VISION

To evolve into a premier engineering institute in the country by continuously enhancing the range of our competencies, expanding the gamut of our activities and extending the frontiers of our operations.

MISSION

Synergizing knowledge, technology and human resource, we impart the best quality education in Technology and Management. In the process, we make education more objective so that the efficiency for employability increases on a continued basis.

Academic Regulations 2013 for M.Tech (Regular)

(With effect from batch admitted in the academic year 2013-2014)

The M.Tech Degree of the Aditya Institute of Technology and Management (Autonomous), Tekkali shall be conferred on candidates who are admitted to the programme and fulfill all the requirements for the award of the Degree.

1. ELIGIBILITY FOR ADMISSIONS:

Admission to the above programme shall be made subject to the eligibility, qualifications and specialization prescribed by the University from time to time. Admissions shall be made on the basis of merit rank obtained by the qualifying candidate in GATE / PGCET, subject to reservations prescribed by the Govt. of AP from time to time.

2. AWARD OF M. Tech DEGREE:

2.1 A student shall be declared eligible for award of the M.Tech degree, if he/she pursues a course of study and completes it successfully in not less than two academic years and not more than four consecutive academic years and registered for **80** credits and he/she must secure total **80** credits.

2.2 A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his/her admission, shall forfeit his/her seat in M.Tech course.

2.3 The minimum clear instruction days for each semester are 95.

3. ATTENDANCE:

3.1 A candidate shall be deemed to have eligibility to write End Semester examinations if he/she has put in a minimum of 75% of attendance in aggregate of all the subjects.

3.2 Condonation of shortage of attendance up to 10% (65% and above, and below 75%) may be given by the College academic committee.

3.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representations by the candidate with supporting evidence.

3.4 Shortage of attendance below 65% shall in NO case be condoned.

3.5 A candidate shall not be promoted to the next semester unless he/she fulfills the attendance requirements of the present semester.

3.6 A stipulated fee shall be payable towards condonation of shortage of attendance.

4. COURSE OF STUDY:

The following specializations are offered at present for the M.Tech course of study.

1	Digital Electronics and Communication Systems
2	VLSI System Design
3	Power Electronics and Electric Drives
4	Computer Science and Engineering
5	Information Technology
6	Thermal Engineering

5. EVALUATION:

The performance of the candidate in each semester shall be evaluated subject-wise, with a Maximum of 100 marks for theory and100 marks for Laboratory, on the basis of Internal Evaluation and End Semester Examination.

5.1 For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination. Out of 40 internal marks 30 marks are assigned for subjective exam, 5 marks for subjective assignments and 5 marks for seminars. The internal evaluation for 30 marks shall be made based on the **average** of the marks secured in the two Mid Term-Examinations conducted, one in the middle of the Semester and the other immediately after the completion of instruction. Each midterm examination shall be conducted in duration of 120 minutes and question paper shall contain **4** questions. The student should answer all **4** questions.

5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations. Out of 40 internal marks 20 marks are assigned based on day to day evaluation and 20 marks are assigned based on the internal test.

5.3 There shall be a technical seminar presentation during 3rd semester. For technical seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee. The Departmental Committee consists of Head of the Department, supervisor and two other senior faculty members of the department. For technical seminar there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% to be declared successful.

5.4 A candidate shall be deemed to have secured the academic requirement in a subject if he/she secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to reappear for the supplementary Examination in that subject.

5.6 The viva-voce examination shall be conducted at the end of the course work and after the candidate passing all subjects.

5.7 Laboratory examination for M.Tech courses must be conducted with two Examiners, one of them being Laboratory Class Teacher and second examiner shall be external examiner.

6. EVALUATION OF PROJECT/DISSERTATION WORK:

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Project Review Committee.

6.1A Project Review Committee (PRC) shall be constituted with Principal as chair person, Head of the department, one senior faculty member and project guide.

6.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects (theory and practical).

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his / her project supervisor, the title, objective and plan of action of his project work (Based on a publication in a Peer Reviewed Journal) to the Project Review Committee for its approval before the second semester end examinations. After obtaining the approval of the Committee, the student can initiate the Project work after the second semester end examinations.

6.4 Every candidate shall work on projects approved by the PRC of the college.

6.5 If a candidate wishes to change his supervisor or topic of the project, he/she can do so with approval of the PRC. However, the Project Review Committee (PRC) shall examine whether the change of topic/supervisor leads to a major change of his initial plans of project proposal. If so, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

6.6A candidate shall submit status report in two stages at least with a gap of 3 months between them.

6.7 The work on the project shall be initiated in the beginning of the second year/III semester and minimum duration of the project is two semesters. The candidate shall identify the problem, Literature survey, design/modeling part of the problem i.e. almost 35% of his dissertation/project work should complete in the III semester itself and it will be evaluated by PRC. If the candidate fails to get the satisfactory report, he has to re-register for the project/dissertation work.

6.8 A candidate shall be allowed to submit the project report only after fulfilling the attendance requirements of all the semesters with approval of PRC and not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Principal (through Head of the Department) and shall make an oral presentation before the PRC.

6.9 The Candidate may be permitted to submit the Project Report, if only after the work is Published/Accepted to be Published in a Journal / International conference of repute and relevance.

6.10 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/Institute.

6.11 The thesis shall be adjudicated by external examiner from outside the college.

6.12 The viva-voce examination shall be conducted by a board consisting of the supervisor, Head of the Department and the examiner outside the college who adjudicated the Thesis.

6.13 The student has to clear all the subjects of M.Tech course before submission of the project thesis/ dissertation

The Board shall jointly report candidates work as :

A. Excellent

B. Good

C. Satisfactory

D. Unsatisfactory

Head of the Department shall coordinate and make arrangements for the conduct of viva-voce examination. If the report of the viva-voce is unsatisfactory, the candidate has to retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination, the candidate may be asked to submit a new project proposal to PRC starting with 6.5

7. METHOD OF AWARDING LETTER GRADES AND GRADE POINTS FOR A COURSE.

A letter grade and grade points will be awarded to a student in each course based on his/her performance as per the grading system given below.

Table: Grading System for M.Tech. Programme

Percentage of Marks	Grade Points	Letter Grade
90-100	10	S
80-89	9	A
70-79	8	B
60-69	7	C
50-59	6	D
40-49	5	E
< 40	0	F (Fail)

7.1 Calculation of Semester Grade Points Average (SGPA)* for semester

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as below:

$$SGPA = \frac{\Sigma(CR \times GP)}{\Sigma CR}$$ (for all courses passed in semester)

Where CR = Credits of a Course

GP = Grade points awarded for a course

*SGPA is calculated for the candidates who passed all the courses in that semester.

