DEPARTMENT OF
MECHANICAL ENGINEERING

Scheme of Instruction and Syllabus
of
M.E. (Mechanical)

Specialization:

TURBOMACHINERY

Full time / Part time
(2015-16)

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous)
Osmania University
Hyderabad – 500 007, Telangana, INDIA
**Scheme of Instruction & Examination**

M.E. (Mechanical Engineering) 4 Semesters (Full Time)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Subject</th>
<th>Hours per week</th>
<th>Duration (Hrs)</th>
<th>Max. Marks</th>
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| Semester - III |   | 4   | 4   | --  | 100** | 8 |
|               | Project+ Seminar*        | --  | 4   | 4   | --   |    |
|               |                          |     |     |     |      |    |

| Semester – IV |   | 6   | 6   | 200 | -    | 16 |
|-------------|---|-----|-----|-----|------|
| 1.          | Dissertation            | --  | 6   | 6   | 200  | -   |

**Note:** Six core subjects, six elective subjects, two laboratory courses and two seminars should normally be completed by the end of semester II.

*One project seminar presentation.*

**50 marks to be awarded by guide and 50 marks to be awarded by viva-voice committee comprising Guide and two internal senior faculty members (subject experts)**
### Scheme of Instruction & Examination
M.E. (Mechanical Engineering) 6 Semesters (Part Time)

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<th>Sl. No</th>
<th>Subject</th>
<th>Hours per week</th>
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Note: Six core subjects, six elective subjects, two laboratory courses and two seminars should normally be completed by the end of semester IV.

* Project seminar presentation on the topic of Dissertation only

** 50 marks to be awarded by guide and 50 marks to be awarded by viva-voice committee comprising Guide and two internal senior faculty members (subject experts)
With effect from 2015 - 16

M. E. Mechanical Engineering(Turbomachinery)

w. e. f. 2015-2016

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CIE : Continuous Internal Evaluation    SEE : Semester End Examination
PRINCIPLES OF TURBO MACHINERY

**Instructions**  3 periods/week

**Credits**  3

**Duration of university Examination:** 3 hours

**SEE:** 70 Marks

**CIE:** 30 Marks

**Objectives:**
1. To learn classification of turbomachines
2. To calculate energy transfer through a turbomachine
3. To understand energy transfer and losses in centrifugal compressors, axial fans and steam turbines

**UNIT-I**


**UNIT-II**


**UNIT-III**


**UNIT-IV**

Flow through Centrifugal compressors. Stage velocity triangles, specific work, forward, radial and backward swept vanes. Enthalpy entropy diagram, degree of reaction, slip factor, efficiency. Vane less and vaned diffuser systems, volute as spiral casing. Surge and stall in compressors

**UNIT-V**

Axial turbine stages, stage velocity triangles, work, efficiency, blade loading, flow coefficient. Single stage impulse and reaction turbines, degree of reaction, 50% reaction turbine stage, Radial equilibrium and Actuator disc approach for design of turbine blades. Partial admission problems in turbines. Losses in turbo machines.

**Suggested Reading:**

1. S.M. Yahya, Turbines, Compressors and Fans, Tata Mcgraw Hill.
5. Balajee, Designing of Turbomachines.
FLUID FLOW AND GAS DYNAMICS

Instructions  3 periods/week
Credits  3

Duration of university Examination: 3 hours
SEE: 70 Marks
CIE: 30 Marks

Objectives:
1) To understand basic concepts of fluid motion
2) To formulate fundamental conservation equations for fluid flow.
3) To understand flow phenomena over an airfoil.
4) To study about the Compressibility effects on fluid flow properties

UNIT-I


UNIT-II


UNIT-III


UNIT-IV


UNIT-V


Suggested Reading:
ME2203

CASCADE AERODYNAMICS

Instructions  3 periods/week
Credits  3  Duration of university Examination: 3 hours

Objective:
1) To understand Airfoil blade nomenclature and NACA Series specifications.
2) To analyse the flow phenomena over turbine /compressor Airfoil blades /cascades.
3) To learn about application of finite difference techniques in study of flow through turbomachinery passages.

