

<b>Subject Code: 1ET4060601</b>	<b>Subject Title: Thermal Engineering</b>
<b>Pre-Requisite</b>	<b>Thermodynamics</b>

**RATIONALE:**

Subject knowledge of thermal engineering is required in many industries. The objective of this course is to establish basic fundamental and practical knowledge in the field of internal combustion engine, refrigeration, air conditioning, eco-friendly fuels, etc. These are major fields of mechanical engineering. Student will be able to understand different systems and apply its competencies in major fields in related industries. These are surface equipments in petroleum field. Knowledge of alternate fuels is required as emerging field and today's need of society which will be provided by the course content.

**COMPETENCY:**

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

**COURSE OUTCOMES:**

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Basics of Two Phase System and Thermodynamic Cycles.
- Basics of Compressors.
- Analyze performance of ICES by operating them and observing changes in thermodynamic properties during each stroke of ICES (and by using thermodynamic diagrams.)
- List characteristics and properties of alternate fuels used for ICES.
- Analyze the performance of Vapor Compression Refrigeration System (VCRS), by operating them and observing the changes in properties of refrigerant during each process on VCRS (and using thermodynamic charts/diagrams.)
- Explain working of various air-conditioning equipments and aids including ducts and fans
- Carryout maintenance task by using suitable tools and equipment

**TEACHING AND EVALUATION SCHEME:**

<b>Teaching Scheme (Hours per week)</b>				<b>Evaluation Scheme (Marks)</b>			
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credit</b>	<b>Theory</b>		<b>Practical</b>	
				<b>University Assessment</b>	<b>Continuous Assessment</b>	<b>University Assessment</b>	<b>Continuous Assessment</b>
4	-	2	5	60	40	20	30

**DETAILS OF COURSE CONTENTS:**

<b>Unit</b>	<b>Topic</b>	<b>Total Hrs.</b>	<b>Weightage %</b>
1	1.1 Concept of two phase system. 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 heat, sensible heat, enthalpy, entropy and specific volume of steam.	05	07
2	2.1 Air compressor-concepts, functions, classification and applications. 2.2 Working of reciprocating air compressor and rotary air compressors. 2.3 Single stage air compressor and multistage air compressor: i. Working. ii. Inter-cooling & after cooling.	05	07
3	<b>Internal Combustion Engines</b> 3.1 IC Engine-concept (comparison with External Combustion engine- EC), classification, working principle and terminology used. 3.2 Main components of IC engine and their functions. 3.3 Petrol engines (Spark Ignition- SI) & diesel engines (Compression Ignition-CI)-two strokes and four strokes both: Working principles. i. Cycles on P-V and T-s diagram. ii. Elements-sketch, working and functions. iii. Various systems- cooling, fuel injection (includes carburetion, fuel pump, fuel injectors, Multi Point Fuel Injection (MPFI), etc.), ignition, governing (quality, quantity and hit and miss governing), exhaust, etc. iv. Comparison between SI & CI Engines. v. Theoretical and actual valve timing diagrams. 3.4 MPFI- need and working. 3.5 Concept of scavenging and turbocharger. 3.6 Concept of Common Rail Direct Injection System- (CRDI) for diesel engine. 3.7 Performance testing of IC engines and its heat balance sheet (Simple numerical examples) with familiarization with testing as per BIS.	12	20
4	<b>Refrigeration</b> 3.1 Introduction to refrigeration.	12	20

	<p>3.2 Reversed Carnot cycle &amp; Bell column cycle. (No numerical)</p> <p>3.3 Unit of refrigeration &amp; basic terminology.</p> <p>3.4 VCRS components, types, their construction, working, applications, (components include compressor- Reciprocating, condensers- Air cooled and water cooled; evaporators-shell and tube type; expansion devices -Automatic, thermostatic expansion valve and capillary tube).</p> <p>3.5 Application of VCRS: Ice Plant, cold storage, water cooler, domestic refrigerator, deep freeze- block diagram, components, working.</p> <p>3.6 Basic concept of Vapor absorption refrigeration system.</p> <p>3.7 Refrigerants, classification, Desirable properties of refrigerants, and properties &amp; applications of commonly used refrigerants including R22, R134a, Hydro Carbon-HC and R717 (Ammonia), need of new refrigerants.</p>		
5	<p>Air-Conditioning</p> <p>4.1 Introduction to air conditioning. Air conditioning- types and its applications.</p> <p>4.2 Dessert cooler, window and split air conditioners- components and working.</p> <p>4.4 Ducts- need, types with applications, constructional materials, and installation, common troubles with their remedies.</p> <p>4.5 Air conditioning fans- types, constructional features, applications and common troubles with their remedies.</p>	05	06

