



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3161910

Semester – 6

Subject Name: Applied Thermodynamics

Type of course: Professional Core

Prerequisite: -

Rationale: A Mechanical Engineer must have good understanding of energy conversion in various thermal devices and must understand phenomena occurring in high speed compressible flow.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Properties of gases and gas mixtures: Avogadro's law, equation of state, Vander Waal's equation, reduced properties, law of corresponding states, compressibility chart, internal energy; enthalpy and specific heat of a gas mixtures	4
2	Psychrometry: Dalton's law of partial pressure, Properties of moist air, temperature and humidity measuring instruments, psychrometric chart, psychrometric processes such as sensible heating and cooling, heating and humidification cooling and dehumidification, chemical dehumidification, adiabatic saturation	8
3	Refrigerant and Refrigeration cycles: Classification, nomenclature and desirable properties of refrigerant, secondary refrigerants, ODP and GWP, Compound compression with intercooler, flash gas removal and flash intercooler, Desirable characteristics of refrigerant absorbent pair for vapor absorption cycle, Simple H ₂ O -NH ₃ cycle, LiBr ₂ – H ₂ O cycle and its working	8
4	Fuel Air and Actual Cycles: Assumptions for fuel–air cycles, reasons for variation of specific heats of gases, change of internal energy and enthalpy during a process with variable specific heats, isentropic expansion with variable specific heats, effect of variable specific heats on Otto, Diesel and Dual cycle, dissociation, comparison of air standard and fuel air cycles, effect of operating variables, comparison of air standard and actual cycles, effect of time loss, heat loss and exhaust loss in petrol and diesel engines,	8
5	IC engine performance and Emissions: Measurement of indicated power, brake power, friction power, fuel consumption and emission, calculation of brake thermal efficiency, brake power and brake specific fuel consumption, variable compression ratio engines, heat balance sheet, principal engine emissions, source of engine emissions, emission measurement instruments like five gas analyzer and smoke meter, Euro and Bharat standards of emissions of	10



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	I.C. Engines, Emission control methods like Air injection, Exhaust gas recirculation, Catalytic converter, Evaporative emissions control	
6	Fundamentals of compressible flow: Ideal gas relationship, Adiabatic energy equation, Mach number and its significance, Mach waves, Mach cone and Mach angle, static and stagnation states, relationship between stagnation temperature, pressure, density and enthalpy in terms of Mach number, stagnation velocity of sound, reference speeds, various regions of flow, Effect of Mach number on compressibility, Area velocity relationship.	8
7	Reciprocating Compressors: Construction and working, Multistage conditions for minimum work, Intercooling, Efficiency and control of air compressors Centrifugal Compressors: Essential parts, Static and total head properties, Velocity diagram, Degree of reaction, surging and choking, Losses in centrifugal compressor Axial Flow Compressors: Construction of an axial flow compressor, Aerofoil blading, Lift and drag, Performance characteristics	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	50	0	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education
2. Refrigeration and Air Conditioning by C P Arora, McGraw-Hill India Publishing Ltd.
3. Internal Combustion Engines by Ganeshan, McGraw-Hill Education
4. Turbines, Compressors and Fans by S.M. Yahya., TMH Publishers
5. Fundamentals of Internal Combustion engine by H.N.Gupta, PHI Learning
6. Internal Combustion Engine Fundamentals by John B. Heywood, McGraw Hill Education Pvt Ltd.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To apply various gas laws of real gas and their mixture, to make use of psychrometric properties to identify basic psychrometric processes.	22
CO-2	To experiment with vapor compression and vapor absorption systems.	14
CO-3	To explain fuel-air and actual cycles for IC engines and to develop understanding of IC engines testing and their emission norms.	32
CO-4	To apply fundamental of compressible fluid flow.	14
CO-5	To demonstrate various air compressors and experiment with them.	18

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List of Experiments:

1. To understand different components of VCR system and to determine its COP.
2. To perform different psychrometric processes and analyze the same using psychrometric chart.
3. To understand construction and working of window air-conditioner/ split air-conditioner and to determine its capacity.
4. To determine COP and apparatus dew point of an air conditioning test rig.
5. To determine $(COP)_C$ and $(COP)_H$ of heat pump.
6. To determine saturation efficiency of air cooler/air washer.
7. Performance test of 4 stroke Petrol Engine.
8. Performance test of 4 stroke Diesel Engine.
9. Determination of friction power of multi cylinder petrol engine using Morse Test Method.
10. Performance test on Reciprocating compressor.
11. To study the constructional details of axial flow compressor and draw its characteristics curve.
12. Performance test on Centrifugal compressor.

Major Equipment: VCR cycle test rig, Mechanical heat pump, psychrometric processes apparatus, window/split air conditioners, air conditioning test rig, air cooler/air washer, 4 stroke petrol engine, 4 stroke diesel engine, Morse test apparatus, reciprocating compressor test rig, axial flow compressor test rig, centrifugal compressor test rig

List of Open Source Software/learning website: <https://nptel.ac.in/course.php>