IV Semester

APPLIED THERMODYNAMICS

Course Code: 19ME1113

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3	0	0	3

Note: Use of steam tables, refrigeration and air-conditioning tables are permitted.

Course Outcomes: At the end of the course, the student will be able to

CO1: Explain the working of IC engines, estimate engine performance and identify the effects of abnormal combustion in IC engines

CO2: Calculate performance of reciprocating and axial flow air compressors

CO3: Explain and evaluate vapour and gas power cycles

CO4: Describe the working principles of steam nozzles and steam turbines

CO5: Outline the operation of refrigerators, identify different refrigerants and use properties of moist air in calculations for air-conditioning system

UNIT- I **10 Lectures**

IC Engines: Working principle and classification of IC engines, valve and port timing diagrams, comparison of two stroke and four stroke engines, comparison of SI and CI engines.

Combustion in IC Engines: SI engine, stages of combustion, normal combustion, abnormal combustion, variables affecting delay period and knocking, pre-ignition. CI engine, stages of combustion, normal combustion, abnormal combustion, variables affecting delay period. Fuel requirements and fuel rating.

Learning Outcomes: At the end of this unit, the student will be able to

1. demonstrate working of IC engines on the basis of air-standard cycles (L3)
2. explain various stages of combustion in SI and CI engines (L3)
3. examine the effect of engine variables on abnormal combustion in IC engines (L3)

UNIT- II **10 Lectures**

Testing of IC Engines: Measuring parameters – brake power – indicated power – friction power – mean effective pressure – specific fuel consumption – mechanical, thermal and volumetric efficiency. Heat balance sheet. Engine performance curves.

Air Compressors: Reciprocating compressors, single stage, work done, effect of clearance volume, volumetric efficiency, multi stage, effect of inter cooling. Axial flow air compressors: construction and working, velocity diagram, degree of reaction, work done factor, isentropic efficiency, losses, surging, choking and stalling.

Learning Outcomes: At the end of this unit, the student will be able to

1. explain testing methods and performance characteristics of IC engines (L3)
2. describe various reciprocating air compressors, the clearance volume and intercooling (L2)
3. explain the construction and working of axial flow air compressors, efficiency and losses (L3)

UNIT- III **10 Lectures**

Steam Power Cycles: Simple Rankine cycle, mean temperature of heat addition, methods to improve performance of Rankine cycle - reheating and regeneration.

Nozzles: Steam nozzles – flow through nozzle – nozzle efficiency – supersaturated flow – general

relationship between area, velocity and pressure in nozzle flow. Propelling nozzles – over expansion - under expansion.

Learning Outcomes: At the end of this unit, the student will be able to

1. explain concepts of steam power cycle used in steam power plant (L2)
2. describe the methods to improve performance of steam power cycles (L2)
3. examine steam flow through nozzle and determine the efficiency of nozzles (L3)

UNIT- IV **10 Lectures**

Steam Turbines: Classification of steam - impulse turbine and reaction turbine -compounding of turbines - velocity diagrams in impulse and reaction turbines, efficiency, degree of reaction - governing of turbines.
Gas Turbines: Simple gas turbine plant – classification – closed and open cycle gas turbines – intercooling, reheating and regeneration.

Learning Outcomes: At the end of this unit, the student will be able to

1. discuss classification of steam turbines and analyze their performance (L2)
2. discuss classification of gas turbines (L2)
3. describe the methods to improve performance of gas turbine cycles (L2)

UNIT- V **10 Lectures**

Refrigeration: Reversed Carnot cycle, Bell-Coleman cycle - vapor compression cycle, effect of vapour condition on COP of vapour compression refrigeration(VCR), vapour absorption cycle, properties of common refrigerants. Psychrometric properties, psychrometric chart, psychrometric processes
Jet Propulsion: Turbo jet – Turboprop – Ram jet – Pulse jet engine – Rocket engines.

Learning Outcomes: At the end of this unit, the student will be able to

1. discuss the working of different refrigeration cycles (L2)
2. determine the properties of moist air by using psychrometric chart (L3)
3. explain working of various jet propulsion systems (L2)

Text Books:

1. R. Yadav, *Applied Thermodynamics*, 6th Revised Edition, Central publishing house, 2011.
2. R.K. Rajput, *Thermal Engineering*, 10th Edition, Laxmi publications, 2018.

Reference Books:

1. T.D. Eastop and McConkey, *Applied Thermodynamics for Engineering Technologies*, 5th Edition, Pearson Education, 2002.
2. P.L. Ballaney, *Thermal Engineering*, 2nd Edition, Khanna publishers, 2005.
3. M.L. Mathur and F.S. Mehta, *Thermal Engineering*, 4th Edition, Jain brothers, 2014.
4. Mahesh M Rathore, *Thermal Engineering*, Tata McGraw Hill, 2010.

Data Books:

1. C.P. Kothandaraman, *Steam Tables*, 4th Edition, New Age International (P) Ltd Publishers, 2015.
2. R.S. Khurmi and N. Khurmi, *Steam Tables with Mollier Diagram* (in SI Units), S. Chand.
3. C.P. Kotandaraman, *Refrigerant Tables and Charts including Air Conditioning Data*, 5th Edition, New Age International (P) Ltd, 2018.
4. R.C. Arora, *Refrigeration and Air-Conditioning Data Book*, Prentice Hall India Learning Private Limited, 2010.