

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT****COURSE CURRICULUM****FUNDAMENTALS OF ENGINEERING THERMODYNAMICS  
(Code : 3330103)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Aeronautical Engineering	3rd Semester

**1. RATIONALE**

Thermodynamics is a science of energy transfer and its effect on physical properties of substances. It is based upon observations of common experiences of energy (mainly heat) transfer. Thermodynamic laws have been formulated based on these experiences. In this course, work and heat transfer with changes in associated properties is studied based on laws of thermodynamics. This course will provide an understanding of the basic principles of thermodynamics which is must for understanding of major fields of aeronautical engineering and technology notably internal combustion engines, gas turbines, air conditioning, refrigeration, gas dynamics, jet propulsion, compressors and energy conversion in different devices.

**2. LIST OF COMPETENCIES**

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the following competencies:

→ **Apply basic concepts, laws and principles of thermodynamics to use and select equipments/devices/engines working on these basics.**

**3. TEACHING AND EXAMINATION SCHEME.**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
04	01	00	05	70	30	20	30	

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.

**4. DETAILED COURSE CONTENTS**

Unit	Major Learning Topics and Sub-topics	Outcomes (in cognitive domain)
<b>UNIT– I INTRODUCTION</b>	<ul style="list-style-type: none"> <li>• Identify a thermodynamic property and use it with appropriate units.</li> <li>• Explain Zeroth law of thermodynamics.</li> </ul>	1.1 Introduction. 1.2 Thermodynamic systems-concept, terminology associated, classification, concept of continuum. 1.3 Thermodynamics properties & their units. 1.4 Concept of energy, heat, work and power- types & simple numerical examples. 1.5 Zeroth law of thermodynamics and its application. 1.6 Name of various Temperature measurement devices/instruments used with related units.
<b>UNIT– II FIRST LAW OF THERMODYNAMICS</b>	<ul style="list-style-type: none"> <li>• Explain first law of thermodynamics.</li> <li>• Apply first law of thermodynamics to real life situations.</li> </ul>	2.1 Joule’s experiment-set up & significance. 2.2 Law of conservation of energy. 2.3 First law of thermodynamics with reference to: i. Closed system. ii. System undergoing a change of state. iii. Open system. 2.4 Energy equation & its application to: i. Non flow process. ii. Open system. iii. Steady flow (Steady flow energy equation –SFEE) 2.5 Limitations of first law of thermodynamics. 2.6 Simple numerical examples based on above.
<b>UNIT– III PROPERTIES OF GASES</b>	<ul style="list-style-type: none"> <li>• Explain various ideal gas laws &amp; thermodynamic processes.</li> <li>• Calculate amount of heat transfer, work transfer &amp; internal energy associated with the process.</li> </ul>	3.1 Various ideal gas laws. 3.2 Characteristic gas equation and Universal gas constant. 3.3 Specific heats & their relationship. 3.4 Different thermodynamic processes, their representation on P-V (Pressure-Volume) and T-s (Temperature-Entropy) diagram. 3.5 Equations for PVT relationship, work transfer, heat transfer internal energy (without derivations). 3.6 Simple numerical examples based on above.

<b>UNIT – IV</b> <b>SECOND LAW OF THERMODYNAMICS</b>	<ul style="list-style-type: none"> <li>Describe second law of Thermodynamics.</li> <li>Apply second law of thermodynamics in real life problems.</li> <li>Appreciate importance of entropy.</li> </ul>	<p>4.1 Concept and real life examples of heat source, heat sink (reservoir), heat engine, heat pump and refrigerator.</p> <p>4.2 Second law of thermodynamics.</p> <ol style="list-style-type: none"> <li>Kelvin-Plank statement</li> <li>Clausius statement.</li> <li>Equivalence of above two statements.</li> <li>Corollary.</li> </ol> <p>4.3 Concept of thermal efficiency and COP (Coefficient of Performance).</p> <p>4.4 Concept, importance and examples of entropy.</p> <p>4.5 Concept of reversibility and irreversibility of thermodynamic processes causes of irreversibility.</p> <p>4.6 Carnot cycle, representation on P-V, T-s diagrams, derivation, examples.</p>
<b>UNIT– V</b> <b>THERMODYNAMIC CYCLES</b>	<ul style="list-style-type: none"> <li>Identify thermodynamic processes in a cycle.</li> <li>Plot various cycles on property diagram</li> <li>Derive expression for efficiency. Solve simple examples of power producing cycle.</li> </ul>	<p>5.1 Concept of air standard efficiency.</p> <p>5.2 Otto, Diesel &amp; Dual Combustion cycle</p> <ol style="list-style-type: none"> <li>Representation on P-V &amp; T-s diagram, derivation for air standard efficiency &amp; simple examples.</li> <li>Limitations, applications &amp; comparison of above cycles based on different parameters.</li> </ol> <p>5.3 Refrigeration cycles: Reversed Carnot cycle, Reversed Brayton cycle:</p> <ol style="list-style-type: none"> <li>Representation on P-V &amp; T-s diagram &amp; expression for COP (without derivation).</li> </ol>