7.2 Calculation of Cumulative Grade Points Average (CGPA) and Award of Division for Entire Programme.

The CGPA is calculated as below:

$$CGPA = \frac{\Sigma(CR \times GP)}{\Sigma CR} \quad \text{(for entire programme)}$$

Where CR = Credits of a course

GP = Grade points awarded for a course

Table: Award of Divisions

CGPA	DIVISION
≥ 8	First Class with distinction
≥ 7 - < 8	First Class
≥ 6 - < 7	Second Class
< 6	Fail

After a student has satisfied the requirements prescribed for the completion of the programme and is eligible for receiving the award of M.Tech. Degree, he shall be placed in one of the above three divisions.

8. WITH-HOLDING OF RESULTS:

If the candidate has not paid any dues to the college or if any case of indiscipline is pending against him / her, the result of the candidate will be withheld and he/she will not be allowed into the next higher semester. The issue of the degree is liable to be with held in such cases.

9. TRANSITORY REGULATIONS:

Candidate who have discontinued or have been detained for want of attendance or who have failed after having undergone the course are eligible for admission to the same or equivalent subjects as and when subjects are offered, subject to 5.5 and 2.0

10. GENERAL:

10.1 The academic regulations should be read as a whole for purpose of any Interpretation.

10.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

10.3 The Institute may change or amend the academic regulations and syllabus at any time and the changes and amendments made shall be applicable to all the students with effect from the date notified by the college.

10.4 Wherever the word he, him or his occur, it will also include she, her and hers.

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M.TECH COURSE STRUCTURE

S. No	Code	Subjects	L	P	C	INT	EXT
	M.Tech (TE) - I SEMESTER						
S. No	**Code**	**Subjects**	**L**	**P**	**C**	**INT**	**EXT**
1	13MTE1001	Optimization Techniques & Applications	4	-	3	40	60
2	13MTE1002	Advanced Thermodynamics	4	-	3	40	60
3	13MTE1003	Advanced Heat & Mass Transfer	4	-	3	40	60
4	13MTE1004	Advanced Fluid Mechanics	4	-	3	40	60
5		**Elective – I**					
	13MTE1005	Turbo-Machines					
	13MTE1006	Cryogenics Engineering	4	-	3	40	60
	13MTE1007	Solar Energy Technology					
6		**Elective – II**					
	13MTE1008	Advanced I.C. Engines					
	13MTE1009	Non-Conventional Energy Sources	4	-	3	40	60
	13MTE1010	Material Science for Thermal Engineering					
7	13MTE1101	Thermal Engineering Lab		4	2	40	60
	Total				**20**	**280**	**420**
	M.Tech (TE) – II SEMESTER						
S. No	**Code**	**Subjects**	**L**	**P**	**C**	**INT**	**EXT**
1	13MTE1011	Fuels, Combustion & Environment	4	-	3	40	60
2	13MTE1012	Energy Management	4	-	3	40	60
3	13MTE1013	Finite Element Analysis	4	-	3	40	60
4	13MTE1014	Computational Fluid Dynamics	4	-	3	40	60
5		**Elective – III**					
	13MTE1015	Equipment Design for Thermal Systems					
	13MTE1016	Convective Heat Transfer	4	-	3	40	60
	13MTE1017	Thermal & Nuclear Power Plants					
6		**Elective – IV**					
	13MTE1018	Thermal Measurements Process Controls					
	13MTE1019	Refrigeration & Air-Conditioning	4	-	3	40	60
	13MTE1020	JET Propulsion & Rocketry					
7	13MTE1102	Computational Methods Lab		4	2	40	60
	Total				**20**	**280**	**420**
M.Tech (TE) - III SEMESTER							
S. No	**Code**	**Subject**	**L**	**P**	**C**	**INT**	**EXT**
1	13MTE2201	Technical Seminar	-	-	2	100	-
2	13MTE2202	Project work phase-1	-	-	18	-	-
	Total				**20**	**100**	**-**
M.Tech (TE) - IV SEMESTER							
S. No	**Code**	**Subject**	**L**	**P**	**C**	**INT**	**EXT**
1	13MTE2203	Project work phase-2	-	-	20	-	-
	Total				**20**	-	-

L – Lecture hours/Week; P – Practical hours/ Week; C – Credits; INT – Internal Marks;

EXT – External Marks;

OPTIMIZATION TECHNIQUES AND APPLICATIONS

SUBJECT CODE: 13MTE1001

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To be able to formulate linear or nonlinear optimization problems as a solution for industrial problems.
- To be able to solve various kinds linear and nonlinear, single and multiple variable, unconstrained and constrained optimization problems using standard optimization algorithms.

COURSE OUTCOMES:

- Should be able to solve linear multivariable optimization using linear programming and perform sensitivity analysis.
- Should be able to solve single-variable, non-linear, unconstrained optimization problems
- Should be able to solve geometric-, dynamic-, integer- and stochastic- programming optimization problems using standard techniques for each case.

UNIT-I

SINGLE VARIABLE NON-LINEAR UNCONSTRAINED OPTIMIZATION:

One dimensional Optimization methods:- Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods – quadratic & cubic interpolation methods. Multi variable non-linear unconstrained opt imization: Direct search method – Univariant method - pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

UNIT-II

GEOMETRIC PROGRAMMING:

Polynomials – arithmetic - geometric inequality – unconstrained G.P- constrained G.P

UNIT-III

DYNAMIC PROGRAMMING:

Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory, allocation, scheduling replacement.

UNIT-IV

Linear programming – Formulation – Sensivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Simulation – Introduction – Types- steps – application – inventory – queuing – thermal system

UNIT-V

Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.

UNIT-VI

Stochastic programming:

Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co variance, joint probability distribution- stochastic linear, dynamic programming.

TEXT BOOKS:

1. Optimization theory & Applications / S.S.Rao / New Age International.
2. Introductory to operation Research / Kasan & Kumar / Springar
3. Optimization Techniques theory and practice / M.C.Joshi, K.M.Moudgalya/ Narosa Publications

REFERENCE BOOKS:

1. S.D.Sharma / Operations Research
2. Operation Research / H.A.Taha /TMH
3. Optimization in operations research / R.LRardin
4. Optimization Techniques /Benugundu & Chandraputla / Pearson Asia

ADVANCED THERMO DYNAMICS

SUBJECT CODE: 13MTE1002

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- Develop an ability to identify, formulate, and solve engineering problems
- Develop an ability to apply knowledge of mathematics, interdisciplinary science, and engineering

COURSE OUTCOMES:

- Students will be able to apply engineering principles and analyze problems dealing with advanced thermodynamics.
- Students will be able to apply mathematics, science, and engineering principles to analyze Advanced thermodynamics problems.

UNIT-I

Review of Thermo dynamic Laws and Corollaries – Transient Flow Analysis – Second law of thermodynamics – Entropy - Availability and unavailability – Irreversibility – Thermo dynamic Potentials – Maxwell Relations – Specific Heat Relations – Mayer's relation - Evaluation of Thermodynamic properties of working substance

UNIT-II

P.V.T. surface – Equations of state – Real Gas Behaviour – Vander Waal's equation - Generalised compressibility Factor – Energy properties of Real Gases – Vapour pressure – Clausius – Clapeyron Equation – Throttling – Joule – Thompson coefficient.

