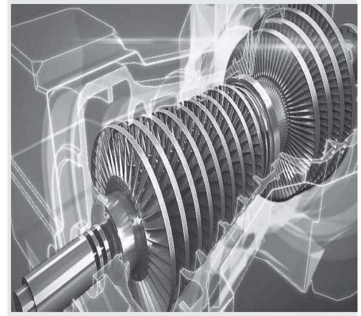
19ME303 APPLIED THERMODYNAMICS



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Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
5	45	-	-	-	-

PRE-REQUISITE COURSE: Engineering Thermodynamics

COURSE DESCRIPTION AND OBJECTIVES:

This course offers fundamental concepts and application of thermodynamic laws for compressors, IC engines and turbines. The objective of this course is to impart basic knowledge on work producing and consuming devices, understanding of performance parameters and methods to improve their efficiencies.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Characterize various performance parameters of energy devices using laws of thermodynamics.	1,2,4,5,12
2	Evaluate the performance parameters of engines and turbinesat different conditions.	1,2,3,4 6, 7,9,
3	Draw velocity triangles to determine efficiencies of steam turbines.	1,2,4,5
4	Apply different methods to improve thermal efficiency of a given system.	1,2,4,6
5	Investigate the working of various work producing devices.	1,2,3,4

SKILLS:

- ✓ Analyze the performance of air compressors.
- ✓ *Compare the performance of IC engines with different fuels.*
- ✓ *Interpret the efficiency of steam turbines for different inlet conditions.*
- ✓ *Estimate the performance of gas turbines using different methods.*

UNIT- I **L-9**

RECIPROCATING COMPRESSORS: Introduction, Classification and working principle, Work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors, Multistage air compressor and inter cooling - working of multistage air compressor.

UNIT- II **L-9**

PERFORMANCE OF I.C ENGINES: Performance parameters - brake power, indicated power, friction power, brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, relative efficiency, IMEP, BMEP, fuel consumption, volumetric efficiency, heat balance.

UNIT- III **L-9**

VAPOUR POWER CYCLES: Rankine cycle with reheat and regeneration, Super-critical and ultra-super-critical Rankine cycle, Binary vapour cycle, Cogeneration cycle.

STEAM NOZZLES: Introduction, Area - velocity relationship, Mass flow rate, Choking of nozzles, Performance characteristics of Nozzles, Super saturated flow.

UNIT- IV **L-9**

IMPULSE TURBINE: Classification, Mechanical details of Impulse turbine, Velocity diagram - effect of friction; Power developed, Axial thrust, Blade or Diagram efficiency, Condition for maximum efficiency, De-Laval Turbine - its features; Methods to reduce rotor speed, Velocity compounding and pressure compounding, Velocity and Pressure variation along the flow, Combined velocity and pressure compounding of impulse turbine.

REACTION TURBINE: Mechanical details, Principle of operation, Thermodynamic analysis of a stage, Degree of reaction, Velocity diagram, Parson's reaction turbine, Condition for maximum efficiency.

UNIT- V **L-9**

GAS TURBINES: Simple gas turbine plant, Ideal cycle, Essential components, Parameters of performance, Actual cycle - regeneration, inter cooling and reheating; Closed and Semi-closed cycles, Merits and demerits.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS : 30**

1. Estimate performance of single stage compressor without intercooler and plot the graphs.
2. Estimate performance of Multi stage compressor with intercooler and plot the graphs.
3. Evaluate the performance and emissions characteristics of a single cylinder 2 stroke petrol engine.
4. Evaluate the performance and emission characteristics of a single cylinder 4 stroke diesel engine.
5. Simulate the flow of steam through nozzle by using ANSYS and conduct flow analysis.
6. Perform thermodynamic cycle simulation of Rankine cycle at different qualities of steam.
7. Perform thermodynamic cycle simulation of impulse turbine at different steam inlet pressure.
8. Perform thermodynamic cycle simulation of reaction turbine at different steam inlet pressures.
9. Evaluate performance characteristics of gas turbine with regeneration using thermodynamic cycle simulation.
10. Perform cycle simulation of gas turbine with reheating unit.

TEXT BOOKS:

1. V.P Vasandani and D.S.Kumar, "Treatise on Heat Engineering", In MKS And SI Units, 4th edition, Metropolitan Book Co.Pvt Ltd, 2008.
2. P.L. Ballaney, "Thermal Engineering", 23rd edition, Khanna Publishers, 2012.
3. V.Ganesan, "Gas Turbines", 3rd edition, Tata McGraw-Hill, New Delhi, 2010.

REFERENCE BOOKS:

1. B. K Sarkar, "Thermal Engineering", 1st edition, Tata McGraw-Hill, 2005.
2. P K Nag, "Power Plant Engineering", 3rd edition, Tata McGraw-Hill, 2008.
3. R.K. Rajput, "Thermal Engineering", 9th edition, Laxmi Publications, New Delhi, 2015.