GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mechanical Engineering (CAD/CAM)

Subject Code: DI04065011

Subject Name : Thermal System Engineering

W. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	PCC

Prerequisite:	Zeal to learn the course
Rationale:	This course will provide the basic knowledge of thermal engineering systems required for a mechanical engineer. It would develop basic knowledge and skills related to boilers, boiler mounting and accessories, steam turbines, condensers, cooling towers, air compressors, heat transfer, internal combustion engines. refrigeration and air conditioning. This course essentially provides adequate knowledge in the field of thermal engineering required for the mechanical engineer specializing in CAD/CAM.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Apply various thermodynamic laws and processes to thermal systems.
02	Identify the various features of steam generators, steam turbines, condensers and cooling towers.
03	Perform the test on Internal combustion engines by considering various operational aspects.
04	Identify the various features of refrigeration systems and air conditionings.
05	Determine the heat transfer parameters related to heat exchanger design for the different situations.

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.	**Introduction to Thermodynamics** 1.1 Concept of state, system, surrounding, boundaries 1.2 Statement of zeroth law of thermodynamics 1.3 First law of thermodynamics - Joules experiment - Statements 1.4 Second law of thermodynamics - Concept of reservoir, heat engine, refrigerator and heat pump - Kelvin-Plank statement - Causius statement 1.5 Statement of third law of thermodynamics 1.6 Thermodynamic processes (**Without Derivations**) - Constant Volume Process - Constant Pressure Process - Constant Temperature Process - Adiabatic Process - Polytrophic Process - Throttling Process	06	13
2.	**Steam Generators** 2.1 Concept and layout of a thermal power plant 2.2 Carnot and Rankine Cycles (Concept only without numerical) 2.3 Formation of steam with the concept of a two-phase system 2.4 Steam types 2.5 Various steam properties - Sensible heat - Latent heat - Superheat - Enthalpy - Entropy - Degree of superheat 2.6 Use of steam table and Mollier chart 2.7 Steam boiler - Concept, definition as per Indian Boilers Regulation (IBR) - Classifications and Applications 2.8 Construction and working of steam boilers - Cochran Boiler	09	20

	- Babcock and Wilcox boiler - Packaged boiler Function and location of boiler mountings & accessories		
3.	**Steam Turbine, Condenser and Cooling Towers** 3.1 Steam turbine - Concept and classifications - Construction and working of impulse and reaction turbine 3.2 Steam condensers 3.3 Concept, functions and classification - Construction and working of surface condensers. 3.4 Cooling towers - Concept, function and classification - Construction and working	06	13
4.	**Internal Combustion Engine** 4.1 Concept, major components & its functions 4.2 Terminology 4.3 Classifications 4.4 Otto, Diesel and Dual Cycles 4.5 Construction & working - Four Stroke Engines - Two Stroke Engines 4.6 Functions of IC engine Systems **(Without construction & working)** 4.7 Engine Performance - Indicated power - Brake power - Friction Power - Efficiencies 4.8 Simple numerical examples	10	22
5.	**Refrigeration and Air Conditioning** 5.1 Concept of refrigerators and heat pumps 5.2 Reverse Carnot cycle and Bell column cycle 5.3 Vapor Compression Refrigeration Cycle - Major components - P-v, T-s and P-h diagram 5.4 Refrigerant - Characteristics - Properties of refrigerants 5.5 Air conditioning	09	20

	-Concept, types and applications 5.6 Properties of air 5.7 Psychometric processes 5.8 Air conditioner - Window air conditioner - Split air conditioner		
6.	**Heat Transfer and Heat Exchangers** 6.1 Concept of heat transfer modes - Conduction - Convection - Radiation 6.2 Heat exchanger - Concept, classification, and application - LMTD **(No derivation)** 6.3 Simple numerical examples	05	12
	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**
40	**40**	**20**	**-**	**-**	**-**

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.	Engineering Thermodynamics	Yunus A. Cengel	Tata McGraw Hill 975-1-25-906256-8
2.	Engineering Thermodynamics-2nd Edition	P.K. Nag	Mc-Graw Hill Education 978-0-07-026062-7
3.	A Textbook of Thermal Engineering	R S Khurmi & J K Gupta	S. Chand & Co.
4.	Heat and mass transfer	R K Rajput	S. Chand & Co.
5.	Thermal Science and Engineering	Dr. D.S.Kumar	S.K.Kataria & Sons.