Non-reactive Mixture of perfect Gases – Governing Laws – Evaluation of properties – Pychrometric Mixture properties and psychrometric chart – Air conditioning processes – Cooling Towers – Real Gas Mixture.

UNIT-III

Combustion – Combustion Reactions – Enthalpy of Formation – Entropy of Formation – Reference Levels for Tables – Energy of formation – Heat of Reaction – Aiabatic flame Temperature General product – Enthalpies – Equilibrium.

Chemical Equilibrium of Ideal Gases – Effects of Non-reacting Gases Equilibrium in Multiple Reactions. The vant Hoff's Equation. The chemical potential and phase Equilibrium – The Gibbs phase Rule.

UNIT-IV

Power cycles, Review Binary vapour cycle, co-generation and Combined cycles – Second law analysis of cycles – Refrigeration cycles.

UNIT-V

Thermo Dynamics off irreversible processes – Introduction – phenomenological laws – Onsagar Reciprocity Relation – Applicability of the phenomenological Relations – Heat Flux and Entropy Production – Thermo dnamic phenomena – Thermo electric circuits.

UNIT-VI

Direct Energy Conversion Introduction – Fuel Cells - Thermo electric energy – Thermo-ionic power generation -Thermodynamic devices Magneto Hydrodynamic Generations – Photo voltaic cells.

TEXT BOOKS

1. Basic and Applied Thermodynamics, P.K. Nag, TMH
2. Thermo dynamics / Holman, Mc Graw Hill

REFERENCE BOOKS

1. Thermo dynamics / Doolittle – Messe
2. Thermo dynamics / Sonnatag & Van Wylen
3. Irreversible Thermo Dynamics / HR De Groff.
4. Engg. Thermo dynamics /PL.Dhar

ADVANCED HEAT AND MASS TRANSFER

SUBJECT CODE: 13MTE1003

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To familiarize concept of heat conduction equation for cylinder and sphere
- To understand steady state and transient heat conduction.
- To develop the concept of finite difference methods for conduction.
- To develop depth knowledge on free and forced convection.

COURSE OUTCOMES:

- Able to apply the concept of heat conduction for various problems.
- Able to use the concept of steady state and transient heat conduction for various simulation problems.
- Able to know the finite difference method for conduction and how it is solved by using simulation tool.
- Able to know the difference of free and forced convection and how to calculate heat transfer coefficient and what are the dimensionless members are useful.

UNIT-I

Brief Introduction to different modes of heat transfer; Conduction: General heat conduction equation-Initial and Boundary conditions **Steady State Heat Transfer**: Simplified heat transfer in 1D and 2D – Fins **Transient heat conduction**; Lumped system analysis- Heisler charts-semi infinite solid-use of shape factors in conduction - 2D transient heat conduction – product solutions

UNIT - II

Finite Difference methods for Conduction: 1D & 2D steady state and simple transient heat conduction problems – implicit and explicit methods.

Forced Convection: Equations of Fluid Flow – Concepts of Continuity, momentum equations – Derivation of Energy equation - Methods to determine heat transfer coefficient:

Analytical Methods - Dimensional Analysis and concept of exact solution. Approximate Method – Integral analysis

UNIT - III

External flows: Flow over a flat plate: Integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometrics for Laminar and Turbulent flows.

Internal flows: Fully developed flow: Integral analysis for laminar heat transfer coefficient – Types of flow – Constant Wall Temperature and Constant Heat Flux Boundary Conditions - Hydrodynamic & thermal entry lengths; use of empirical correlations.

UNIT - IV

Free convection: Approximate analysis on laminar free convective heat transfer – Boussinesque Approximation - Different geometries – combined free and forced convection

UNIT - V

Boiling and condensation: Boiling curve – Correlations- Nusselt's theory of film condensation on a vertical plate – Assumptions & correlations of film condensation for different geometrics.

UNIT - VI

Radiation Heat Transfer: Radiant heat exchange in grey, non-grey bodies, with transmitting, reflecting and absorbing media, specular surfaces, gas radiation – radiation from flames.

Mass Transfer: Concepts of mass transfer – Diffusion & convective mass transfer Analogies – Significance of non-dimensional numbers.

TEXT BOOKS

1. Heat Transfer – Necati Ozisik (TMH)
2. Heat and Mass Transfer – O P Single (Macmillan India Ltd)
3. Heat Transfer – P.S. Ghoshdastidar (Oxford Press)
4. Engg. Heat & Mass Transfer- Sarit K. Das (Dhanpat Rai)

REFERENCE BOOKS

1. Fundamentals of Heat & Mass Transfer – Incroera Dewitt (Jhon Wiley)
2. Heat Transfer : A basic approach – Yunus Cangel (MH)
3. Heat & Mass Transfer – D.S. Kumar
4. Heat Transfer – P.K. Nag(TMH)
5. Principle of Heat Transfer – Frank Kreith & Mark.Bohn.

ADVANCED FLUID MECHANICS

SUBJECT CODE: 13MTE1004

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To develop Knowledge on viscous flow
- To develop depth of knowledge on boundary layer theory
- To develop fundamental knowledge on turbulence
- To understand the thermodynamic applications in fluid mechanics

COURSE OUTCOMES:

- Able to understand the difference between Lagrangian and Eulerain principles and which theory is better and follows.
- Able to understand the depth of Navier Stoke and Coutte flow equations.
- Able to understand the Von-Karman momentum integral equation for laminar boundary layer.
- Should be able to apply the concept of thermodynamics to various fluid flows.

UNIT-I

Non – viscous flow of incompressible Fluids:

Lagrangian and Eulerain Descriptions of fluid motion- Path lines, Stream lines, Streak lines, stream tubes – velocity of a fluid particle, types of flows, Equations of three dimensional continuity equation- Stream and Velocity potential functions.

Basic Laws of fluid Flow:

Condition for irrotationality, circulation & vorticity Accelerations in Cartesystems normal and tangential accelerations, Euler's, Bernouli equations in 3D– Continuity and Momentum Equations

UNIT-II

Principles of Viscous Flow:

Derivation of Navier-Stoke's Equations for viscous compressible flow – Exact solutions to certain simple cases : Plain Poisoulle flow - Coutte flow with and without pressure gradient - Hagen Poisoulle flow - Blasius solution.

UNIT-III

Boundary Layer Concepts

Prandtl's contribution to real fluid flows – Prandtl's boundary layer theory - Boundary layer thickness for flow over a flat plate – Approximate solutions – Creeping motion (Stokes) – Oseen's approximation - Von-Karman momentum integral equation for laminar boundary layer –– Expressions for local and mean drag coefficients for different velocity profiles.

