Lok Jagruti Kendra University
University with a Difference

Diploma in Automation and Robotics

LJ Polytechnic

Course Code: 025120304

Thermodynamics

Propgramme / Branch Name			Diploma in Automation and Robotics			
Course Name	Thermodynamics				**Course Code**	025120304
Course Type	HSSC	BSC	ESC	PCC	OEC	PEC

Legends: HSSC: Humanities and Social Sciences Courses BSC: Basic Science Courses
ESC: Engineering Science Courses PCC: Program Core Courses
OEC: Open Elective Courses PEC: Program Elective Courses

1. Teaching and Evaluation Scheme

Teaching Hours / Week				**Evaluation Scheme**			
L	**T**	**P**	**Total Credit**	**CCE**	**SEE (Th)**	**SEE (Pr)**	**TOTAL**
3	0	0	3	50	50	-	100

Legends:
L: Lectures T: Tutorial P: Practical
CCE: Continuous & Comprehensive Evaluation
SEE (Th): Semester End Evaluation (Theory)
SEE (Pr): Semester End Evaluation (Practical)

2. Prerequisites

- ✓ Engineering Mathematics-I
- ✓ Engineering Physics

3. Rationale

Thermodynamics is the science of energy transfer and its effect on the physical properties of substances. Thermodynamics is the first course on Thermal Science and Engineering. It studies various energy interactions notably heat and work transfer, different properties of the perfect gases, different thermodynamic processes. Standard cycles and their practical significance. A diploma holder in this course is supposed to maintain steam generators, turbines, compressors, and other power plant equipment. Therefore, it is essential to impart to him basic concepts of thermodynamics.

4. Objectives

- ✓ It is a science of energy transfer and its effect on the physical properties of substances. It is based upon observations of common experiences of energy (mainly heat) transfer.
- ✓ This course will provide an understanding of the basic principles of thermodynamics which is a must for an understanding of major fields of mechanical engineering systems.
- ✓ To understand the basic terminologies and basic concepts of thermodynamics such as system, processes, and cycles and about the thermodynamic properties emerging out of the law of thermodynamics.
- ✓ To integrate zeroth and first law to coin second law of thermodynamics and to understand the concept of Carnot cycle, application of second law.
- ✓ To apply the principles of thermodynamics to Mechanical Engineering applications.

5. Contents

Unit No.	Unit Name	Topics	Learning Outcome	% Weightage	Hours
1.	**Fundamental Concepts**	1.1. Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe 1.2. Types of Systems- closed, open and isolated systems with examples. 1.3. Properties of system, Macroscopic and Microscopic viewpoints, – intensive and extensive 1.4. Thermodynamic Equilibrium, State, Property, Process, Quassi-static, reversible and irreversible processes. Work and heat (sign Convention) 1.5. Zeroth of Thermodynamics**,** Temperature scale 1.6. Definition of properties like pressure, volume, temperature, enthalpy, internal energy.	• To understand the basic concepts of systems and their types and their various properties. • Thermodynamics equilibrium, heat and Work transfer, and its applications. • To understand the zeroth law of thermodynamics and its real-life examples • To understand the various properties like pressure, volume, temperature, enthalpy, and internal energy.	14	6
2.	**Law of Perfect Gases**	2.1. Rigid Definition of gases, explanation of perfect gas laws – Boyle's law, Charle's law, Avogadro's law, Regnault's law. 2.2. Universal gas constant, Characteristic gas constants. 2.3. Derivation Specific heat at constant pressure, specific	• To understand the various gas laws. • To understand the concept of universal gas constant and characteristic gas constants. • To solve the problems related to the various gas laws.	14	5