UNIT-I
Airfoil blade geometry. Blade terminology – leading and trailing edges, flow angles, blade angles, camber line, chord line, solidity, space to chord ratio, aspect ratio, Comparison of turbine and compressor blade/cascade profiles.

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
Application of finite difference techniques for study of flow phenomena – first & second order accuracy relations for forward, rearward & central difference relations. Two dimensional supersonic flow through a turbo machine passage – application of Mack’s finite difference Methods, transformation of physical plane into computational plane, governing equations, primitive variables, flux variables, predictor – corrector approach for obtaining numerical solutions.

Suggested Reading:
HEAT TRANSFER AND HEAT EXCHANGERS IN POWER PLANTS

**Instructions**  3 periods/week  
**Credits**  3  
**Duration of university Examination:**  3 hours  
**SEE:**  70 Marks  
**CIE:**  30 Marks

**UNIT-I**  
Conduction: Two dimensional steady state problems – Cartesian and cylindrical geometries. General unsteady state heat conduction equation in cylindrical and spherical co-ordinates. Periodic and non periodic temperature variations within a semi-infinite solid within infinite wall. Extended Surfaces (Fins): Heat transfer from a straight fin (Plate) of a uniform cross section, Error in measurement of temperature in a thermometer well, Fin efficiency, Applications.

**UNIT-II**  

**UNIT-III**  

**UNIT-IV**  
Boiling and condensation: Boiling: Boiling phenomenon, Boiling curve, Mechanism of nucleate boiling, Stable film boiling, Forced convection boiling. Condensation: Condensation phenomenon, Film Condensation on a vertical surface, Condensation out side a horizontal tube or a tube bank, Condensation inside a horizontal tube. Drop wise Condensation. Introduction to two-phase flow: Simple momentum and energy equations.

**UNIT-V**  

**Suggested Reading:**  
ME2205

DESIGN OF STEAM TURBINES

Instructions: 3 periods/week
Credits: 3

Duration of university Examination: 3 hours
SEE: 70 Marks
CIE: 30 Marks

UNIT-I


UNIT-V Blade attachment techniques. Critical speeds and balancing of rotors, speed regulation of turbines. Static and dynamic balancing of turbogenerator sets.

Suggested Reading:
ME2206

COMPUTATIONAL FLUID DYNAMICS

Instructions 3 periods/week  Duration of university Examination: 3 hours
Credits 3  SEE: 70 Marks  CIE: 30 Marks

Objectives:
1. To convert the conservation equations of fluid flow in differential form into algebraic equations and apply numerical methods to obtain solutions.
2. To learn the finite difference method.
3. To learn finite volume method and solution methodology for fluid flow problems.

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

Suggested Reading:
DESIGN OF GAS TURBINES

Instructions  3 periods/week  
Credits  3  
Duration of university Examination: 3 hours  
SEE: 70 Marks  
CIE: 30 Marks

UNIT-I

UNIT-II
Applications of Turbo Compressors (Centrifugal and axial flow) in Gas turbine power plant. Euler equation of energy transfer in a turbomachine. Design of two stage centrifugal compressor with vaneless and vaned diffusers. Design of multi stage axial flow compressors.

UNIT-III
Types of combustion chambers. Combustion chamber design for modern gas turbines. Can type, annular and tube type of combustors.

UNIT-IV
Analysis and design of 2-D and 3-D flow for axial flow turbines. Matching of compressor and turbine for varying load operation. Gas turbine for super charging and cryogenic applications. Small gas turbines for space applications.

UNIT-V

Suggested Reading:
ME2208

POWER PLANT STEAM GENERATORS

Instructions  3 periods/week  Duration of university Examination: 3 hours
Credits  3  SEE: 70 Marks  CIE: 30 Marks

UNIT-I

UNIT-II
Requirements in modern boilers, Types of steam generators and their construction and application, Fuels and Fuel Handling systems, for steam generators.

UNIT-III
Air-handling systems, Combustion in combustion systems with different types of fuels, combustion calculations, Once-thro’ boilers, Fluidised bed combustion boilers, Cyclone furnace boilers.