UNIT-IV

Introduction to Turbulent Flow:

Fundamental concept of turbulence – Time Averaged Equations – Boundary Layer Equations - Prandtl Mixing Length Model - Universal Velocity Distribution Law: Van Driest Model –Approximate solutions for drag coefficients – More Refined Turbulence Models – k-epsilon model - boundary layer separation and form drag – Karman Vortex Trail, Boundary layer control, lift on circular cylinders

Internal Flow: Smooth and rough boundaries – Equations for Velocity Distribution and frictional Resistance in smooth rough Pipes – Roughness of Commercial Pipes – Moody's diagram.

UNIT-V

Compressible Fluid Flow – I:

Thermodynamic basics – Equations of continuity, Momentum and Energy - Acoustic Velocity Derivation of Equation for Mach Number – Flow Regimes – Mach Angle – Mach Cone – Stagnation State

UNIT-VI

Compressible Fluid Flow – II:

Area Variation, Property Relationships in terms of Mach number, Nozzles, Diffusers – Fanno and Releigh Lines, Property Relations – Isothermal Flow in Long Ducts – Normal Compressible Shock, Oblique Shock: Expansion and Compressible Shocks – Supersonic Wave Drag.

TEXT BOOKS

1. Schlichting H – Boundary Layer Theory (Springer Publications).
2. Convective Heat and Mass Transfer – Oosthigen, McGrawhill
3. Convective Heat and Mass Transfer – W.M. Kays, M.E. Crawford, McGrawhill

REFERENCE BOOKS

1. Yuman S.W – Foundations of Fluid Mechanics.
2. An Introduction to Compressible Flow – Pai.
3. Dynamics & Theory and Dynamics of Compressible Fluid Flow – Shapiro.

TURBO MACHINES
(Elective-I)

SUBJECT CODE: 13MTE1005

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- Appreciate the role of fluid mechanics and thermodynamics mechanics in engineering.
- Discern the importance of basic similarity parameters such as specific speed and flow coefficients.
- Demonstrate comprehension of the Euler Turbomachinery Equations, derive from the angular momentum equation, and apply to problems encompassing the operation of the basic elements of turbomachinery.
- Gain an integrated view of the common principles of turbomachine stage performance: expansion, diffusion and extraction or addition of energy and angular momentum. Apply cycle modeling and efficiencies for performance projections.
- Demonstrate and apply comprehension of the fluid mechanics responsible for limits of turbomachinery operability and stability, particularly, stall, surge, cavitation, and choke. Study unsteady effects.
- Gain understanding of the energy and power density implications of hydroelectric and wind power plants.
- Understand the principles of loss calculations in axial and radial units.

COURSE OUTCOMES:

- Knowingly discuss the possibilities of steam turbines, gas turbines, hydro and wind for serving the domestic and international power generation market.
- Estimate performance of turbomachines using conservation laws, integrating the Laws of Thermodynamics and efficiencies with knowledge of fluid motion.
- Determine by inspection whether a certain blading is impulse or reaction type.
- Identify by inspection specific speed relationships and complete degree of reaction calculations.

- Estimate stagnation pressure losses on the basis of loss correlations for axial gas machines, steam turbines and hydraulic machines. Relate to efficiencies.
- Understand the necessity and implications of unsteadiness in turbomachines, with acoustic natural frequency calculations.

UNIT – I

Fundamentals of Turbo machines: Classification, Applications Thermodynamic analysis; Isentropic flow, Energy transfer; Efficiencies; static and Stagnation conditions; continuity equation; Euler's flow through variable cross sectional area; unsteady flow in turbo machines.

UNIT –II

Steam Nozzles: Convergent and Convergent – Divergent nozzles; Energy balance; effect of back – pressure on the analysis; Design of nozzles.

Steam Turbines : Impulse Turbines: Compounding; work done and velocity triangles; Efficiencies; Constant Reaction Blading; Design of blade passages, angles and height; Secondary flow; leakage losses; Thermodynamic analysis of steam turbines.

UNIT – III

Gas Dynamics: Fundamentals thermodynamic concepts; Isentropic conditions; Mach number and Area – Velocity relation; Dynamic pressure; normal shock relations for perfect gas; supersonic flow, oblique shock waves ; normal shock recovery ; detached shocks ; Aerofoil theory.

UNIT – IV

Centrifugal Compressor: Types; Velocity triangles and efficiencies; Blade passage design; Diffuser and pressure recovery; slip factor; stanitz and stodolas formulae; Effect of inlet mach number; Prewirl; performance.

UNIT – V

Axial Flow Compressors: Flow analysis, work and velocity triangles ; Efficiencies; Thermodynamic analysis; stage pressure rise ; Degree of reaction ; stage loading ; general design, effect of velocity incidence ; performance.

Cascade Analysis: Geometry and Terminology; Blade forces, Efficiency; losses; free and forced vortex blades.

UNIT – VI

Axial Flow Gas Turbines: Work done; velocity triangles and efficiencies; thermodynamic flow analysis; degree of reaction; Zweifels relation; Design cascade analysis – Soderberg – Hawthrone – ainley-correlations; secondary flow; Free-vortex blades; Blade angles for variable degree of reaction; Actuator disc theory; stresses in blades; Blade assembling; materials and cooling of blades; performance; Matching of compressor and turbine; off-design performance.

TEXT BOOKS

1. Fundamentals of Turbo machines – Shephard
2. Practise on Turbomachines – G. Gopalakrishnan & D. Prithviraj, SciTech Publishers, Chennai.
3. Theory and practice of steam turbines – Kearton
4. Gas Turbines – Theory and practice – Zucrow

REFERENCE BOOKS

1. Elements of Gas Dynamics – Liepman and Roshkow
2. Elements of Gas Dynamics – Yahya
3. Turbines, Pumps, Compressors – Yahya
4. Axial Flow Compressors – Horlock.
5. Gas Turbines- Cohen, Roger & Sarvanamuttu

CRYOGENIC ENGINEERING
(Elective-I)

SUBJECT CODE: 13MTE1006

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To develop knowledge on different properties of cryogenic fluids
- To provide knowledge on liquefaction system for different components
- To provide application knowledge for concept of cryogenic systems

COURSE OUTCOMES:

- Able to gain the different properties of cryogenic fluids
- Able to design different systems for different components
- Able to apply this concept to different components which are working under low temperature (freezing)

UNIT -I

Introduction to CRYOGENIC Systems – Mechanical Properties at low temperatures Properties of cryogenic fluids.