6.	IC Engine	Mathur and Sharma	DhanpatRai Publication
7.	Refrigeration and air conditioning	Arora & Domkundwar	Khanna publication.
8.	A Text Book of Refrigeration and Air Conditioning	R S Khurmi	Eurasia Publishing House
9.	Refrigeration & Air-Conditioning	R.K.Rajput	S.K.Kataria & Sons.

(b) Open source software and website:

1. https://nptel.ac.in/courses/112/105/112105123/
2. https://vlab.amrita.edu/index.php?sub=1&brch=194
3. https://www.youtube.com/watch?v=WTtxlaeC9PY
4. https://www.youtube.com/watch?v=Jsnv8L7HdEk
5. https://virtuallabs.hkust.edu.hk/TubularHeatExchanger/VirtualExperiment
6. https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=709&cnt=4
7. https://www.spiraxsarco.com/resources-and-design-tools/steam-tables/superheated-steam-region
8. https://www.youtube.com/watch?v=mHcZdknYtkY
9. https://www.youtube.com/watch?v=EGFDqqX_Iek&list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&index=7
10. https://www.youtube.com/watch?v=hx5xy33spnU&list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&index=17
11. http://nptel.ac.in/courses/112105128/
12. http://www.youtube.com/playlist?list=PLE2DA184A2E479885
13. http://www.kolpak.com/asset/?id=tuqvr
14. https://www.kwangu.com/work/psychrometric.htm
15. http://people.tamu.edu/~i-choudhury/psych.html
16. https://www.youtube.com/playlist?list=PLwdnzlV3ogoXHbVNKWL1BYOo_8PpyNtnC
17. http://vlabs.iitkgp.ernet.in/rtvlas/exp1/index.html#

Suggested Course Practical List:

1. Determine the steam properties using: (a) Steam table, (b) Mollier chart
2. Demonstrate Steam boilers.
3. Demonstrate various steam turbines.
4. Demonstrate steam condensers.
5. Demonstrate cooling towers.
6. Perform a test on four stroke Petrol/Diesel engine test rig.
7. Demonstrate the major components of VCRS.

8. Determine of properties of air.
9. Demonstrate the major components of Window/Split air conditioner.
10. Determine the overall heat transfer coefficient and LMTD of a heat exchanger.

List of Laboratory/Learning Resource Required:

1. Models of various steam boilers.
2. Models of various boiler mountings and accessories.
3. Models of various steam turbines.
4. Models of various steam condensers.
5. Models of various cooling towers.
6. Models of: (a) 4-stroke Petrol engine cut section, (b) 4-stroke Diesel engine cut section
7. Four stroke Petrol/Diesel engine test rig.
8. Chart of VCRS.
9. Chart of window and split air conditioner.
10. Psychometer and thermometer for wet bulb and dry bulb temperatures.
11. Parallel and counter flow heat exchanger test rig.

Suggested Activities for Students:

1. Identify and list real situations working on thermodynamic laws.
2. Prepare a display chart of various accessories of boiler
3. Prepare a display chart of various mountings of boiler as per IBR.
4. Prepare a display chart of different types of condensers along with application.
5. Prepare a display chart of different types cooling towers along with application.
6. Make a PowerPoint presentation on the latest industry trends in turbines and condenser.
7. Enlist IC Engine specifications which is available in your laboratory.
8. Search different ICE components from scrap and identify type of defect/ failure.

9. Visit any Industry running or power plant working on IC Engine.
10. Enlist VCRS system specifications which is available in your laboratory.
11. Preparation of small model of VCRS.
12. Undertake 2 to 5 days of training in an automobile workshop.
13. Identify and list at least ten devices that require heat transfer and prevention of heat transfer. Also, state the mode of heat transfer and methods used to prevent heat transfer.
14. Arrange a visit of Dairy and prepare a Report on Boiler and heat exchangers.

* * * * * * *