		heat at constant volume of gas. 2.4. Simple Problem on gas Equation.			
3.	**Thermodynamic Processes on Gases**	3.1. Thermodynamic processesIsochoric, Isobaric, Isothermal, Hyperbolic, Isentropic, Polytropic and throttling processes, equations representing the processes. 3.2. Derivation of work done, change in internal energy, rate of heat transfer for the above processes. 3.3. Simple Numerical examples.	• To understand the various thermodynamics processes and their equations. • To understand the derivation of work done, change in internal energy, heat transfer for the various processes. • To solve the problems related to the various processes.	18	7
4.	**Laws of Thermodynamics**	4.1. Laws of conservation of energy, first law of thermodynamics (Joule's experiment) 4.2. Application of first law of thermodynamics, Steady flow energy equation 4.3. Application of steady flow energy to equation, turbines, pump, boilers, nozzles 4.4. Heat source and heat sinks, statement of second laws of thermodynamics 4.5. Kelvin Planck's statement, Clausius statement 4.6. Perpetual motion Machine of first kind & second kind 4.7. Carnot cycle and theorem	• To understand the law of conservation of energy. • To apply the first law of thermodynamics with Joule's experiments. • To apply the concept of the first law of thermodynamics. • To understand the application of Steady flow energy equations. • To understand the second law of thermodynamics. • To understand the concept of Perpetual motion machines. • To understand the concept and applications of the Carnot cycle.	28	12

		4.8. Introduction of third law of thermodynamics, entropy, concept of reversibility and irreversibility	• To understand the concept of entropy with the third law of thermodynamics and reversibility & irreversibility.		
5.	**Thermodynamic Cycles**	5.1. Concept of Air-standard efficiency 5.2. Otto cycle, Diesel cycle & it's Comparison 5.3. S.I. Engine , C.I Engine & it's comparison 5.4. Refrigeration Cycle: Revered Carnot Cycle, Reversed Brayton cycle 5.5. Simple Vapour Compression Refrigeration (VCR) cycle on P-h and T-s diagrams 5.6. Simple numerical examples based on above cycles	• To understand the concept of Air-Standard efficiency • To understand the working of S.I engine and C.I engine. • To understand the various thermodynamic cycles and their efficiency. (No derivation) • To understands the basic cycles and concepts. • Vapour Compression Refrigeration cycles • To solve the problems related to various cycles	26	12
				Total Hours	**42**

6. Suggested Specification Table for Evaluation Scheme

Unit No.	Unit Name	Distribution of Topics According to Bloom's Taxonomy					
		R %	**U %**	**Ap %**	**C %**	**E %**	**An %**
1.	Fundamental Concepts	40	46	14	-	-	-
2.	Law of Perfect Gases	40	20	-	-	20	20
3.	Thermodynamic Processes on Gases	20	-	-	20	20	40
4.	Laws of Thermodynamics	46	38	16	-	-	-
5.	Thermodynamic Cycle	16	40	34	-	10	-

Legends: R: Remembering U: Understanding
App: Applying C: Creating
E: Evaluating An: Analyzing

7. Textbooks

1) Thermodynamics – An Engineering Approach by Yunus Centel & Boles(8^{th} edition), Tata Mc Graw Hill, New Delhi
2) Engineering Thermodynamics by R.K. Rajput, Laxmi Publications, New Delhi

8. Reference Books

1) Engineering Thermodynamics by CP Arora; Tata McGraw Hill, Delhi.
2) A text book of Thermal Engineering -R.S.Khurmi& J.K.Gupta
3) Fundamentals of Engineering Thermodynamics by R.Yadav, Central Publishing House, Allahabad
4) Thermodynamics – Theory & Application by Robert Balmer, Jaico publication house

9. Open Sources (Website, Video, Movie)

1) https://www.youtube.com/playlist?list=PLDq1y_5mpm2DCqD3qXGafXz7ANXnqDn--
2) https://www.youtube.com/playlist?list=PLtpgVX7NgMc89mSmdizlTauwasgvKPzcf
3) https://www.youtube.com/playlist?list=PLD8E646BAB3366BC8
4) https://www.youtube.com/playlist?list=PL3zvA_WajfGAwLuULH-L0AG9fKDgplYne
5) https://www.youtube.com/playlist?list=PLPA2YbyQreSPkMmhGzrN7mh2bZvaeOsr5
6) https://www.youtube.com/playlist?list=PLOKNrldi7Clif1WeC-hAZZ3a7tGAXLfb4
7) https://www.youtube.com/watch?v=YM-uykVfq_E
8) https://www.youtube.com/watch?v=G4pRW1HNSlQ
9) https://www.youtube.com/watch?v=1_InUUX5-LE
10) https://www.youtube.com/watch?v=lvy8h-yWhRQ&list=PLD8E646BAB3366BC8&index=6