UNIT-IV
Furnace sizing, Burner selection and design combined cycle power plant steam generators, Emissions from steam generators and its control.

UNIT-V
Boiler maintenance, safety regulation and inspection, Ash handling Case study of typical modern boiler systems.

Suggested Reading:
ME2401  

FINITE ELEMENT TECHNIQUES  

Instructions  3 periods/week  

Duration of university Examination: 3 hours  

Credits  3  

SEE: 70 Marks  

CIE: 30 Marks  

Objectives:  

- To understand the theory and application of the finite element method for analyzing structural systems.  
- To learn Approximation theory for structural problems as the basis for finite element methods.  
- To learn formulations for a variety of elements in one, two, and three dimensions.  
- To understand modeling and analysis of structures using planar, solid, and plate elements.  

UNIT-I  


UNIT-II  

Analysis of trusses and frames: Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node. Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element.  

UNIT-III  

Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmmetric solids subjected of axisymmetric loading with triangular elements. Convergence requirements and geometric isotropy.  

UNIT-IV  


UNIT-V  


Suggested Reading:  

ME2306

COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS

Instructions 3 periods/week  Duration of university Examination: 3 hours
Credits 3  SEE: 70 Marks  CIE: 30 Marks

Objectives:
- To develop students knowledge and understanding of Bending of Plates.
- To understand the basics of designing pressure vessels against internal and external pressure loads. To understand the effect of thermal stress on pressure vessel.
- To understand the phenomenon of buckling in pressure vessels and usage of various methods available to prevent buckling of pressure vessels.
- To understand the importance of numerical methods in solving multi degree freedom dynamic analysis problems.

To understand various numerical methods available for solving eigen values problems

UNIT-I
Stresses in flat plates: Introduction, Bending of plate in one direction, Bending of plate in two perpendicular directions, Thermal stresses in plates, Bending of circular plates of constant thickness, Bending of uniformly loaded plates of constant thickness.

UNIT-II
Design of pressure Vessels: Introduction and constructional features of pressure vessels, stresses in pressure vessels, shrink fit stresses in built up cyliners, autofrettage of thick cylinders, thermal stresses and their significance. Stress concentration at a variable thickness, thickness transition in a cylindrical vessel, about a circular hole, elliptical openings, reinforcement design

UNIT-III
Buckling in vessels: Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT-IV
Eigen Value Problems: Properties of Eigen values and Eigen Vectors, Torsional, Longitudinal vibration, lateral vibration, Sturm sequence. Subspace iteration and Lanczo’s method, Component mode synthesis, Eigen value problems applied to stepped beams and bars.

UNIT-V

Suggested Reading:

With effect from 2015 - 16
VIBRATION ANALYSIS AND CONDITION MONITORING

Instructions  3 periods/week  
Credits  3  

Duration of university Examination: 3 hours  
SEE: 70 Marks  
CIE: 30 Marks

Objectives
- Fully understand importance of vibrations in mechanical design of machine parts that operate under vibratory conditions.
- Able to write differential equation of motion of vibratory system and understand free and forced modes of vibration
- Able to obtain linear vibratory models of dynamic systems of varying complexity (SDOF, MDOF)
- Able to understand the various condition monitoring techniques available in the literature.
- Able to understand the various devices available to record interpret and understand the vibration data.

UNIT-I
Causes and effects of vibration. Vibrations of Single Degree of freedom systems. Free, Damped and Forced vibrations

UNIT-II
Two Degree of freedom systems. Bending vibrations of two degree of freedom systems, Steady state and transient characteristics of vibration, vibration absorber and vibration isolation.

UNIT-III

UNIT-IV

UNIT-V
Contaminant analysis, SOAP and other contaminant monitoring techniques. Special vibration measuring techniques - Change in sound method, Ultrasonic measurement method, Shock pulse measurement, Kurtosis, Acoustic emission monitoring, Cepstrum analysis, Modal analysis, critical speed analysis, Shaft –orbit & position analysis.