**LIST OF PRACTICAL:**

<b>S. No.</b>	<b>Practical Exercises</b> (outcomes in Psychomotor Domain)	<b>Approx. Hours. required</b>
1	<p><b>Preparatory Activity:</b></p> <p>a. Student will recall and write basic thermodynamic units.</p> <p>b. Teacher will demonstrate working of I.C. Engine.</p> <p>i) Demonstrate and explain working and function of I.C. Engine.</p> <p>ii) Demonstrate working of two stroke and four stroke engine.</p>	02
2	<p><b>Demonstration of Air Compressor</b></p> <p>a. Demonstration and performance testing of air compressor</p>	02

3	<p><b>Demonstration of IC engine parts:</b></p> <ol style="list-style-type: none"> <li>Demonstrate and explain dismantling, assembling, working and inspection of fuel pump, fuel injector, carburetor and multipoint fuel injection system.</li> <li>Sketch and explain working of fuel pump, fuel injector, carburetor and multipoint fuel injection system.</li> <li>List dismantling and assembling methods/ steps in logical sequence. Record observations during inspection.</li> </ol>	04
4	<p><b>Perform test and prepare heat balance sheet of IC Engine. (Petrol and Diesel-both separately);</b></p> <ol style="list-style-type: none"> <li>Write specifications of IC engine undertaken for test.</li> <li>Demonstrate and perform test on IC engine.</li> <li>Observe and record test parameters.</li> <li>Derive required parameters- Indicated Power (IP), Break Power (BP), fuel consumption for varying load, efficiency, etc.</li> <li>Observe and record parameters required for heat balance sheet (For full load conditions).</li> <li>Prepare heat balance sheet.</li> <li>Interpret test results and heat balance sheet.</li> </ol>	04
5	<p><b>Refrigeration tubing operations:</b></p> <ol style="list-style-type: none"> <li>Demonstrate VCRS on any car/Bus from tubing point of view.</li> <li>Demonstrate various tubing tools and tubing operations.</li> <li>Perform various tubing operations.</li> <li>Sketch and explain VCRS demonstrated on any vehicle.</li> <li>Sketch and explain various tools used for refrigeration tubing.</li> <li>Describe tubing operations with neat sketches. Also state applications of each.</li> </ol>	02
6	<b>Leak detection, evacuation and refilling of the refrigerant</b>	04
7	<b>Demonstration of Refrigerator</b>	02
8	<b>Demonstration of window / split air- conditioner</b>	02
10	<p><b>Industrial visit: (ANY TWO)</b></p> <ol style="list-style-type: none"> <li>Visit cold storage plant, ice plant and air- conditioning plant to observe VCRS, different kinds of ducting.</li> <li>Visit any Industry working on I C Engine manufacturing/ running or power plant working on <b>I C Engine. (D. G. Power Plant.)</b></li> <li>Visit any petrol/ diesel/ CNG/ LPG station and study different fuel filling systems along with different parameters affected.</li> <li>Student will visit and prepare industrial visit report.</li> </ol>	04

**LIST OF REFERENCES:**

Sr. No.	Title of Books	Author	Publication
01	Heat Engines.	Pandya and Shah.	Charotar Publishing House.
02	Thermodynamics and Heat power Engg.	Mathur and Mehta.	Tata Mcgraw- Hill.
03	Heat Engines.	D. A. Wrangham.	Cambridge University Press.
04	Thermal Engineering.	R K Rajput.	Laxmi. Publications
05	A Text book of Thermal Engineering.	R S Khurmi& J.K. Gupta.	S Chand & Co.
06	I C Engine	Domkundwar	
07	I C Engine	Mathur and Sharma.	DhanpatRaiPubli.
08	Principles of Refrigeration	Dossat	Pearson Education
09	Refrigeration and Air conditioning	Arora & Domkundwar	Khanna publication
10	A Text Book of Air Refrigeration and Conditioning	R S Khurmi	Eurasia Publishing House
11	Thermal engineering	P.L.Ballaney	Khanna Publication
12	Thermal Science and Engineering	Dr. D.S.Kumar	S.K.Kataria & Sons.
13	Refrigeration & Air Conditioning.	R.K.Rajput	S.K.Kataria& Sons.