Engineering Thermodynamics is the first course on Thermal Science and Engineering. It studies various energy interactions notably heat and work transfer. It is based on certain laws of nature which are never seen to be violated.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	To identify the unique vocabulary associated with thermodynamics and explain the basic concepts of thermodynamics	Understand
2	To apply first law of thermodynamics for closed and open systems undergoing different thermodynamic processes and evaluate the feasibility of thermodynamic cycles and processes using second law of thermodynamics	Apply
3	To apply the concept of entropy and exergy to different thermodynamic processes and cycles	Apply
4	To make use of different gas and vapor power cycles	Apply

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	TW/SL	TH		ESE (E)	PA (M)	PA/ (I)	TW/ SL (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Basic Concepts:** Microscopic and macroscopic point of view, thermodynamic system and control volume, thermodynamic properties, state of a substance, process and cycle, thermodynamic equilibrium, concept of continuum, quasi- static process, zeroth Law of thermodynamics, temperature scales	04	09
2.	**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 **Second law of thermodynamics:** 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	13	29
3.	**Entropy:** Clausius theorem, property of entropy, Clausius inequality, entropy change in an irreversible process, principle of increase of entropy, entropy change for non-flow and flow processes **Exergy:** 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, Gouy-Stodola theorem and its applications	13	29
4.	**Vapor Power cycles:** Carnot vapor cycle, Rankine cycle, comparison of Carnot and Rankine cycle, cycle analysis using steam tables and Mollier diagram, variables affecting efficiency of Rankine cycle, reheat cycle, regenerative cycle, reheat-regenerative cycle, feed water heaters **Gas Power cycles:** Dual cycle, Comparison of Otto, Diesel and Dual cycles, air standard efficiency, mean effective pressure, brake thermal efficiency, relative efficiency, simple Brayton cycle, open and closed cycle, actual Brayton cycle, optimum pressure ratio for maximum thermal efficiency and work output, work ratio, air rate, effect of operating variables on the thermal efficiency and work output, Brayton cycle with regeneration, reheating and intercooling	15	33
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
-	**30**	**70**	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per

Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education
2. Thermodynamics – An Engineering Approach by Yunus Cengel & Boles, McGraw-Hill Education
3. Fundamentals of Thermodynamics by Borgnakke & Sonntag, Wiley India (P) Ltd.
4. Fundamental of Engineering Thermodynamics by Moran and Shapiro, Wiley India (P) Ltd.
5. Engineering Thermodynamics by Gordon Rogers and Yon Mayhew, Pearson Education Ltd.

(b) Open source software and website:

1. https://onlinecourses.nptel.ac.in/noc23_me76/preview
2. https://archive.nptel.ac.in/courses/112/106/112106310/
3. https://archive.nptel.ac.in/courses/112/105/112105123/
4. https://archive.nptel.ac.in/courses/112/105/112105266/
5. https://archive.nptel.ac.in/courses/112/104/112104113/
6. www.vlab.co.in

Suggested Course Practical List:

1. To understand applications of SFEE.
2. To verify First and Second Law with Mechanical Heat Pump.
3. To verify First and Second Law with I.C. Engine.
4. To determine heat loss from pipe-in-pipe heat exchanger using SFEE and to verify entropy principle for the heat exchanger.
5. To understand applications of entropy principle.
6. To understand applications of Gouy-Stodola theorem.
7. To compare Otto, Diesel and Dual cycles.
8. To study variables affecting the performance of Rankine cycle.
9. To study variables affecting the performance of Brayton cycle.
10. To study Brayton cycle with reheat, regeneration and intercooling.

Students must be given at least 4 assignments targeting applications based on the above course content.

List of Laboratory/Learning Resources Required:

Mechanical Heat Pump, Internal combustion engine, Heat exchanger

- **Activities suggested under self-learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5hrs., Report preparation = 5hrs. Total = 10hrs.	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.

2.	Technical Video based learning related to the subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 4hrs. each. Total = 20hrs.	Based on the correctness of submittedassignment.
4.	Problem solving/Coding using C, C++, MATLAB, Python, SCILAB,modeling and Analysis software or any other software	5 small coding-based assignment of 2hrs. each. Total = 10hrs.	Based on the coding solution submitted.
5.	Self-learning online course	Minimum duration of the course should be 10hrs.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Identification and solution of Complex problem	Maximum 2 problems. Study of the problem and solution finding, Total = 10hrs.	Based on the depth of the solution submitted.
7	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on quiz/report submitted
8	Technical paper reading and summarization of research papers based on relevant subject	5 research papers = 20 hrs.	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 hrs.	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 hrs. Non- working = 8 hrs.	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/sustainability/any other issue	Duration = 15 hrs. for industrial exposure Problem identification and tentative solution = 10 hrs. Total = 20 hrs.	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = Min. 1 hr.per subject. Max. 3 hrs. per subject	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software	Duration = 10 hrs.	Depending on the complexity

	development		of the Application/Software
15.	Research paper publication	Duration = 10 hrs.	Based on submission of proof of publication
16.	Upgradation/Reverse engineering studies of existing equipment of the laboratory	Duration 10 hrs.	Based on the performance of the equipment
17.	Expert lecture/session	Duration 3 hrs. For attending the lecture/session– 2 hrs. and for report writing 1 hr.	Based on the proof of attendance and report submitted
18.	Annotated Video Explanation of Concept/Problem	10h (Preparation + Recording + Submission)	Based on accuracy of explanation, clarity, and presentation style.
19.	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.

Note:

- All the suggested activity should be related to the subject.
- The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- Subject teacher can add the relevant activities other than those listed above, with the consent of head of the department and DQAC.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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