GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mechanical Engineering

Subject Code: DI05019021

Subject Name: Thermal Engineering-II

W. e. f. Academic Year:	2026-27
Semester:	5th
Category of the Course:	PCC

Prerequisite:	(1) Elements of Mechanical Engineering (DI01000191) **(2)** Engineering Thermodynamics (DI03019011)
Rationale:	The course covers a wide range of topics related to the principles of thermodynamics and their practical applications in various engineering systems. Students will learn about Internal Combustion Engines (ICEs), refrigeration, air conditioning, hydrogen technology and IC engine fuels, which are all critical components of thermal system/device. The course will deliver the working principles of IC engine, including the several type of engines, their components, and their applications. The course will cover ICE fuels and their properties. It also covers the refrigeration and air conditioning systems, including the principles of heat transfer, refrigerants. Finally, course will also cover hydrogen production, storage, transportation and fuel cell. Overall, it provides a comprehensive understanding of thermal systems/devices and their applications, which are essential for engineers.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
CO-1	Analyze performance of internal combustion engines using performance parameters and heat balance sheet.
CO-2	Select IC engine fuels and related support system for internal combustion engines.
CO-3	Analyze the performance of refrigeration system using standard procedures.
CO-4	Estimate air conditioning parameters for particular appliances.
CO-5	Identify the salient features of hydrogen production, storage, transportation and fuel cell.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Internal Combustion Engines** 1.1 Introduction 1.2 Theoretical and actual valve timing diagrams 1.3 Fuel Injection system - Carburation - Fuel pump - Multi Point Fuel Injection (MPFI) - CRDI 1.4 Cooling System 1.5 Lubrication system 1.6 Ignition system 1.7 Governing & Scavenging system 1.8 Exhaust system (considering pollution reduction) 1.9 Supercharging & Turbocharging 1.10 Performance testing of IC engines - Performance parameters (Indicated power, Brake power, Friction Power, A/F ratio, specific fuel consumption, efficiencies) - Heat balance sheet - Morse test 1.11 Simple numerical examples	15	34
2.	**IC Engine Fuels** 2.1 Alternative fuels - Alcohols - Hydrogen - LPG - Biogas - CNG	07	16

	- Biofuel - Supply requirement for CNG and LPG 2.2 Rating of engine fuels - Octane Number - Cetane Number 2.3 Pollution and control - Emission norms - Effect emitted gases - E-20 ethanol bending 2.6 Analysis of exhaust gas		
3.	**Refrigeration** 3.1 Introduction 3.2 Vapor Compression Refrigeration Cycle - Major components - P-v, T-s and P-h diagram - Working 3.3 Performance of VCRS 3.4 Effect of Change in operating condition 3.5 Simple numerical on VCRS performance 3.6 Application of VCRS - Domestic refrigerator - Ice plant - Water cooler 3.7 Vapor Absorption Refrigeration System (VARS) 3.8 Refrigerant and its properties - Characteristics - Properties - Commonly used refrigerants - Eco friendly refrigerants	08	17
4.	**Air-Conditioning** 4.1 Air conditioning - Concept - Types - Applications 4.2 Properties of air - Psychometric relations - Humidity and temperature measurement 4.3 Psychometric - Psychometric processes - Basic load calculations	07	16

	4.4 Simple numerical examples 4.5 Air conditioner - Window air conditioner - Split air conditioner		
5.	**Hydrogen Technology** 5.1 Concept 5.2 Green hydrogen 5.3 Liquid and compressed hydrogen 5.4 Production 5.5 Electrolysis 5.6 Storage and storage issues 5.7 Transportation 5.8 Fuel cells 5.9 Principal and types 5.10 Construction and working 5.11 Safety - Hydrogen Safety - Hydrogen Vehicles - Hybrid Energy Systems 5.12 Future of Hydrogen	08	17
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
37	**38**	**25**	**-**	**-**	**-**

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:

Sr. No.	Title of Books	Author	Publication& ISBN
1.	Heat Engines	Pandya and Shah	Charotar Publishing House.
2.	Thermodynamics and Heat power Engineering	Mathur and Mehta	Tata Mcgraw- Hill.

