



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mechanical Engineering

Subject Code: DI04019011

Subject Name : Thermal Engineering - I

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

Prerequisite:	(1) Elements of Mechanical Engineering (DI01000191) (2) Engineering Thermodynamics (DI03019011)
Rationale:	Diploma Mechanical engineers are supposed to operate and maintain various equipments and various home appliances in industrial and domestic fields, in which energy transition occurs particularly as heat and work. This course will provide the basic knowledge of Thermal Engineering, which acts as a foundation for various fields related to mechanical engineering. This course would develop basic knowledge and skills related to heat transfer, thermal insulators and heat exchangers, air compressors, boilers as well as steam generators, steam condensers, cooling towers, steam nozzles, steam turbines and gas turbines. Thus, this course is very essential for mechanical engineers, especially in fields related to energy transition like process industries, textile industries, food processing and pharmaceutical industries, refineries and power plants, etc.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
CO-1	Determine heat transfer parameters related to heat exchangers for different situations.
CO-2	Calculate the power requirement and volumetric efficiency of air compressors.
CO-3	Evaluate the boiler performance based on given parameters and operational data sheets.
CO-4	Identify various features of steam nozzles, steam turbines, condensers, and cooling towers.
CO-5	Identify various features of gas turbine power plant systems.

Teaching and Examination Scheme:

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



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Heat Transfer and Heat Exchangers 1.1 Concept of heat transfer 1.2 Conduction - Fourier's law - Conduction through plain & composite wall, and cylinder (No derivation) 1.3 Convection - Newton's law - Free and forced convection 1.4 Radiation - Concept of Incident energy - Concept of Absorptivity, reflectivity and transmissivity - Concept of black and grey body - Concept of emissive power and emissivity 1.5 Thermal insulation/insulators - Concept, properties, classifications, and types 1.6 Heat exchanger - Concept, classification, and application - LMTD (No derivation) 1.7 Simple numerical examples	07	16
2.	Air Compressors 2.1 Concepts, classification, and applications. 2.2 Construction and working of Reciprocating air compressor: - Single stage - Multi-stage (without & with intercooler) 2.3 Performance of reciprocating compressor (No derivation) - Work required, and efficiency (No derivation) - Simple numerical examples 2.3 Construction and working of rotary compressors - Roots blower - Vane type - Screw type - Scroll type 2.4 Construction and working of Dynamic air compressor: - Centrifugal - Axial	08	17
3.	Steam Formation and its Properties	04	9



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	3.1 Steam Formation <ul style="list-style-type: none"> - Industrial Applications - Representation on PV, T-s, and h-s diagrams. 3.2 Calculation of Steam Properties <ul style="list-style-type: none"> - Steam table - Mollier chart 3.3 Measurement of dryness fraction <ul style="list-style-type: none"> - Barrel calorimeter - Separating calorimeter - Separating & Throttling calorimeter - Electrical calorimeter 3.4 Simple numerical examples		
4.	Steam Generators 4.1 Steam boilers <ul style="list-style-type: none"> - Concept, definition as per Indian Boilers Regulation (IBR) - Classifications and Applications 4.2 Construction and working of steam boilers <ul style="list-style-type: none"> - Packaged boiler (Fire, water and combined tube) - Waste heat recovery boiler - Fluidized bed combustion boiler 4.3 Boiler Draft 4.4 Functions and locations of boiler mountings & accessories 4.5 Boiler performance <ul style="list-style-type: none"> - Equivalent of evaporation - Boiler power - Boiler efficiency - Heat balance sheet 4.6 Simple numerical examples	11	25
5	Prime Movers 5.1 Steam Nozzle <ul style="list-style-type: none"> - Concept, classification and application - Nozzle types 5.2 Steam turbine <ul style="list-style-type: none"> - Concept and classifications - Major components - Working of Impulse and reaction turbines - Necessity of compounding and its types 	03	07
6	Steam Condensers, and Cooling Towers 6.1 Steam condensers	06	13



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	<ul style="list-style-type: none"> - Concept, Functions and classification - Construction and working of jet condensers - Construction and working of surface condensers - Effect of air leakage & Leak detection techniques <p>6.2 Cooling Towers</p> <ul style="list-style-type: none"> - Concept, Function and classification - Construction and working of cooling towers 		
7	<p>Gas Turbines</p> <p>7.1 Concept and classifications</p> <p>7.2 Brayton cycle</p> <ul style="list-style-type: none"> - P-v and T-s diagram - Actual cycle <p>7.3 Open and closed cycle gas turbine</p> <p>7.4 Performance improvement methods</p> <ul style="list-style-type: none"> - Intercooling - Reheating - Regeneration <p>7.5 Combustion chamber</p> <p>7.6 Usages of gas turbine</p> <p>7.7 Simple numerical</p>	06	13
	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.	A Textbook of Thermal Engineering	R S Khurmi & J K Gupta	S. Chand & Co.
2.	Thermal Engineering	R K Rajput	Laxmi.Publications
3.	Thermodynamics and Heat Power Engg.	Mathur and Mehta	Tata Mcgraw- Hill