Suggested Readings:
2. V.P.Singh, Mechanical vibrations, Dhanpat Rai Publications, 2015
ME2107

MECHANICS OF COMPOSITE MATERIALS

**Instructions**  3 periods/week  
**Credits**  3  
**Duration of university Examination:** 3 hours  
SEE: 70 Marks  
CIE: 30 Marks

UNIT-I


UNIT-II

Micromechanics of Composites: Mechanical properties: Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

UNIT-III

Macromechanics of Composites: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams.

UNIT-IV


UNIT-V


**Suggested Reading:**

FLUID POWER SYSTEMS

Instructions: 3 periods/week
Duration of university Examination: 3 hours

Credits: 3
SEE: 70 Marks
CIE: 30 Marks

Objectives
- The course will develop the students’ knowledge and understanding of hydraulic and pneumatic devices and systems.
- The students should be able to understand the principles of operation and the design details of hydraulic pumps, motors, valves, actuators, and systems.
- The student should be able to analyze both the steady-state and the dynamic performance of individual hydraulic components and systems.
- The student should also be able to relate the theory with the practical applications of these principles.

UNIT - I
Advantages and Disadvantages of Fluid control, Types of Hydraulic Fluids, physical, chemical and thermal properties of hydraulic fluids, selection of hydraulic fluid, fluid flow fundamentals. Hydraulic Pumps and Motors: Basic Types and constructions, ideal pump and motor analysis, Performance curves and parameters

UNIT - II
Hydraulic Control Valves- Valve configurations, general valve analysis, critical center, open center, three way spool valve analysis and Flapper valve analysis, pressure control valves, single and two stage pressure control valves, flow control valves, introduction to electro hydraulic valves.

UNIT - III
Hydraulic Power Elements: Valve controlled motor, valve controlled piston, three way valve controlled piston, pump controlled motor, pressure transients in power elements.

UNIT - IV

UNIT - V
Control of pressure and speed in Hydraulic and Pneumatic Systems, Fluidics:proportional amplifier, bistable amplifier, vortex amplifier, turbulence amplifier, impact modulator, Boolean algebra, fluid logics,manipulation of logic expressions, special circuits and sequential circuits.

Suggested Reading:
2 D McCloy & H R Martin,” The control of fluid power” Longman publications.1980
ADVANCED ENERGY SYSTEMS

Instructions 3 periods/week  Duration of university Examination: 3 hours
Credits 3 SEE: 70 Marks  CIE: 30 Marks

Objectives:
- To explain the concept of various forms of renewable energy sources.
- To design renewable/hybrid energy systems that meet specific energy demands, are economically feasible and have a minimal impact on the environment.
- Explain the concepts of waste heat recovery, Fluidization and applications.
- The students will have sufficient knowledge on working of various fuel cells.

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

Suggested Reading:
EXPERIMENTAL TECHNIQUES IN TURBO MACHINES

Instructions 3 periods/week  
Duration of university Examination: 3 hours
Credits 3

Objectives
- To develop innovative techniques to solve turbomachinery problems.
- To apply a deep working knowledge on instruments for experiments in areas related to turbomachinery and thermal systems.
- To design and implement new experiments in turbomachinery.

UNIT-I
Experiment planning, experiment design factors. Classification of measurement techniques. Conventional techniques for measurement of Flow, Pressure, Temperature and Velocity in turbomachinery passages.

UNIT-II
Temperature measuring devices – Thermo electric thermometry and pyrometry. Instantaneous pressure measurement using pressure transducers, Pitot tube, probes,. Boundary layer measurement. Calibration of probe.

UNIT-III
Wind tunnels: Schematic layout of wind tunnel with test section, subsonic, transonic and supersonic wind tunnels. Measurement of turbulence using a Hot wire anemometer and Laser Doppler anemometer.

UNIT-IV
Calibration methods and signal processing techniques. General data acquisition system Data transmission, A/D and D/A conversion, Recorders with digital display. Data collection and storage.

UNIT-V

Suggested Reading:
1. R.C.Dean, Aerodynamics Measurements, Gas Turbine Laboratory, Massachusetts Institute of Technology, Cambridge, 1953.
2. David Japikse (Editor),Advanced Experimental Techniques In Turbomachinery, December 1986.
ME2211

**ROTOR DYNAMICS**

**Instructions** 3 periods/week  
**Credits** 3  
**Duration of university Examination:** 3 hours  
**SEE:** 70 Marks  
**CIE:** 30 Marks

**UNIT-I**


**UNIT-II**


**UNIT-III**

Vibrations of multi rotor systems – Matrix method, Influence coefficient methods, Transfer matrix analysis and Holzers method.