UNIT - II

Gas Liquefaction: Minimum work for liquefaction – Methods to produce low temperature – Liquefaction systems for gases other than Neon, Hydrogen and Helium

UNIT - III

Liquefaction systems for Neon, Hydrogen and Helium Components of Liquefaction systems – Heat Exchangers – Compressors and Expanders – expansion valve – Losses for real machines

UNIT - IV

Gas separation and purification systems – Properties of mixtures – Principles of mixtures – Principles of gas separation – Air separation systems

UNIT - V

Cryogenic Refrigeration Systems – Working media – Solids, Liquids and gases-Cryogenic fluid storage & transfer – Cryogenic storage systems – Insulation – Fluid transfer mechanisms – Cryostat – Cryo C

UNIT - VI

Applications – Space technology – In-flight air seperation and collection of LOX – Gas Industry – Biology – Medicine - Electronics

TEXT BOOK

1. Cryogenic Systems – R.F. Barron, Oxford University Press

REFERENCE BOOKS

1. Cryogenic Research and Applications – Marshall Sitting, Von Nostrand Inc, New Jersey
2. Cryogenics Engineering Edit by B.A.Hands, Academic Press, 1986
3. Cryogenics Engineering – R. B. Scott, Von Nostrand Inc, New Jersey, 1959
4. Experimental Techniques in Low Temperature Physics – G.K. White, Oxford Press, 1968
5. Cryogenics process Engineering – K.D.Timmerhaus & TM Flynn, Plenum press, 1998
6. Cryogenic Heat Transfer - R.F. Baron.
7. Cryogenic Two Phase flow – N.N . Falina and J.G. Weisend –II
8. Cryogenic Regenerative Heat Exchangers – Robert Ackermann, Plenum Press, 1997
9. Cryogenic Engineering – Thomas M. Flynn
10. Safety in Handling of Cryogenic Fluids – Fredrick J. Edeskutty and Watter F. Stewart, Plenum Press,1996.
11. Hand Book of Cryogenic Engineering – J.G.Weisend –II, Taylor and Francis, 1998

SOLAR ENERGY TECHNOLOGY

(Elective-I)

SUBJECT CODE: 13MTE1007

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To know clear concept between sun and earth
- To design the different component for utilization of solar energy
- To design and develop different systems which are useful to store the energy.

COURSE OUTCOMES:

- Able to understand the relation between sun and earth
- Able to design the different component for utilization of solar energy
- Able design and develop different systems which are useful to store the energy

UNIT - I

Introduction – Solar energy option, specialty and potential – Sun – Earth – Solar radiation, beam and diffuse – measurement – estimation of average solar radiation on horizontal and tilted surfaces – problems – applications.

UNIT - II

Capturing solar radiation – physical principles of collection – types – liquid flat plate collectors – construction details – performance analysis – concentrating collection – flat plate collectors with plane reflectors – cylindrical parabolic collectors – Orientation and tracking – Performance Analysis.

UNIT - III

Design of solar water heating system and layout

Power generation – solar central receiver system – Heliostats and Receiver – Heat transport system – solar distributed receiver system – Power cycles, working fluids and prime movers.

UNIT - IV

Thermal energy storage – Introduction – Need for – Methods of sensible heat storage using solids and liquids – Packed bed storage – Latent heat storage – working principle – construction – application and limitations.

Other solar devices – stills, air heaters, dryers, Solar Ponds & Solar Refrigeration.

UNIT - V

Direct energy conversion – solid-state principles – semiconductors – solar cells – performance – modular construction – applications.

UNIT - VI

Economics – Principles of Economic Analysis – Discounted cash flow – Solar system – life cycle costs – cost benefit analysis and optimization – cost based analysis of water heating and photo voltaic applications.

TEXT BOOKS

1. Principles of solar engineering – Kreith and Kerider
2. Solar energy thermal processes – Duffie and Beckman
3. Solar energy – Sukhatme

REFERENCE BOOKS

1. Solar energy – Garg
2. Solar energy – Magal
3. Soloar energy – Tiwari and Suneja
4. Power plant technology – El Wakil

ADVANCED I.C. ENGINES
(Elective-II)

SUBJECT CODE: 13MTE1008

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- This course is designed to give students an understanding of the principles and design concepts as well as practices associated with modern mobility power systems. Emphasis is given to state of the art and emerging energy conversion science and technologies such as those applied to modern and advanced automotive (i.e. self-propelled) vehicle.

COURSE OUTCOMES:

- Students will learn about conventional as well as advanced concepts being pursued for modern mobility power. In addition to understanding engine energy configurations, a comprehension of energy resource options being considered for use should be made clear. Students will be able to determine engine performance characteristics for these conventional and alternative mobility power plants for operation on a variety of fuel alternatives by applying thermochemical principles of energy, material and chemical balances through appropriate modeling. Students will be exposed to various critical environmental drivers relevant to vehicular fuel - engine interfaces. Knowledge gained here will help prepare students for a career in ever important traditional and emerging energy fields of the automotive (i.e. self- propelled) industry.

UNIT – I

Introduction – Historical Review – Engine Types – Design and operating Parameters.

Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles – Real Engine cycles - differences and Factors responsible for – Computer Modeling.

UNIT – II

Gas Exchange Processes: Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging.

Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

UNIT – III

Engine Combustion in S.I engines: Combustion and Speed – Cyclic Variations – Ignition – Abnormal combustion Fuel factors, MPFI, SI engine testing.

Combustion in CI engines: Essential Features – Types off Cycle. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system

UNIT – IV

Pollutant Formation and Control: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.

UNIT - V

Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen.

UNIT - VI

Modern Trends in IC Engines

Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio – fuels, HCCI and GDI concepts

TEXT BOOKS:

1. I.C. Engines Fundamentals/Heywood/Mc Graw Hill
2. The I.C. Engine in theory and Practice Vol.I / Teylor / IT Prof. And Vol.II
3. I.C. Engines: Obert/Int – Text Book Co.

REFERENCE BOOKS:

1. I.C. Engines: Maleev
2. Combustion Engine Processes: Lichty
3. I.C. Engines: Ferguson
4. Scavenging of Two – stroke Cycle Engines – Switzer.
5. I.C.Engines by V.Ganesan

NON CONVENTIONAL ENERGY RESOURCES

(Elective-II)

SUBJECT CODE: 13MTE1009

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To know the relation between sun and earth and application of solar energy
- To know the concept and how to develop geothermal energy
- To know the principle of bio mass energy and its development
- To develop the wind, tidal and ocean energy

COURSE OUTCOMES:

- Able to understand the relation between sun and earth and application of solar energy
- Able to design and development of various renewable energies that should minimize our economical status

UNIT – I

Introduction – Energy Sinario - Survey of Energy Resources – Classification – Need for Non-Conventional Energy Resources. **Solar Energy:** The Sun – Sun-Earth Relationship – Basic matter to waste heat energy circuit – Solar radiation – Attention – Radiation measuring instruments.

UNIT – II

Solar Energy Applications:

Solar water Heating, space heating – active and passive heating – energy storage – selective surface – solar stills and ponds – solar refrigeration – photovoltaic generation .

UNIT - III

Geothermal Energy:

Structure of Earth – Geothermal Regions – Hot springs – Hot Rocks – Hot Aquifers – Analytical Methods to estimate Thermal Potential – Harnessing Techniques – Electricity Generating Systems.

UNIT -IV

Direct Energy Conversion:

Nuclear Fusion:

Fusion – Fusion Reaction- P-P Cycle carbon Cycle, Deuterium cycle – condition for controlled Fusion.

