SANKALCHAND PATEL UNIVERSITY
।। अथातो ज्ञानजिज्ञासा ।।

Faculty of Engineering and Technology
Second Year Diploma Engineering
In Effect from Academic Year 2021-22

Subject Code: 1ET4020401	**Subject Title: Thermal Engineering - I**
Pre-Requisite	

RATIONALE:

The object of this course is to establish basic fundamental practical knowledge in the field of thermal engineering which includes two phase system, boiler operations, boiler mountings and accessories, heat transfer, condensers, air compressor etc. The course will provide a grown-up approach to the law of thermodynamics and basic principles of thermal engineering which will function as foundation in applications in major fields of mechanical engineering and technology outstandingly in steam and nuclear power plants, compressors, small package boiler plants in different devices, etc.
It will help to train mechanical engineer thorough grading in the basic knowledge of thermal engineering.

COMPETENCY:

Apply basic concepts, laws of thermodynamics and principles of thermal engineering to use equipment/devices/machines working on thermal engineering systems.

COURSE OBJECTIVE:

1. Determine steam properties and dryness fractions.
2. Classify and explain boilers, boiler mountings and accessories.
3. Determine boiler performance based on given specific parameters.
4. Explain working of steam prime movers.
5. Identify the elements and processes of steam condensers and cooling towers.
6. Operate air compressors and observe the parameters affecting the performance.
7. Identify heat transfer mode and calculate heat transfer for given heat transfer system.

TEACHING AND EVALUATION SCHEME:

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**			
				Theory		**Practical**	
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous assessment**
3	-	2	4	60	40	20	30

DETAILS OF COURSE CONTENTS:

SR. NO.	**TOPIC**	**Total Hrs.**	**WEIGHTAGE in marks**
1	**Two Phase Systems** 1.1 Concept of two phase system	7	10

	1.2 Formation of steam, its various phases, definition and representation of wet steam, dry steam, saturated steam and superheated steam on PV, T-s and H-s diagram. 1.3 Concept, definition and determination of dryness fraction and degree of superheat. 1.4 Concept, definition and determination of latent, sensible heat, enthalpy, entropy and specific volume of steam. 1.5 Use of steam table and Mollier chart (H-S diagram) 1.6 Numerical example based on above 1.7 Throttling process 1.8 Methods of measurement of steam, quality, Calorimeter- Bucket, Separating, Throttling and Combined Calorimeters. (No numerical problems)		
2	Boilers, Mountings and Accessories 2.1 Steam Boiler-concept, definition as per Indian Boilers Regulation (IBR), functions, features and classification. 2.2 Working of simple low pressure boilers along with merits and demerits – Simple Vertical boiler, Lancashire boiler, Cochran boiler, Babcock and Wilcox water tube boiler, Packaged boiler, Waste heat recovery boiler. 2.3 Functions, working and location of Boiler mountings & accessories 2.4 Boiler Draught System – concept and classification 2.5 Boiler performance – parameters, evaporative capacity, equivalent evaporation, efficiency, heat balance sheet, simple numerical examples 2.6 Concept of fluidized bed combustion boilers. 2.7 Maintenance, inspection and safety measures in boiler (as per IBR), check list in boilers.	10	15
3	Steam Prime movers 3.1 Concept and classification of prime movers 3.2 Steam nozzles-types, working and applications. Mass and velocity of steam discharge through nozzle (no derivation). Simple examples. 3.3 Steam turbine – concept and classification. Impulse and reaction turbines (constructional and materials details) working and differences. 3.4 Compounding of steam turbine- need, pressure compounding, velocity compounding and pressure-velocity compounding.	6	10
4	Steam Condensers and Cooling Towers	3	5

	4.1 Elements of a steam condensing plant, concept, function and classification of condensers. 4.2 Jet condensers and surface condensers – working and differences. 4.3 Vacuum efficiency and condenser efficiency of condensers- simple numerical example. 4.4 Classification, function and working of cooling towers.		
5	Air Compressors 5.1 Concepts, functions, classification and application 5.2 Working of reciprocation air compressor and rotary air compressors 5.3 Working of single stage air compressor and multistage air compressor , Inter-cooling and after cooling. 5.4 Power required and efficiency of reciprocating air compressor-single and two stages, simple numerical examples. 5.5 Concept of screw compressors for oil free air.	8	10
6	Heat Transfer 6.1 Various modes of heat transfer 6.2 Conduction heat transfer – Fourier's law (no Cartesian or other derivation of equations), thermal conductivity, heat transfer through plain wall, composite wall and cylinder. 6.3 Convection heat transfer, Newton's law of convection, Free and force convection, coefficient of convection. 6.4 Radiation heat transfer, blackbody concept, emissivity, refractivity, absorptivity, Stefan and Boltzmann's law. 6.5 Define thermal conductivity 6.6 Need, types, properties and applications of insulating materials in various industries. 6.7 Difference between hot and cold insulation 6.8 Overall heat transfer coefficient 6.9 Simple numerical examples 6.10 Heat exchanger- introduction, types and applications. Logarithmic Mean Temperature Difference (LMTD)	8	10

COURSE OUTCOME:

Students will develop awareness about the technologies involved in tapping such basic thermal engineering and equipments for putting them in use effectively for the service of mankind. They will think about the new era of technology for energy conversion and utilization for required task.

LIST OF PRACTICAL:

1. Demonstration of low pressure boilers
2. Demonstration of Boiler mountings and accessories
3. Boiler performance – Determination of boiler efficiency, equivalent evaporation and heat balance sheet. (Based on in-house performance or from data collected during industrial visit)
4. Demonstration of Steam prime movers – impulse and reaction turbines.
5. Demonstration Steam condensers and cooling towers
6. Performance test to determine volumetric efficiency of reciprocating air compressor.
7. Performance test of Heat Exchanger to determine overall heat transfer coefficient and LMTD of heat exchanger

LIST OF REFERENCES:

Sr. No.	Title of Books	Author	Publication
01	Heat Engines	Pandya and Shah	Charotar Publishing
02	Thermodynamics and Heat Power	Mathur and Mehta	Tata Mcgraw-hill
03	Thermal Engineering	P. L. Ballaney	Khanna Publications
04	Thermal Engineering	R K Rajput	Laxmi Publication
05	Practical Thermodynamics	G D Rai	Khanna Publication
06	Basic Boiler Attendant	M Mdalchawal	New Popular Prakashan
07	Heat and Mass Transfer	D S Kumar	S K Publication
08	Heat and Mass Transfer	R K Rajput	S Chand & Co.
09	A Text book of Thermal Engineering	R S Khurmi & JK Gupta	S Chand & Co.