**UNIT-IV**

Torsional vibrations in rotating machinery – Equivalent discrete system, transient response, branched system.

**UNIT-V**


**Suggested Reading:**

ME2212

FLOW INDUCED VIBRATIONS

Instructions  3 periods/week  Duration of university Examination: 3 hours
Credits  3  SEE: 70 Marks  CIE: 30 Marks

UNIT-I

Single degree system with external excitation. Two degree System, Modal analysis, Principal coordinates.

UNIT-II Non dimensional variables, Vortex induced vibrations, Vortex wake of a stationary cylinder, Strouhal’s number, Wake oscillatory model, Correlation model, Reduction of vortex induced vibrations.

UNIT-III

Stall flutter, Stability of one degree and two degree freedom systems. Response of one degree and two degree of freedom systems, Galloping of a beam and cable and reduction of galloping vibrations.

UNIT-IV

Vibrations induced by oscillatory flow, solution of linearised equations, Oscillatory flow with mean zero flow and with mean flow, Sound induced by vortex shedding.

UNIT-V

Vibrations of pipe containing fluid flow, Vibrations of cantilever and pinned-pinned pipe, Pipe whip.

Suggested Reading:

ME2213

FUELS AND COMBUSTION

Instructions 3 periods/week  Duration of university Examination: 3 hours
Credits 3

SEE: 70 Marks  CIE: 30 Marks

UNIT-I
Introduction: General, Conventional energy resources, Solar energy, Nuclear power, Energy from biomass, Wind power, Tidal power, Geothermal energy, Energy survey for India, Rocket Fuels, Definitions, Units, Measures.

UNIT-II
Solid Fuels: General, Biomass, Peat, Lignite or Brown Coal, Sub-bituminous Coal or Black Lignite, Bituminous Coal, Semi-anthracite, Anthracite, Cannel coal and Boghead coal, Natural coke (Jhama)/SLV fuel, Origin of coal, Composition of coal, Analysis and properties of coal, Action of heat on coal, Oxidation of coal, Hydrogenation of coal, Classification of coal. Processing of Solid Fuels: General Coal preparation, Storage of coal, Coal carbonization, Briquetting of solid fuels, Liquefaction of solid fuels.

UNIT-III
Liquid Fuels: General, Petroleum, Origin of Petroleum, Petroleum production, Composition of petroleum, Classification of petroleum, Nature of Indian crude’s, Petroleum processing, Important petroleum products, Properties and testing of petroleum and petroleum products, Petroleum refining in India, Liquid fuels from sources other than petroleum, Gasification of liquid fuels, Storage and handling of liquid fuels.

UNIT-IV
Gaseous fuels: General, Types of gaseous fuels, Natural gas, Methane from coal mines, Producer gas, Water gas, Carbureted water gas, Complete gasification of coal, Underground gasification of coal, Coal gas, Blast furnace gas, Gases from biomass, Refinery gases, Liquefied petroleum gases (LPG), Oil gasification, Cleaning and purification of gaseous fuels.

UNIT-V

Suggested Reading:
DESIGN OF THERMAL SYSTEMS

Instructions  3 periods/week

Duration of university Examination: 3 hours

Credits  3

SEE: 70 Marks  CIE: 30 Marks

UNIT-I


UNIT-II


UNIT-III


UNIT-IV


UNIT-V


Suggested Reading:

ME2215

DESIGN OF PUMPS AND COMPRESSORS

Instructions 3 periods/week
Credits 3

Duration of university Examination: 3 hours
SEE: 70 Marks
CIE: 30 Marks

UNIT-I

Introduction to pumps and compressors. Characteristics of working fluids, Fluid mechanics concepts and governing laws of fluid flow.

