DEPARTMENT OF
MECHANICAL ENGINEERING

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

Specialization:
TURBO MACHINERY

Full time / Part time
(2012-13)

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous)
Osmania University
Hyderabad – 500 007, A.P., INDIA
### Scheme of Instruction & Examination
**M.E. (Mechanical Engineering) 4 Semesters (Full Time)**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Subject</th>
<th>Periods per week</th>
<th>Duration (Hrs)</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L/T</td>
<td>D/P</td>
<td>Univ. Exam</td>
</tr>
</tbody>
</table>

#### Semester - I

<table>
<thead>
<tr>
<th>No.</th>
<th>Subject</th>
<th>L/T</th>
<th>D/P</th>
<th>Duration (Hrs)</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Core</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>2.</td>
<td>Core</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>3.</td>
<td>Core / Elective</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>4.</td>
<td>Core / Elective</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>5.</td>
<td>Core / Elective</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>6.</td>
<td>Elective</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>7.</td>
<td>Laboratory - I</td>
<td>--</td>
<td>3</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>8.</td>
<td>Seminar - I</td>
<td>--</td>
<td>3</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

**Total**: 18 L/T 6 D/P 480 Duration (Hrs) 220 Max. Marks

#### Semester - II

<table>
<thead>
<tr>
<th>No.</th>
<th>Subject</th>
<th>L/T</th>
<th>D/P</th>
<th>Duration (Hrs)</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Core</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>2.</td>
<td>Core</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>3.</td>
<td>Core / Elective</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>4.</td>
<td>Core / Elective</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>5.</td>
<td>Core / Elective</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>6.</td>
<td>Elective</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>7.</td>
<td>Laboratory - II</td>
<td>--</td>
<td>3</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>8.</td>
<td>Seminar - II</td>
<td>--</td>
<td>3</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

**Total**: 18 L/T 6 D/P 480 Duration (Hrs) 220 Max. Marks

#### Semester - III

<table>
<thead>
<tr>
<th>No.</th>
<th>Subject</th>
<th>L/T</th>
<th>D/P</th>
<th>Duration (Hrs)</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Project Seminar*</td>
<td>--</td>
<td>6</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

#### Semester - IV

<table>
<thead>
<tr>
<th>No.</th>
<th>Subject</th>
<th>L/T</th>
<th>D/P</th>
<th>Duration (Hrs)</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dissertation</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Viva - Voce (Grade ***)</td>
</tr>
</tbody>
</table>

Note: Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only
** 50 marks awarded by the project guide and 50 marks by the internal committee.
*** Excellent/Very Good/Good/Satisfactory/Unsatisfactory
With effect from the academic year 2012-2013

**Scheme of Instruction & Examination**
M.E. (Mechanical Engineering) 6 Semesters (Part Time)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Subject</th>
<th>Periods per week</th>
<th>Duration (Hrs)</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L/T</td>
<td></td>
<td>Univ. Exam</td>
</tr>
<tr>
<td>1.</td>
<td>Core</td>
<td>3</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>2.</td>
<td>Core / Elective</td>
<td>3</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>3.</td>
<td>Elective</td>
<td>3</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>4.</td>
<td>Lab. I / Seminar - I</td>
<td>--</td>
<td>3</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>3</strong></td>
<td><strong>240</strong></td>
</tr>
</tbody>
</table>

**Semester - II**

|        |                        | L/T              |                | Univ. Exam | Sessionals |
| 1.     | Core                   | 3                | 3              | 80         | 20         |
| 2.     | Core / Elective        | 3                | 3              | 80         | 20         |
| 3.     | Elective               | 3                | 3              | 80         | 20         |
| 4.     | Lab. I / Seminar - I   | --               | 3              | --         | 50         |
|        | **Total**              | **9**            | **3**          | **240**    | **110**    |

**Semester - III**

|        |                        | L/T              |                | Univ. Exam | Sessionals |
| 1.     | Core                   | 3                | 3              | 80         | 20         |
| 2.     | Core / Elective        | 3                | 3              | 80         | 20         |
| 3.     | Elective               | 3                | 3              | 80         | 20         |
| 4.     | Lab. II / Seminar - II | --               | 3              | --         | 50         |
|        | **Total**              | **9**            | **3**          | **240**    | **110**    |

**Semester - IV**

|        |                        | L/T              |                | Univ. Exam | Sessionals |
| 1.     | Core                   | 3                | 3              | 80         | 20         |
| 2.     | Core / Elective        | 3                | 3              | 80         | 20         |
| 3.     | Elective               | 3                | 3              | 80         | 20         |
| 4.     | Lab. II / Seminar - II | --               | 3              | --         | 50         |
|        | **Total**              | **9**            | **3**          | **240**    | **110**    |