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4.	Heat Engines	Pandya and Shah	Charotar Publishing House
5.	Heat and mass transfer	R K Rajput	S. Chand & Co.
6.	Heat and mass transfer	D S Kumar	S K Kataria & Sons
7.	Thermal Engineering	P. L. Ballaney	Khanna Publishers

(b) Open source software and website:

1. <https://vlab.amrita.edu/index.php?sub=1&brch=194>
2. <https://virtuallabs.hkust.edu.hk/TubularHeatExchanger/VirtualExperiment>
3. <https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=709&cnt=4>
4. <https://www.spiraxsarco.com/resources-and-design-tools/steam-tables/superheated-steam-region>
5. <https://www.youtube.com/watch?v=mHcZdknYtkY>
6. https://www.youtube.com/watch?v=EGFDqqX_Iek&list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&index=7
7. https://www.youtube.com/watch?v=h1Yt4ibYXfA&list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&index=12
8. https://www.youtube.com/watch?v=DuLFDzQVTU4&list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&index=16
9. https://www.youtube.com/watch?v=hx5xy33spnU&list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&index=17
10. Aspen plus simulation software
11. EES (Engineering Equation Solver) software

Suggested Course Practical List

1. Determine thermal conductivity /emissivity of given material for given condition.
2. Determine the overall heat transfer coefficient and LMTD of a heat exchanger.
3. Performance test on reciprocating air compressor.
4. Determine the steam properties using: (a) Steam table, (b) Mollier chart.
5. Demonstrate Steam boilers.
6. Determine boiler efficiency, equivalent evaporation, and heat balance sheet by collecting data from the industry.
7. Demonstrate various steam turbines.
8. Demonstrate steam condensers.
9. Demonstrate cooling towers.



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10. Demonstrate the Gas Turbine Power Plant System.

List of Laboratory/Learning Resources Required:

1. Parallel and counter flow heat exchanger test rig.
2. Emissivity measurement test rig.
3. Multi wall thermal conductivity measuring test rig.
4. Two-stage reciprocating air compressor test rig.
5. Models/charts of various steam boilers.
6. Steam Tables.
7. Mollier Charts.
8. Models/charts of various steam turbines.
9. Models/charts of various steam condensers.
10. Models/charts of various cooling towers.
11. Models/charts of various gas turbine power plant systems/components.

Suggested Project List:

1. Make a Model of any heat exchanger with parallel and counter flow arrangement in a workshop with 4-6 students in a group.
2. Prepare a tabulated summary of the types of air compressors available in the market. (Summary includes type, specification, rate, and applications).
3. Collect and analyze technical specifications of Reciprocating / Rotary Air Compressors from manufacturers' websites and other resources.
4. Prepare a demonstration model/chart of boiler for different type of fuel.
5. Collect information about nearby industries and collect technical data of major thermal devices/equipment's.
6. Carry out a comparative study of conventional boilers used in industries and the upcoming latest technologies in a boiler.



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7. Prepare a display chart of different types of condensers along the with application.
8. Prepare a display chart of different types cooling towers along the with application.
9. Prepare a display chart of different gas turbine power plant components.
10. Arrange a visit and prepare a report on nearby process industry particularly related to Thermal utilities.
11. Undertake 2 to 5 days of training in a Thermal Power Plant.
12. Make a PowerPoint presentation on the latest industrial trends in heat exchangers, compressors, turbines, condenser and cooling towers.

Suggested Activities for Students:

1. Collect/ download product catalogues with a specification of various types of energy conservation equipment/ devices and heat exchangers of recent trends.
2. List out at least ten devices that require heat transfer and identify ways of energy loss in particular device. Also, state the mode of heat transfer and methods used to prevent heat loss.
3. Prepare a chart/presentation to select a particular heat exchanger for a particular application.
4. Prepare a chart/presentation to select a particular air compressor for a particular application.
5. Select at least three problems on the boiler performance and prepare a report containing their solutions.
6. Prepare a chart/presentation to select a particular boiler for a particular application.
7. Prepare a chart/presentation for a selection criterion for a condenser.
8. Prepare a chart/presentation for a selection criterion for the cooling tower.
9. Prepare a chart/presentation for a selection criterion for the gas turbine components.

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