UNIT-II


Suggested Reading:

ME2216

NUMERICAL METHODS

**Instructions** 3 periods/week

**Credits** 3

**Duration of university Examination:** 3 hours

**SEE:** 70 Marks

**CIE:** 30 Marks

**UNIT-I**

Solving linear sets of equations Gauss Elimination, LV Decomposition, Matrix Inversion, Scalar Tridiagonal Matrix, Thomas Algorithm, Gauss Seidel Method, Secant Method

**UNIT-II**


**UNIT-III**

Interpolation & Polynomial Approximation Least Squares Method, Lagrange Interpolation, Hermite Interpolation, Cubic Spline Interpolation, Chebeshev Polynomials & Series

**UNIT-IV**

Numerical Differentiation & Integration Numerical Differentiation, Richardson's Extrapolation, Definite & Indefinite Integrals, Simpson's Rule, Trapezoid Rule, Gaussian Quadrature

**UNIT-V**


**Suggested Reading:**

ME2001

ENGINEERING RESEARCH METHODOLOGY

Instructions 3 periods/week  
Credits 3  
Duration of university Examination: 3 hours  
SEE: 70 Marks  
CIE: 30 Marks

Objectives:

1. To learn the research types, methodology and formulation.
2. To know the sources of literature, survey, review and quality journals.
3. To understand the research design for collection of research data.
4. To understand the research data analysis, writing of research report and grant proposal.

Unit - I


Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

Unit - II


Unit - III


Unit - IV

Data Collection: Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Sample Design, Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V/s Non Parametric methods, Descriptive Statistics, Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software.
Data Analysis: Deterministic and random data, Uncertainty analysis, Tests for significance: Chi-square, student’s t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

Unit - V


Suggested Reading:

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
5. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
ME2231

TURBOMACHINERY LABORATORY

Instructions 3 periods/week
Credits 2

Objectives:
- To get exposure on fluid flow parameters/properties measurement methods.
- To learn about the use of instrumentation in fluid flow devices
- To gain knowledge about the practical applications of course subjects.
- To understand the working principles of devices used in turbo machinery systems.

List of Experiments:

1) Determination of static pressure distribution on a turbine blade surface at mid span on Low speed wind tunnel.
2) To Study downstream wake profile of a turbine cascade at mid span on Low speed wind tunnel.
3) To Study downstream wake profile of a compressor cascade at mid span on Low speed wind tunnel.
4) Determination of Overall heat transfer coefficient in parallel and counter flow on Finned Tube Heat Exchanger
5) Determination of Overall heat transfer coefficient in parallel and counter flow on Shell and Tube Heat Exchanger
6) Study on performance of Centrifugal blower with forward swept blades.
7) Study on performance of Centrifugal blower with backward swept blades.
8) Study on performance of Centrifugal blower with radial blades.
9) Unsteady state Heat Transfer.
10) Thermal Conductivity of Liquid.
11) Experiments on Convergent Divergent Subsonic Nozzle.
12) To estimate the I-V and P-V characteristics of series and parallel combination of Solar Photovoltaic modules.
13) Workout power flow calculations of standalone Solar Photovoltaic system of DC and AC load with battery.
ME2232

COMPUTATIONAL FLUID DYNAMICS LABORATORY

Instruction 3 Periods/week
Credits: 2

CIE: 50 Marks

Objectives:

1. To learn how to model physical problem in CFD software
2. To learn geometric modeling, meshing and boundary conditions settings to solve the problem
3. To learn post processing of results and analyzing the results

Experiments:

1. Introduction to CFD – Pre Processor, Solver, Post Processor
2. Ansys Work bench – Modelling tools
3. Ansys Work Bench – Grid Generation
4. Ansys CFX pre – Properties of fluids, Boundary Conditions
5. Ansys Solver, Post processor
6. Exercise 1: Flow through a Nozzle – Modeling, Grid generation
7. Exercise 1: Flow through a Nozzle – Pre, Solver, Post Processor
8. Exercise 2: Flow past a cylinder – Modeling, Grid generation
10. Exercise 3: Static Mixer – Modeling, Grid generation
11. Exercise 3: Static Mixer – Pre, Solver, Post Processor
13. Exercise 4: Flow Mixing in a pipe bend - Pre, Solver, Post Processor