### 5. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY).

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	INTRODUCTION	08	04	03	03	10
II	FIRST LAW OF THERMODYNAMICS	08	03	03	04	10
III	PROPERTIES OF GASES	10	04	06	06	16
IV	SECOND LAW OF THERMODYNAMICS	11	04	07	05	16
V	THERMODYNAMIC CYCLES	11	04	06	08	18
<b>TOTAL</b>		<b>48</b>	<b>19</b>	<b>25</b>	<b>26</b>	<b>70</b>

**Legends:** R = Remember U= Understand; A= Apply and above levels (Bloom's revised taxonomy).

**6. SUGGESTED LIST OF EXERCISES/PRACTICALS/TUTORIALS.**

The tutorial exercises should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the above mentioned competencies.

SR. NO.	UNIT NO.	TUTORIALS / EXPERIMENT
1	I	INTRODUCTION
2	II	FIRST LAW OF THERMODYNAMICS
3	III	PROPERTIES OF GASES
4	IV	SECOND LAW OF THERMODYNAMICS
5	V	THERMODYNAMIC CYCLES

**7. SUGGESTED LIST OF STUDENT ACTIVITIES.**

Following is the list of proposed student activities like:

**SR.NO. ACTIVITY**

- 1 Identify and list real situations which works on:
  - a: Zeroth law.
  - b: First law of thermodynamics.
  - c: Second law of thermodynamics.
- 2 Prepare charts of diesel, dual and gasoline cycles. Tabulate main points of differences between them.
3. Write the specifications of domestic refrigerator available at your home and I.C.Engine of any two wheelers. Also draw & explain cycle on which domestic refrigerator and I.C.Engine works.
4. Prepare chart of p-v & p-h diagram for refrigeration cycle.
5. Prepare chart for different thermodynamics process with the help of p-v, t-s, h-s diagram.

**NOTE** These could be individual or group-based.

**8. SUGGESTED LEARNING RESOURCES.****A. List of Books:**

SR. NO.	TITLE OF BOOK	AUTHOR	PUBLICATION
1.	Thermodynamics	R. Yadav	CPH
2.	Thermodynamics for Engineers	M.L. Mathur	Dhanpatrai & sons
3.	Heat Engines	C.S. Shah & N.C. Pandya	Charotar Publi. House
4.	Elements of Heat Engines Vol. I&II	R.C. Patel	Acharya Book Depot
5.	Thermodynamics	SAAD	Prentice-Hall
6.	Engineering Thermodynamics- 2nd edition	P. K. Nag	McGraw Hill Education
7.	Applied Thermodynamics	R.C. Patel	Acharya Book Depot

**B. List of Software/Learning Websites**

- a. <http://www.nptel.iitm.ac.in/video.php?subjectId=112105123>(IIT-B Vidéo lectures)
- b. <http://www.thermofluids.net/>
- c. <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv301-Page1.htm>
- d. <http://www.grc.nasa.gov/WWW/k-12/airplane/thermo.html>
- e. <http://www.youtube.com/watch?v=Xb05CaG7TsQ>
- f. <http://www.youtube.com/watch?v=aAfBSJObd6Y>
- g. <http://www.youtube.com/watch?v=DHUwFuHuCdw>
- h. <http://www.youtube.com/watch?v=kJlmRT4E6R0>
- i. <http://www.youtube.com/watch?v=GKqG6n6nAmg>

**9. COURSE CURRICULUM DEVELOPMENT COMMITTEE****Faculty Members from Polytechnics.**

- **Prof. ANKIT PATEL**, H.O.D., Aeronautical Dept. Parul institute of engg. & tech-  
Diploma studies