Fuel Cells and Photovoltaic –Thermionic and Thermoelectric Generation – MHD Generator.

Hydrogen gas a Fuel – Production methods – Properties – I.C. Engines Applications – Utilization Strategy – Performances.

UNIT – V

Bio – Energy:

Biomass Energy Sources – Plant Productivity, Biomass Wastes – Aerobic and Anaerobic bio-conversion processes – Raw Materials and properties of Bio-gas-Bio-gas plant Technology and Status – The Energetics and Economics of Biomass Systems – Biomass gasification.

UNIT – VI

Wind Energy:

Wind – Beaufort number – characteristics – wind energy conversion systems – types – Betz model – Interference Factor – Power Coefficient – Torque Coefficient and thrust coeff.- Lift machines and drag machines – matching – electricity generation.

Energy from Oceans:

Tidal Energy; Tides – Diurnal and Semi – Diurnal Nature – Power from Tides.

Wave Energy ; Waves – Theoretical Energy Available – Calculation of period and phase velocity of waves – wave power systems – submerged devices. Ocean Thermal Energy : principles – Heat Exchangers – Pumping requirements – Practical Considerations.

TEXT BOOK:

1. Renewable Energy Resources – Basic Principles and Applications – G.N.Tiwari and M.K.Ghosal, Narosa Pub

REERENCE BOOKS:

1. Renewable Energy Resources / John Twidell & Tony Weir
2. Biological Energy Resources / Malcolm Flescher & Chrris Lawis

MATERIAL SCIENCE FOR THERMAL ENGINEERING

(Elective-II)

SUBJECT CODE: 13MTE1010

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To introduce the students to the relationships that exists between the structure and properties of engineering materials.
- To introduce the students to the production, properties and application of the major groups of engineering materials
- To allow the students to interpret the phase diagrams of metals and alloys and use them in thermal processing of the materials.
- To introduce the students to the basic principles involved in materials selection based on the properties of materials and failure in service.

COURSE OUTCOMES:

- Use subject specific terminology correctly, expressing the basic principles of Materials Science through the correct use of verbal, mathematical and graphic language.
- Distinguish the main types of materials and be able to match their different characteristics to their various applications.
- Match the internal structure of materials to their specific physicochemical and mechanical properties, determining the impact of these properties on the practical function of each material.
- Handle the concept of equilibrium state of a material and be able to reason how a mechanical or heat treatment can change that state, and hence, the properties of the material.
- Work cooperatively to complete tasks in the field of Materials Science, carrying out team tasks and analyzing and discussing ideas contributed by other members of the team.

UNIT-I

Introduction–Materials used in Thermal Engineering applications, Stainless steels, Cast Iron,

UNIT-II

Super Alloys and Titanium and its alloys

UNIT-III

Graphite, Oxide Ceramides, Borides

UNIT-IV

Nitrides, Silicides, Refractory Metals and alloys (W, Ta, Cb, Rh & Mo)

UNIT-V

Cermets, Composites, C-C Composites

UNIT-VI

Ablation & Ablative Materials.

TEXT BOOK

1. High temperature materials technology – Campbell E.E. and Sherwood – John Wiley and Sons, 1967

REFERENCE BOOKS

1. High temperature technology – Campbell I.E. – John Wiley
2. High temperature materials – Hehmann R.F. – Wiley and sons, 1967.
3. Behaviour of high temperature alloys – Proceeding of International conference, 1979.

THERMAL ENGINEERING LABORATORY

SUBJECT CODE: 13MTE1101

L	P	C	INT	EXT
0	4	2	40	60

COURSE OBJECTIVES:

- To introduce the student the fundamental theories and the industrial applications of thermodynamics, heat transfer, and fluid mechanics. This laboratory supports the courses for the undergraduate and graduate studies. Moreover, this laboratory also supports the advanced research in the area of thermal engineering, heat transfer, and fluid mechanics.

COURSE OUTCOMES:

- Able to calculate compressibility factor for different real gases.
- Able to analyze and calculate different factors which are use full to his thesis work.
- Able to know how to utilize the renewable energy sources.

LIST OF EXPERIMENTS:

1. Compressibility factor measurement of different real gases.
2. Dryness fraction estimation of steam.
3. Flame propagation analysis of gaseous fuels.
4. Performance test and analysis of exhaust gases of an I.C. Engine.
5. Heat Balance sheet, Volumetric Efficiency and air fuel ratio estimation of an I.C. Engine.
6. COP estimation of vapour compression refrigeration test.
7. Performance analysis of Air conditioning unit.
8. Performance analysis of heat pipe.
9. Solar Flat Plate Collector
10. Evacuative tube concentrator.

FUELS, COMBUSTION AND ENVIRONMENT

SUBJECT CODE: 13MTE1011

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To make students familiar with the basic energy transfer processes that govern existing and proposed methods of power generation for a global society.
- To make students familiar with the traditional and non-traditional fuel sources in terms of energy content, accessibility required processing steps and projected remaining reserves.
- To teach the evaluation of heat, work and energy transfer steps associated with advanced power train strategies and stationary power systems.
- To teach the fundamental thermodynamics, physics and chemistry relevant to evaluating combustion emissions and efficiencies.

COURSE OUTCOMES:

- Identify and quantify the important energy transfer for solar, nuclear, fossil fuel combustion and wind power generation schemes.
- Quantify the limiting efficiencies for solar, nuclear, fossil fuel combustion and wind power generation schemes.
- Quantify the energy densities/specific energy content of a fuel.
- Identify the opportunities and challenges of advances in electro-chemistries used for energy storage and delivery.
- Identify the thermodynamic conditions limiting vehicle emissions.

UNIT – I

Fuels – detailed classification – Conventional and Unconventional Solid, Liquid, gaseous fuels and nuclear fuels – Origin of Coal – Analysis of coal.

Coal – Carborisation, Gasification and liquification – Lignite: petroleum based fuels – problems associated with very low calorific value gases: Coal Gas – Blast Furnace Gas Alcohols and Biogas.

UNIT – II

Principles of combustion – Chemical composition – Flue gas anlaysis – dew point of products – Combustion stoichiometry.

UNIT – III

Chemical kinetics – Rate of reaction – Reaction order – Molecularity – Zeroth, first, second and third order reactions - complex reactions – chain reactions. Theories of reaction Kinetics – General oxidation behavior of HC's.

UNIT – IV

Thermodynamics of combustion – Enthalpy of formation – Heating value of fuel - Adiabatic flame Temperature – Equilibrium composition of gaseous mixtures.

UNIT – V

Laminar and turbulent flames propagation and structure – Flame stability – Burning velocity of fuels – Measurement of burning velocity – factors affecting the burning velocity. Combustion of fuel, droplets and sprays – Combustion systems – Pulverised fuel furnaces – fixed, Entrained and Fluidised Bed Systems.