**Semester – V**

|        |                        | L/T              |                | Univ. Exam | Sessionals |
| 1.     | Project Seminar*       | --               | 6              | --         | 100**      |

**Semester - VI**

|        |                        | L/T              |                | Univ. Exam | Sessionals |
| 1.     | Dissertation           | --               | --             | --         | Viva - Voce (Grade ***)|

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 awarded by the project guide and 50 marks by the internal committee.
*** Excellent/Very Good/Good/Satisfactory/Unsatisfactory
Scheme of Instruction & Examination of Post Graduate course in Mechanical Engineering with specialization in *Turbo Machinery*

Course duration: 4 Semesters (Full Time), 6 semesters (Part – Time)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Syllabus Ref. No.</th>
<th>Subject</th>
<th>Scheme of Instruction</th>
<th>Scheme of Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L/T</td>
<td>T/D/P</td>
</tr>
<tr>
<td>1.</td>
<td>ME 537</td>
<td>Principles of Turbo Machinery</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ME 538</td>
<td>Fluid Flow and Gas Dynamics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ME 539</td>
<td>Aero Thermodynamics of Turbo machines</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>ME 540</td>
<td>Heat Transfer and Heat Exchangers in Power Plants</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>ME 541</td>
<td>Design of Steam Turbines</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>ME 542</td>
<td>Computational Fluid Dynamics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>ELECTIVES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>ME 531</td>
<td>Fluid Power System</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ME 508</td>
<td>Finite Element Techniques</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ME 510</td>
<td>Computer Aided Modeling and Design</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>ME 534</td>
<td>Vibration Analysis and Condition Monitoring</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>ME 514</td>
<td>Mechanics of Composite Materials</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>ME 543</td>
<td>Design of Gas Turbines</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>ME 544</td>
<td>Advanced Energy Systems</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>ME 545</td>
<td>Experimental Techniques in Turbo Machines</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>ME 546</td>
<td>Rotor Dynamics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>ME 547</td>
<td>Flow Induced Vibration</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>ME 548</td>
<td>Fuels and Combustion</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>ME 549</td>
<td>Design of Thermal Systems</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>ME 550</td>
<td>Power Plant Steam generators</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>ME 551</td>
<td>Power Plant Control and Instrumentation</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>ME 552</td>
<td>Design of Pumps and Compressors</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>ME 553</td>
<td>Numerical Methods</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>ME 521</td>
<td>Engineering Research Methodology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>DEPARTMENTAL REQUIREMENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>ME 554</td>
<td>Turbo Machinery Lab (Lab – I)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ME 555</td>
<td>CFD Lab (Lab – II)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ME 525</td>
<td>Seminar – I</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>ME 526</td>
<td>Seminar – II</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>ME 527</td>
<td>Project Seminar</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>ME 528</td>
<td>Dissertation</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

*Excellent/Very Good/Good/Satisfactory/Unsatisfactory*
PRINCIPLES OF TURBO MACHINERY

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

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

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

Suggested Reading:
3. Shapiro, Compressible fluid flow.
4. Liepmen & Rosko, Gas Dynamics.
5. Zoeb Hussain, Gas Dynamics Though Problems.
AERO THERMODYNAMICS OF TURBO MACHINES

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Introduction to Cascades. Blade terminology – leading and trailing edges, flow angles, blade angles, camber line, chord line, solidity, chord to space ratio, aspect ratio, Comparison of turbine and compressor cascades.

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

Instruction
Duration of University Examination
University Examination
Sessional

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 outside 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:

DESIGN OF STEAM TURBINES

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

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

Suggested Reading:

ME 542

With effect from the Academic Year 2012 - 2013

COMPUTATIONAL FLUID DYNAMICS

Instruction
Duration of University Exam
University Exam.
Sessional

3 periods/week
3 Hours
80 Marks
20 Marks

UNIT-I

UNIT-II
Classification of PDEs – Elliptic, parabolic and hyperbolic equations. Initial and boundary value problems.


UNIT-III

UNIT-IV

UNIT- V

Suggested Reading:

FLUID POWER SYSTEMS

Instruction
3 Periods/week

Duration of University Examination
3 Hrs

University Examination
80 Marks

Sessional
20 Marks

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.

