SCHEME OF COURSE WORK:

Course Details:

Course Title	**THERMAL TURBOMACHINES**					
Course Code	19ME2206	**LTPC**	**3**	**0**	**0**	**3**
Program	M.Tech.					
Specialization	Thermal Engineering					
Semester	II					
Prerequisites	Fluid Mechanics and Thermal Engineering					
Course to which is a prerequisite	NA					

Course Outcomes:

CO1	Apply thermodynamic principles to nozzles, diffusers and methods to estimate the stage work and efficiency of radial turbines.
CO2	Apply the methods to estimate the stage work and efficiency of axial turbines.
CO3	Apply the methods to estimate the stage work and efficiency of axial compressors.
CO4	Apply the methods to estimate the stage work and efficiency of centrifugal compressors.
CO5	Explain the parameters required for the design of fans.

Program Outcomes:

PO Code	**Program Outcome (PO)**
PO1	exhibit in-depth knowledge in thermal engineering specialization
PO2	think critically and analyse complex engineering problems to make creative advances in theory and practice
PO3	solve problem, think originally and arrive at feasible and optimal solutions with due consideration to public health and safety of environment
PO4	use research methodologies, techniques and tools, and will contribute to the development of technological knowledge
PO5	apply appropriate techniques, modern engineering tools to perform modelling of complex engineering problems with knowing the limitations
PO6	understand group dynamics, contribute to collaborative multidisciplinary scientific research
PO7	demonstrate knowledge and understanding of engineering and management principles and apply the same with due consideration to economical and financial factors
PO8	communicate complex engineering problems with the engineering community and society, write and present technical reports effectively
PO9	engage in life-long learning with a high level of enthusiasm and commitment to improve knowledge and competence continuously
PO10	exhibit professional and intellectual integrity, ethics of research and scholarship and will realize the responsibility towards the community
PO11	examine critically the outcomes of actions and make corrective measures

Course Outcome Vs Program Outcomes

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	M	M	M	M							
CO2	S	M	M	M	M	M						
CO3	S	M	M			M						
CO4	S	M	M			M						
CO5	S											

S - Strongly correlated, M - Moderately correlated, Blank - No correlation

Assessment Methods:
Assignment/Quiz/Seminar/Case Study, Mid term exam and End term examination.

Week	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING - LEARNING STRATEGY	Assessment Method & Schedule
1	Turbo machines, thermodynamics -basic definitions and laws, energy equation, adiabatic flow through nozzles, adiabatic flow through diffusers, work and efficiencies in turbine stages,	CO1	Define turbo machine What is difference between energy transfer and energy transformation? How to determine the stagnation properties?	▫ Lecture ▫ Demo class	
2	work and efficiencies in compressor stages Radial turbine stages -elements of a radial turbine stage,	CO1	Differentiate efficiency based on the pressure ratio? Describe the working of Radial flow turbine	▫ Lecture ▫ Discussion	**Assignment-1 (Week 2- 6)**
3	stage velocity triangles, enthalpy-entropy diagram and Problems	CO1	Problems on Radial flow turbines.	▫ Lecture ▫ Discussion	
4	stage losses, performance characteristics, outward flow radial stages.	CO1	What are the various stage losses?	▫ Lecture ▫ Discussion	
5	Axial turbine stages -stage velocity triangle, single impulse stage, multi stage velocity and pressure compounded impulses,	CO2	Draw and represent the static and total quantities of system on h-s diagram of an axial turbine	▫ Lecture ▫ Problem solving	
6	reaction stages, blade-to-gas speed ratio, losses and efficiencies, performance charts,	CO2	Draw and describe the velocity triangles for pure impulse, 50% reaction and pure reaction turbines	▫ Lecture ▫ Problem solving	
7	Problems and low hub-trip ratio stages.	CO2	problems	▫ Lecture ▫ Discussion	
8	Axial compressor stages -stage velocity triangles, enthalpy-entropy diagram	CO3	Explain the energy transfer and transformation across the axial compressor stage and draw the h-s diagram	▫ Lecture ▫ Discussion	
9	**Mid-Test 1**				**Mid-Test 1 (Week 9)**
10	flow through blade rows, stage losses and efficiency, work done factor and Problems	CO3	Derive the equation for work input to an axial flow compressor in terms of blade angle	▫ Lecture ▫ Discussion ▫ Problem solving	
11	Problems, low hub-tip ratio stages, supersonic and transonic stages	CO3	Problems	▫ Lecture ▫ Discussion ▫ Problem solving	
12	Centrifugal compressor stages -elements of centrifugal compressor stage, stage	CO4	Explain the energy transfer and transformation across the	▫ Lecture ▫ Discussion	**Assignment- 2 (Week 11- 16)**

	velocity triangle,		Centrifugal compressor stage and draw the h-s diagram	▫ Lecture ▫ Discussion	
13	enthalpy-entropy diagram, nature of impeller flow, slip factor,	CO4		▫ Lecture ▫ Discussion	
14	diffuser, performance characteristics	CO4	Describe the function of diffuser and what are all various types of diffuser vanes?	▫ Lecture ▫ Discussion ▫ Problem solving	
15	Problems	CO4	Problems	▫ Lecture ▫ Discussion	
16	fan applications, axial fans, fan stage parameters, types of axial fan stages	CO5	Differentiate among fan, blower and compressor? What are various axial fan stage parameters?	▫ Lecture ▫ Discussion Problemsolving	
17	types of centrifugal fans, centrifugal fan stage parameters, design parameters	CO5	What are various centrifugal fan stage parameters?	▫ Lecture Discussion	
18	Problems on Axial and Centrifugal Fans	CO5	Problems	▫ Lecture ▫ Discussion Problemsolving	
19	**Mid-Test 2**				**Mid-Test 2 (Week 19)**