UNIT – VI

Environmental considerations – Air pollution – Effects on Environment, Human Health etc. Principal pollutants – Legislative Measures – Methods of Emission control.

TEXT BOOKS:

1. Combustion Fundamentals by Roger A strehlow – Mc Graw Hill
2. Fuels and combustion by Sharma and Chander Mohan – Tata Mc Graw Hill
3. Combustion Engineering and Fuel Technology by Shaha A.K. Oxford and IBH.
4. Principles of Combustion by Kanneth K.Kuo, Wiley and Sons.
5. Combustion by Sarkar – Mc. Graw Hill.

REFERENCE BOOKS:

1. An Introduction to Combustion – Stephen R. Turns, Mc. Graw Hill International Edition.
2. Combustion Engineering – Gary L. Berman & Kenneth W. Ragland, Mc. Graw Hill International Edition.
3. Combustion- I. Glassman

ENERGY MANAGEMENT

SUBJECT CODE: 13MTE1012

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- Familiarizing with management, especially with management in energy sector engineering. Fundamentals of product strategy management. Studying methods of energy accounting and energy auditing in energy sector, industry and final consumption. Finding opportunities to increase the rational use of energy.

COURSE OUTCOMES:

- Understanding basics of demand side management and mechanisms (technical, legal or financial) that influence energy consumption. Recognizing opportunities for increasing rational use of energy. Learning the basics of energy auditing with application on different sectors.

UNIT-I

Introduction: Principles of Energy Management – Managerial Organization – Functional Areas for i. Manufacturing Industry ii. Process Industry iii. Commerce iv. Government.
Role of Energy Manager in each of these organization. Initiating, Organising and Managing Energy Management Programs

UNIT-II

Energy Audit: Definition and Concepts, Types of Energy Audits – Basic Energy Concepts – Resources for Plant Energy Studies – Data Gathering – Analytical Techniques.

UNIT-III

Energy Conservation: Technologies for Energy Conservation , Design for Conservation of Energy materials – energy flow networks – critical assessment of energy usage – formulation of objectives and constraints – synthesis of alternative options and technical analysis of options – process integration.

UNIT-IV

Economic Analysis: Scope, Characterization of an Investment Project – Types of Deprecication – Time Value of money – budget considerations, Risk Analysis.

UNIT-V

Methods of Evaluation of Projects : Payback – Annualised Costs – Investor's Rate of return – Present worth – Internal Rate of Return – Pros and Cons of the common methods of analysis – replacement analysis. Energy Consultant: Need of Energy Consultant – Consultant Selection Criteria.

UNIT-VI

Alternative Energy Sources : Solar Energy – Types of devices for Solar Energy Collection – Thermal Storage System – Control Systems-

Wind Energy – Availability – Wind Devices – Wind Characteristics – Performance of Turbines and systems.

TEXT BOOKS

1. Energy Management Hand book by W.C. Turner (Ed)
2. Management by H.Koontz and Cyrill O Donnell

REFERENCE BOOKS

1. Financial Management by S.C. Kuchhal
2. Energy Management by W.R.Murthy and G.Mc Kay
3. Energy Management Principles by CB Smith.

FINITE ELEMENT ANALYSIS

SUBJECT CODE: 13MTE1013

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- Provide knowledge Finite Element Methods for solving various field problems.
- Provide knowledge to solve, one-dimensional, two-dimensional steady state heat analysis problems

COURSE OUTCOMES:

- Able to analyze the stress- strain relations of different problems using stiffness matrix calculations.
- Able to solve one- dimensional, two-dimensional steady state heat transfer problems.

UNIT -I

Introduction to FEM: basic concepts, historical back ground, application of FEM, general description, comparison of fem with other methods, variational approach, Galerkin Methods

UNIT -II

Co-ordinates, basic element shapes, interpolation function. Virtual energy principle, Rayleigh- Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain displacement relations

UNIT -III

1-D structural problems – axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape function. Analysis of Trusses – Plane Truss and Space Truss elements. Analysis of beams – Hermite shape functions – stiffness matrix – Load vector – Problems – analysis.

UNIT -IV

2-D problems –CST, force terms, Stiffness matrix and load vector, boundary conditions, Isoparametric element – quadrilateral element, Shape functions – Numerical Integration

3-D problems – Tetrahedran element – Jacobian matrix – Stiffness matrix

UNIT -V

Scalar field problems - 1-D Heat conduction – 1-D fin element – 2-D heat conduction problems – Torsion.

UNIT -VI

Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen Vector, natural frequencies – mode shapes – modal analysis.

TEXT BOOKS:

1. Introduction to finite elements in engineering – Tirupathi K. Chandrupatla and Ashok D. Belagundu.
2. The finite element methods in Engineering – S.S. Rao _ Pergamon, New York
3. An Introduction to Finite Element Methods – J. N. Reddy – Mc Grawhill

REFERENCE BOOKS:

1. The Finite element method in engineering science – O.C. Aienkowitz, Mc Grawhill.
2. Concepts and applications of finite element analysis – Robert Cook
3. Finite Element Procedures in Engineering analysis – K.J Bathe

COMPUTATIONAL FLUID DYNAMICS

SUBJECT CODE: 13MTE1014

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- Should be able to solve a given partial differential equation using finite-difference and finite-volume methods
- Should be able to formulate various turbulence models and their solution procedures.

COURSE OUTCOMES:

- Should be able to formulate and solve various finite difference schemes for elliptic, parabolic and hyperbolic PDEs.
- Should be able to solve 1D steady and unsteady heat conduction with convection and source terms using finite volume method.
- Should be able to solve continuity and momentum equations with pressure coupling using vorticity and stream-function formulation with SIMPLE and SIMPLER algorithms.
- Should be able to formulate DNS, LES and RANS turbulence modeling.

UNIT-I

Introduction to Numerical Methods - Finite Difference, Finite Element and Finite Volume Methods – Classification of Partial Differential Equations – Solution of Linear Algebraic Equations – Direct and Iterative Approaches

UNIT-II

Finite difference methods: Taylor's series – FDE formulation for 1D and 2D steady state heat transfer problems – Cartesian, cylindrical and spherical co-ordinate systems – boundary conditions – Un steady state heat conduction – Errors associated with FDE - Explicit Method – Stability criteria – Implicit Method – Crank Nickolson method – 2-D FDE formulation – ADI – ADE

UNIT - III

Finite Volume Method: Formation of Basic rules for control volume approach using 1D steady heat conduction equation – Interface Thermal Conductivity - Extension of General Nodal Equation to 2D and 3D Steady heat conduction and Unsteady heat conduction

UNIT-IV

FVM to Convection and Diffusion: Concept of Elliptic, Parabolic and Hyperbolic Equations applied to fluid flow – Governing Equations of Flow and Heat transfer – Steady 1D Convection Diffusion – Discretization Schemes and their assessment – Treatment of Boundary Conditions

UNIT-V

Calculation of Flow Field: Vorticity & Stream Function Method - Staggered Grid as Remedy for representation of Flow Field - Pressure and Velocity Corrections – Pressure Velocity Coupling - SIMPLE & SIMPLER (revised algorithm) Algorithm.