UNIT - II
Hydraulic Pumps and Motors: Basic Types and constructions, ideal pump and motor analysis, Performance curves and parameters.
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
Characteristics of Pneumatics, Applications of Pneumatics, Basic Pneumatic elements, Steady flow of Ideal gases, orifice and nozzle calculations, capillary flow, flow of real gases, linearised flow equations in Orifices and Nozzles.
Steady state analysis of pneumatic components: Multiple restriction and volume calculations, sensing chambers, valves, Single acting actuators.

UNIT - V
Transients in elementary pneumatic systems: Linear dynamics-linear pneumatic spring rate, linear dynamics of a variable volume of gas, Pneumatic transmission lines, linear dynamics in single acting actuators.
Applications in industrial process controls: On-Off pneumatic feedback systems, feedback control of proportional gain, derivative action, integral action, Design of a Pneumatic Pressure Regulator.

Suggested Reading:
ME 508

With effect from the academic year 2012 - 2013

FINITE ELEMENT TECHNIQUES

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

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 Axisymmetric solids subjected of axisymmetric loading with triangular elements.
Convergence requirements and geometric isotropy.

UNIT-IV
Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional conduction analysis of thin plate.
Time dependent field problems: Application to one dimensional heat flow in a rod.
Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

UNIT-V
Finite element formulation of three dimensional problems in stress analysis.
Finite Element formulation of an incompressible fluid. Potential flow problems
Bending of elastic plates. Introduction to non-linear problems and Finite Element analysis software.

Suggested Reading:
COMPUTER AIDED MODELLING & DESIGN

Instruction
Duration of University Examination
University Examination
Sessional
3 Periods/week
3 Hrs.
80 Marks
20 Marks

UNIT-I
Introduction to CAD, Criteria for selection of CAD workstations, Shigle Design Process, Design criteria, Geometric modeling, entities, 2D & 3D Primitives.
2D & 3D Geometric Transformations: Translation, Scaling, Rotation, Reflection and Shearing, conlatenation. Graphics standards: GKS IGES, PDES.

UNIT-II
Wire frame modeling: Curves: Curve representation. Analytic curves – lines, Circles, Ellipse, Conis. Synthetic curves – Cubic, Bezier, B-Spline, NURBS.

UNIT-III
Surface Modeling: Surface entities, Surface Representation.
Analytic Surface – Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder.
Synthetic Surface-Cubic, Bezier, B-spline, Coons.

UNIT-IV
Solid Modeling Techniques: Graph Based Model, Boolean Models, Instances, Cell Decomposition & Spatial – Occupancy Enumeration, Boundary Representation (B-rep) & Constructive Solid Geometry (CSG).

UNIT-V
Capabilities of Modeling & Analysis Packages such as solid works, Unigraghics, Ansys, Hypermesh. Computer Aided Design of mechanical parts and Interference Detection by Motion analysis.

Suggested Reading:
VIBRATION ANALYSIS AND CONDITION MONITORING

Instruction 3 Periods /Week
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Causes and effects of vibration. Vibrations of Single Degree, Two Degree and Multi Degree of freedom systems. Steady state and transient characteristics of vibration.

UNIT-II
Introduction to Condition Monitoring. Failure types, investigation and occurrences. Causes of failure, Characteristics of vibration – SHM, Periodic motion, Displacement, Velocity and acceleration. Peak to peak & RMS, linear and logarithmic scales and phase angle.

UNIT-III

UNIT-IV
Condition Monitoring through vibration analysis. Frequency analysis, Filters, Vibration signature of active systems, vibration limits and standards. Contaminant analysis, SOAP and other contaminant monitoring techniques.

UNIT-V
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 Reading:
4. Pox and Zenkins, Time Series Analysis.
MECHANICS OF COMPOSITE MATERIALS

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 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
Strength, fracture, fatigue and design:
Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: Single and multiple fracture, de-bonding, fibre pullout and de-lamination failure, fatigue of laminate composites. Effect of variability of fibre strength.
Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials.

UNIT-V
Analysis of plates and stress:
Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite materials. Analysis of composite cylindrical shells under axially symmetric loads.

Suggested Reading:
DESIGN OF GAS TURBINES

Instruction: 3 Periods/week
Duration of University Examination: 3 Hrs.
University Examination: 80 Marks
Sessional: 20 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 vane 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:
ME 544

ADVANCED ENERGY SYSTEMS

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

Suggested Reading:

5. V.D. Hunt, Wind Power.
EXPERIMENTAL TECHNIQUES IN TURBO MACHINES

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Classification of measurement techniques. General strategy for Turbomachinery testing. Conventional techniques for measurement of flow Pressure, temperature and velocity in turbomachinery passages.

