TURBO MACHINERY AND DYNAMICS

II Semester: AE								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BAEC21	**Elective**	3	-	-	3	30	70	100
Contact Classes:45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course provides an introduction to the working principles, performance and design of turbo machinery. The course first covers a review of essential fluid and thermo-dynamics. Concepts relevant to all turbo machines are then introduced. Axial turbines and compressors are studied in depth, including their kinematics, performance and design. The three-dimensional effects in turbo machinery, centrifugal machines, propellers, hydraulic turbines and wind turbines.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The working principles of turbines and pumps/compressors
II. The basic loading and performance analysis for a variety of machines
III. The fluid-thermodynamic mechanisms associated with performance degradation
IV. The basic operating principles of centrifugal machines, propellers, hydraulic turbines and wind turbines.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1	**Relate** the working principles of turbo machines for predicting its thermodynamic.	**Analyze**
CO 2	**Demonstrate** typical designs of turbo machines and differentiate from positive displacement machines.	**Understand**
CO 3	**Illustrate** the off-design behavior of turbines and compressors and relate it to changes in the velocity triangles.	**Apply**
CO 4	**Analyze** the relations between choices made early in the turbo machinery design process and the final components and operability.	**Analyze**
CO 5	**Apply** the Euler's equations for turbomachinery to analyze energy transfer in turbomachines	**Apply**
CO 6	**Analyze** the performance of turbo machinery by using the preliminary designs of pumps, compressors and turbines.	**Analyze**

IV. SYLLABUS:

MODULE-I: ENERGY TRANSFER IN TURBOMACHINES (08)

Application of first and second laws of thermodynamics to turbo machines, moment of momentum equation and Euler turbine equation, principles of impulse and reaction machines, degree of reaction, energy equation for relative velocities, one dimensional analysis only.

MODULE-II: STEAM TURBINES (10)

Impulse staging, velocity and pressure compounding, utilization factor, analysis for optimum U.F curtis stage, and rate stage, include qualitative analysis, effect of blade and nozzle losses on vane efficiency, stage efficiency and analysis for optimum efficiency, mass flow and blade height; Reactions staging: Parson‟s stages, degree of reaction, nozzle efficiency, velocity coefficient, stator efficiency, carry over efficiency, stage efficiency, vane efficiency, conditions for optimum efficiency, speed ratio, axial thrust, reheat factor in turbines, problem of radial equilibrium, free and forced vortex types of flow, flow with constant reaction, governing and performance characteristics of steam turbines.

MODULE-III: WATER TURBINES (10)

Classification, Pelton, Francis and Kaplan turbines, vector diagrams and work-done, draft tubes, governing of water turbines; Centrifugal pumps: classification, advantage over reciprocating type, definition of mano-metric head, gross head, static head, vector diagram and work done.

Performance and characteristics: Application of dimensional analysis and similarity to water turbines and centrifugal pumps, unit and specific quantities, selection of machines, hydraulic, volumetric, mechanical and overall efficiencies, Main and operating characteristics of the machines, cavitations.

MODULE-IV: ROTARY FANS, BLOWERS AND COMPRESSORS (09)

Classification based on pressure rise, centrifugal and axial flow machines; Centrifugal Blowers Vane shape, velocity triangle, degree of reactions, slip coefficient, size and speed of machine, vane shape and stresses, efficiency, characteristics, fan laws and characteristics; Centrifugal Compressor – Vector diagrams, work done, temp and pressure ratio, slip factor, work input factor, pressure coefficient, Dimensions of inlet eye, impeller and diff user; Axial flow compressors; Vector diagrams, work done factor, temp and pressure ratio, degree of reaction, dimensional analysis, characteristics, surging, polytrophic and is entropic efficiencies.

MODULE-V: POWER TRANSMITTING TURBO MACHINES (08)

Application and general theory, their torque ratio, speed ratio, slip and efficiency, velocity diagrams, fluid coupling and Torque converter, characteristics, positive displacement machines and turbo machines, their distinction; Positive displacement pumps with fixed and variable displacements, hydrostatic system shy draulic intensifier, accumulator, press and crane.

V. TEXT BOOKS:

1. Yahya S.H.,Turbines,"Compressor and Fans",TMH,2nd Edition, 2008.
2. Venkanna B.K., "Fundamentals of Turbo Machines", PHI Learning Private Limited, 5th Edition, 2005.

VI. REFERENCE BOOKS:

1. Kadambi V Manohar Prasad; "An Introduction to EC Turbo Machinery" Vol.III, Wiley Eastern, 1st Edition, 1999.

VII. WEB REFERENCES:

1. http://www.slideshare.net/asifzhcet/fluid-mechanics-and-hydraulic-machines-dr-r-k-bansal
2. http://as.wiley.com/WileyCDA/WileyTitle/productCd-0470124229.html

VIII. E-TEXT BOOKS:

1. http://files.asme.org/Divisions/FED/16300.pdf
2. ftp://210.212.172.242/Digital_Library/Mechanical/TURBOMACHINES/Principles%20of%20Turbomachinery.pdf