GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

THERMODYNAMICS
(Code: 3331902)

Diploma Programme in which this course is offered	Semester in which offered
Mechanical 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 mechanical engineering and technology notably in steam and nuclear power plants, internal combustion engines, gas turbines, air conditioning, refrigeration, gas dynamics, jet propulsion, compressors and energy conversion in different devices.

2. COMPETENCY (Programme Outcome according to NBA Terminology):

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competency

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

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	0	3	70	30*	00	00	100

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

* 30 marks of Theory PA include two assignments each of 5 marks. First assignment must have total 12 numerical from Unit number I,II and III. Second assignment must be of 10 numerical from Unit number IV and V and report on student activities performed. Each numerical of each assignment must have different parameters for each student, that is each student will get total 22 numerical with same problem but with varied parameters. (Values of temperature, pressure, volume, etc may be different for each student.).

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I **Basic concepts of thermodynamics**	1.a Identify a thermodynamic property and use it with appropriate units. 1.b Explain Zeroth law of thermodynamics.	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.
Unit – II **First law of thermodynamics**	2.a Explain first law of thermodynamics. 2.b Apply first law of thermodynamics to real life situations.	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.
Unit – III **Ideal gases and thermodynamic processes**	3.a Explain various ideal gas laws & thermodynamic processes. 3.b Calculate amount of heat transfer, work transfer & internal energy associated with the process.	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).

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
		3.6 Simple numerical examples based on above.
Unit – IV Second law of thermodynamics	4.a Describe second law of Thermodynamics. 4.b Apply second law of thermodynamics in real life problems. 4.c Appreciate importance of entropy.	4.1 Concept and real life examples of heat source, heat sink (reservoir), heat engine, heat pump and refrigerator. 4.2 Second law of thermodynamics. i. Kelvin-Plank statement ii. Clausius statement. iii. Equivalence of above two statements. iv. Corollary. 4.3 Concept of thermal efficiency and COP (Coefficient of Performance). 4.4 Concept, importance and examples of entropy. 4.5 Concept of reversibility and irreversibility of thermodynamic processes causes of irreversibility. 4.6 Carnot cycle, representation on P-V, T-s diagrams, derivation, examples.
Unit – V Thermodynamic cycles	5a. Identify thermodynamic processes in a cycle. 5b. Plot various cycles on property diagram 5c. Derive expression for efficiency. 5d. Solve simple examples of power producing cycle.	5.1 Concept of air standard efficiency. 5.2 Otto, Diesel & Dual Combustion cycle : i. Representation on P-V & T-s diagram, derivation for air standard efficiency & simple examples. ii. Limitations, applications & comparison of above cycles based on different parameters. 5.3 Refrigeration cycles: Reversed Carnot cycle, Reversed Brayton cycle: i. Representation on P-V & T-s diagram & expression for COP (without derivation).

5. SUGGESTED SPECIFICATIONTABLE WITH HOURS & MARKS(THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basic concepts of thermodynamics	06	04	03	03	10
II	First law of thermodynamics	06	03	03	04	10
III	Ideal gases and processes	10	04	06	06	16
IV	Second law of thermodynamics	10	04	07	05	16
V	Thermodynamic cycles	10	04	06	08	18
Total		**42**	**19**	**25**	**26**	**70**

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

Notes:

1. This specification table shall be treated as a general guideline for students and Teachers. The actual distribution of marks in the question paper may slightly vary from above Table.
2. If midsem test is part of continuous evaluation, unit numbers I, II and unit III up to 3.4 are to be considered.
3. Ask the questions from each topic as per marks weightage. Numerical questions are to be asked only if it is specified. Optional questions must be asked from the same topic.

6. SUGGESTED LIST OF PRACTICAL/EXERCISES

Not Applicable

7. SUGGESTED LIST OF STUDENT ACTIVITIES

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, duel 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.

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

Sr. No.	Unit	Unit Title	Strategies
1	I	Basic concepts of thermodynamics.	Real life examples. Demonstration of real systems. Movies/Animations. Numerical.
2	II	First law of thermodynamics.	
3	III	Ideal gases and processes.	
4	IV	Second law of thermodynamics.	
5	V	Thermodynamic cycles.	

9. SUGGESTED LEARNING RESOURCES

(A) List of Books:

Sr. No.	Title of Books	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
6.	Thermodynamics	SAAD	Prentice-Hall
7.	Engineering Thermodynamics- 2nd edition	P. K. Nag	McGraw Hill Education
8.	Applied Thermodynamics	R.C. Patel	Acharya Book Depot
9.	Thermodynamics	Gupta	Pearson

(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

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. S. R. Pareek**, Head of Department, Mechanical Engineering Department, Tolani F. G. Polytechnic, Adipur.
- **Prof. D. M. Trivedi**, Lecture in Mechanical Engineering, K.J. Polytechnic, Baruch.
- **Prof. Shah Atul S**., Lecturer in Mechanical Engineering, Government Polytechnic, Waghai.
- **Prof. M. N. Patel**, Lecturer in Mechanical Engineering, Government Polytechnic, Chhota Udepur.

Coordinator and Faculty Members from NITTTR Bhopal:

- **Prof. Sharad Pradhan**, Associate Professor and Head Department of Mechanical Engineering,
- **Dr. Vandana Somkuwar** Associate Professor, Department of Mechanical Engineering