3.	Thermal Engineering	R K Rajput	Laxmi. Publications
4.	A Text book of Thermal Engineering	R S Khurmi & J.K. Gupta	S Chand & Co.
5.	Thermal engineering	P.L.Ballaney	Khanna Publication
6.	Thermal Science and Engineering	Dr. D.S.Kumar	S.K.Kataria & Sons.
7.	IC Engine	Mathur and Sharma	DhanpatRai Publication
8.	Principles of Refrigeration	Dossat	Pearson Education
9.	Refrigeration and air conditioning	Arora & Domkundwar	Khanna publication.
10.	A Text Book of Refrigeration and Air Conditioning	R S Khurmi	Eurasia Publishing House
11.	Refrigeration & Air-Conditioning	R.K.Rajput	S.K.Kataria & Sons.
12.	Introduction to Hydrogen Technology	K.S.V. Santhanam	John Wiley & Sons Inc

(b) Open source software and website:

1. https://www.youtube.com/playlist?list=PLwdnzlV3ogoXHbVNKWL1BYOo_8PpyNtnC
2. http://vlabs.iitkgp.ernet.in/rtvlas/exp1/index.html#
3. https://vlabs.iitkgp.ac.in/rtvlas/
4. http://nptel.ac.in/courses/112105128/
5. https://www.kwangu.com/work/psychrometric.htm
6. http://people.tamu.edu/~i-choudhury/psych.html

Suggested Course Practical List

1. Prepare an actual valve timing diagram of given IC engine.
2. Perform a test on four stroke Petrol engine test rig. also prepare a heat balance sheet.
3. Perform a test on four stroke Diesel engine test rig. also prepare a heat balance sheet.
4. Measure and analyze the emitted gases from IC engine (in context of pollution).
5. Demonstrate various tools for refrigeration tubing operation.
6. Determine the COP of VCRS system.

7. Demonstrate leak detection with various leak detection techniques, evacuation and refilling of refrigerant.
8. Determine properties of air.
9. Determine of capacity of window / split air-conditioner.
10. Demonstration of hydrogen production, storage and transportation systems.

List of Laboratory/Learning Resources Required:

1. Actual cut section of 4-stroke Diesel engine for valve timing diagram.
2. Four stroke Petrol engine test rig.
3. Four stroke Diesel engine test rig.
4. Exhaust gas analyzer: (i) Petrol engine, (ii) Diesel engine
5. Refrigeration tubing operation kit.
6. VCRS test rig.
7. Leak detection kit.
8. Evacuation and refilling station for refrigeration system.
9. Psychometer and thermometer for wet bulb and dry bulb temperatures.
10. Window/split air conditioner test rig.
11. Models/charts of:
    a. Hydrogen production systems
    b. Hydrogen storage systems
    c. Hydrogen transportation systems

Suggested Project List:

1. Prepare a display chart of different types IC engine systems.
2. Prepare a display chart of different types of IC engine fuels.
3. Make a PowerPoint presentation on the latest industry trends in IC engines.
4. Prepare a chart of possible minor fault and remedies while driving two wheelers and four wheels.
5. Prepare chart of CNG/LPG/Diesel/ Petrol engine fueling system.
6. Make a PowerPoint presentation on the latest trends in IC engines fuels.

7. Prepare a tabulated summary of the types of air conditioners used in a home, office, mall, cinema and vehicle which are available in the market. (Summary includes tonnage capacity, types of compressors, types of refrigerants, types of expansion system etc).
8. Prepare a chart of installation and maintenance of A.C. at home or office.
9. Collect and analyse technical specifications of split air conditioner from manufacturers' websites and other resources.
10. Collect and analyze technical specifications of refrigerator from manufacturers' websites and other resources.
11. Carry out a comparative study of hydrogen production, storage and transportation systems used in the field of green energy and the upcoming latest technologies.
12. Make a PowerPoint presentation on the latest industry trends in green hydrogen technology.

Suggested Activities for Students:

1. Enlist IC Engine specifications which is available in your laboratory.
2. Search different ICE components from scrap and identify type of defect/ failure.
3. Visit any Industry working on IC Engine manufacturing/ running or power plant working on IC Engine.
4. Visit any automobile service center in nearby area.
5. Visit any Petrol/ Diesel/ CNG/ LPG station and study different fuel filling systems along with different parameters affected.
6. Enlist VCRS system specifications which is available in your laboratory.
7. Prepare chart VCRS/ VARS.
8. Visit cold storage plant, ice plant and air-conditioning Plant to observe VCRS or VARS.
9. Preparation of small model of VCRS.
10. Built up/ evacuate VCRS available at your institute.
11. Prepare property table for different types of refrigerants/ alternate fuels.
12. Undertake 2 to 5 days of training in an automobile workshop.

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