UNIT-II

UNIT-III

UNIT-IV
Calibration methods and signal processing techniques. Instantaneous pressure measurement using pressure transducers. Recorders with digital display. Data acquisition System for collection and storage of data.

UNIT-V

Suggested Reading:
1. R.C. Dean, Aerodynamics measurements,
2. David (Editor), Advanced Experimental Techniques in Turbomachinery,
4. Beckwith and Buck, Mechanical Measurements.
5. A.K.Tayal, Instruments And Mechanical Measurements, Galgotia Publications.
ME 546

With effect from the academic year 2012 – 2013

ROTOR DYNAMICS

Instruction
Duration of University Examination
University Examination
Sessional

3 Periods/week
3 Hrs.
80 Marks
20 Marks

UNIT-I
Single degree of freedom system – Free vibrations. Damped vibrations and forced vibrations, Two
degree of freedom systems – Undamped vibration, absorbers, Forced Damped vibrations, Vibration
isolation.

UNIT-II
speeds.

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
Out-of-rotors in rigid supports, simply supported rotor with overhangs. Gyroscopic effects.
Rotor mounted on fluid film bearings – Transfer matrix analysis of turbine rotor by distributed elements,
Dual rotor system analysis. Balancing of rotors.

Suggested Reading:
FLOW INDUCED VIBRATIONS

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 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:
FUELS AND COMBUSTION

Instruction
3 Periods/week

Duration of University Examination
3 Hrs.

University Examination
80 Marks

Sessional
20 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

Combustion Thermodynamics: General


Combustion Applications: General, Gas burners, Oil burners, Coal burning equipment.

Suggested Reading:

DESIGN OF THERMAL SYSTEMS

Instruction
Duration of University Examination
University Examination
Sessional

3 Periods/week
3 Hrs.
80 Marks
20 Marks

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

Suggested Reading:
ME 550

POWER PLANT STEAM GENERATORS

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 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:

ME 551

With effect from the academic year 2012–2013

POWER PLANT CONTROL AND INSTRUMENTATION

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Introduction: Static & dynamic characteristics of instruments, sensors, signal processing & data transmission elements, indicating & recording elements.

UNIT-II
Use of computers for data acquisition & instrumentation for measuring temperature, pressure flow, speed, vibration & noise.

UNIT-III

UNIT-IV
Stability, Digital Control System Modern Control theory. Boiler Control, Governing & Control of turbomachines.

UNIT-V

Suggested Reading:
1. Beckwith and Buck, *Mechanical Measurements*.
DESIGN OF PUMPS AND COMPRESSORS

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

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

UNIT-II

UNIT-III
Operation and maintenance – installation of pumping system. Testing of the pumping systems – Various methods based on the working fluid, drive and pump etc., Maintenance of the pumps – Prediction and correction methods, Factors affecting the maintenance and their evaluation.

UNIT-IV

UNIT-V

Suggested Reading:

ME 553

With effect from the academic year 2012 – 2013

NUMERICAL METHODS

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 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
Ordinary Differential Equations:
First and Higher Order Taylor Series, First order Runge-kutta Method, Fourth order Runge-kutta Method, Stiff Equations, Errors, Convergence Criteria.

Suggested Reading:

ENGINEERING RESEARCH METHODOLOGY

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

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
Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.

UNIT III

UNIT IV
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
4. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
ME 554

TURBOMACHINARY LABORATORY

List of Experiments:

1. Determination of static pressure distribution on a turbine blade surface at mid span on Low speed wind tunnel.
2. Study on downstream wake profile of a turbine cascade at mid span on Low speed wind tunnel.
3. Study on downstream wake profile of a compressor cascade at mid span on Low speed wind tunnel.
8. Study on performance of Centrifugal blower with forward swept blades.
10. Study on performance of Centrifugal blower with radial blades.
11. Unsteady state Heat Transfer.
14. Thermal Conductivity of Liquid.
15. Heat Transfer through Composite walls
17. Experiments on Convergent Divergent Subsonic Nozzles.
CFD LABORATORY

Instruction
Sessional

3 Periods/week
50 Marks

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 : Static Mixer – Modeling, Grid generation
11. Exercise 3 : Flow Mixing in a pipe bend - Pre, Solver, Post Processor
12. Exercise 4 : Aerodynamic analysis over a body – Modeling, Grid generation
13. Exercise 4 : Aerodynamic analysis over a body – Pre, Solver, Post Processor
14. Exercise 5 : Cascade Analysis – Modeling, Grid generation
15. Exercise 5 : Cascade Analysis - Pre, Solver, Post Processor