TURBOMACHINES

Course Code: 13ME2310 **L P C**
4 0 3

Pre requisites: Basic Thermodynamics and Thermal Engineering

Course Educational Objectives:

To make the student understand the concepts of

1. gas and steam turbine plants
2. axial and centrifugal compressor stages
3. axial and radial turbine stages
4. axial and centrifugal fans

Course Outcomes:

The student will be able to

1. apply thermodynamic principles to various stages of compressors and turbines
2. explain flow through cascades of compressors and turbines
3. draw velocity triangles for various stages of compressors and turbines
4. explain parameters required for the design of fans

UNIT-I

Turbo machines, turbines, pumps and compressors, fans and blowers, compressible flow machines, incompressible flow machines, turbine, compressor and fan stages, extended turbo machines, axial stages, radial stages, mixed flow stages, impulse stages, reaction stages, variable reaction stages, multistage machines, stage velocity triangles, design conditions, off-design conditions, applications.

Thermodynamics -basic definitions and laws, energy equation, adiabatic flow through nozzles, adiabatic flow through diffusers, work and efficiencies in turbine stages, work and efficiencies in compressor stages.

UNIT-II

Gas and steam turbine plants **-** open and closed circuit plants - aircraft gas turbine plants - gas turbines for surface vehicles, electric power station, petro-chemical plants and cryogenics.

Types of steam turbines – steam power cycle – industrial steam turbines – combined steam and gas turbine plants.

Flow through cascades **-**two-dimensional flow, cascade of blades, cascade performance, axial turbine cascades, axial compressor cascades, annular cascades, radial cascades.

UNIT-III

Axial compressor stages **-**stage velocity triangles, enthalpy-entropy diagram, flow through blade rows, stage losses and efficiency, work done factor, low hub-tip ratio stages, supersonic and transonic stages, performance characteristics.

Centrifugal compressor stages -elements of centrifugal compressor stage, stage velocity triangle, enthalpy-entropy diagram, nature of impeller flow, slip factor, diffuser, volute casing, stage losses and performance characteristics.

UNIT-IV

Axial turbine stages -stage velocity triangle, single impulse stage, multi stage velocity and pressure compounded impulses, reaction stages, blade-to-gas speed ratio, losses and efficiencies, performance charts, low hub-trip ratio stages.

Radial turbine stages **-e**lements of a radial turbine stage, stage velocity triangles, enthalpy-entropy diagram, stage losses, performance characteristics, outward flow radial stages.

UNIT-V

Axial fans and centrifugal fans **-**fan applications, axial fans, fan stage parameters, types of axial fan stages, types of centrifugal fans, centrifugal fan stage parameters, design parameters.

TEXT BOOKS:

1. S.M. Yahya, "*Turbines, Pumps, Compressors"*, 4th Edition, Tata McGraw Hill, 2010.

REFERENCES:

1. Charles A, Earsons, "*The steam turbine"*, Cambridge University Press, 2012.
2. Norman Davey, "*Gas Turbines – Theory and practice"*, 3rd Edition, Merchant Books, 2006.
3. S.M. Yahya, "*Fundamentals of Compressible flow with aircraft and rocket propulsion"*, New Age International, 2010.
4. Cophen, Roger and Sarvanamiuttu, "*Gas Turbines"*, 6th Edition, Pearson, 2008.
5. Seppo A. Korpela, "*Principles of turbomachinery"*, John Wiley & Sons, 2011.