UNIT-VI:

Turbulent Flows: Direct Numerical Simulation, Large Eddy Simulation and RANS Models

Compressible Flows: Introduction - Pressure, Velocity and Density Coupling.

TEXT BOOKS:

1. Computational Fluid Flow and Heat Transfer – Muralidharan & Sundarajan (Narosa Pub)
2. Numerical heat transfer and fluid flow – S.V. Patankar (Hemisphere Pub. House)
3. An Introduction to Computational Fluid Dynamics – FVM Method – H.K. Versteeg, W. Malalasekhara (PHI)
4. Computational Fluid Dynamics – Anderson (TMH)
5. Computational Methods for Fluid Dynamics – Ferziger, Peric (Springer)

REFERENCE BOOKS:

1. Computational Fluid Dynamics, T.J. Chung, Cambridge University
2. Computaional Fluid Dynamics – A Practical Approach – Tu, Yeoh, Liu (Elsevier)
3. Text Book of Fluid Dynamics, Frank Chorlton, CBS Publishers

EQUIPMENT DESIGN FOR THERMAL SYSTEMS
(Elective-III)

SUBJECT CODE: 13MTE1015

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To familiarize the knowledge of simple heat exchangers and its design
- To design and develop the double pipe and shell& tube heat exchanger
- To design and develop different types of extended surfaces

COURSE OUTCOMES:

- Able to gain concept of simple heat exchanger and its design
- Able to design and develop the double pipe and shell& tube heat exchanger
- Able to design and develop different types of extended surfaces

UNIT - I

Classification of heat exchangers: Introduction, Recuperation & Regeneration – Tubular heat exchangers: double pipe, shell & tube heat exchanger, Plate heat exchangers, Gasketed plate heat exchanger, spiral plate heat exchanger, Lamella heat exchanger, extended surface heat exchanger, Plate fin, and Tubular fin.

UNIT -II

Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow, multipass, cross flow heat exchanger design calculations.

UNIT - III

Double Pipe Heat Exchanger: Film Coefficient for fluids in annulus, fouling factors, calorific temperature, average fluid temperature, the calculation of double pipe exchanger, Double pipe exchangers in series-parallel arrangements.

Shell & Tube Heat Exchangers: Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell & tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers.

UNIT - IV

Condensation of single vapors: Calculation of a horizontal condenser, vertical condenser, De-super heater condenser, vertical condenser – sub-cooler, horizontal condenser – subcooler, vertical reflux type condenser, condensation of steam.

UNIT – V

Vaporizers, Evaporators and Reboilers: Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of a reboiler.

Extended Surfaces: Longitudinal fins, weighted fin efficiency curve, calculation of a double pipe fin efficiency curve, calculation of a double pipe finned exchanger, calculation of a longitudinal fin shell and tube exchanger.

UNIT -VI

Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb & dew point temperatures, the Lewis number, and classification of cooling towers, cooling tower internals and the roll of fill, Heat balance, heat transfer by simultaneous diffusion and convection. Analysis of cooling tower requirements, Design of cooling towers, Determination of the number of diffusion units, calculation of cooling tower performance.

TEXT BOOK:

1. Process Heat Transfer – D.Q. Kern, TMH.

REFERENCE BOOKS:

1. Cooling Towers by J.D. Gurney
2. Heat Exchanger Design – A.P.Fraas and M.N. Ozisick. John Wiely & sons, New York.

CONVECTIVE HEAT TRANSFER

(Elective-III)

SUBJECT CODE: 13MTE1016

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To understand the problem of the calculation of the convection heat transfer.
- To learn the classification of the different convection types and how is possible their characterization.
- To know the non-dimensional numbers used to characterize the convection and the basic structure of the mathematical correlations for the different convection types.
- To know the phase change convection.
- To define the most used correlations for forced internal and external convection
- Description of the non-dimensional numbers characteristics at free convection.

COURSE OUTCOMES:

- Able to understand the problem of the calculation of the convection heat transfer
- Able to classification of the different convection types and how is possible their characterization.
- Able to know the phase change convection
- Able to use correlations for forced internal and external convection

UNIT-I

Introduction: Forced, free & combined convection – convective heat transfer coefficient – Application of dimensional analysis to convection – Physical interpretation of dimensionless numbers.

Equations of Convective Heat Transfer: Continuity, Navier-Strokes equation & energy equation for steady state flows – similarity – Equations for turbulent convective heat transfer – Boundary layer equations for laminar, turbulent flows – Boundary layer integral equations.

UNIT-II

External Laminar Forced Convection: Similarity solution for flow over an isothermal plate – integral equation solutions – Numerical solutions – Viscous dissipation effects on flow over a flat plate.

External Turbulent Flows: Analogy solutions for boundary layer flows – Integral equation solutions – Effects of dissipation on flow over a flat plate.

UNIT-III

Internal Laminar Flows: Fully developed laminar flow in pipe, plane duct & ducts with other cross-sectional shapes – Pipe flow & plane duct flow with developing temperature field – Pipe flows & plane duct flow with developing velocity & temperature fields.

Internal Turbulent Flows: Analogy solutions for fully developed pipe flow –Thermally developing pipe & plane duct flow.

UNIT – IV

Natural Convection: Boussineq approximation – Governing equations – Similarity – Boundary layer equations for free convective laminar flows – Numerical solution of boundary layer equations.

Free Convective flows through a vertical channel across a rectangular enclosure – Horizontal enclosure – Turbulent natural convection.

UNIT – V

Combined Convection: Governing parameters & equations – laminar boundary layer flow over an isothermal vertical plate – combined convection over a horizontal plate – correlations for mixed convection – effect of boundary forces on turbulent flows – internal flows - internal mixed convective flows – Fully developed mixed convective flow in a vertical plane channel & in a horizontal duct.

UNIT - VI

Convective Heat Transfer Through Porous Media: Area weighted velocity – Darcy flow model – energy equation – boundary layer solutions for 2-D forced convection – Fully developed duct flow – Natural convection in porous media – filled enclosures – stability of horizontal porous layers.

TEXT BOOK:

1. Introduction to Convective Heat Transfer Analysis – Patrick H. Oosthuigen & David Naylor (MCH)

REFERENCE BOOK:

1. Convective Heat & Mass Transfer – Kays & Crawford (TMH)

THERMAL AND NUCLEAR POWER PLANTS

(Elective-III)

SUBJECT CODE: 13MTE1017

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To know the principle of combustion and its analysis
- To gain the concept of all the cycles and its application for power generation
- To provide the students with an introduction to nuclear reactor technology with particular emphasis of power generation
- To know that the factors affecting the economy of power generation

COURSE OUTCOMES:

- Able to understand the principle of combustion and its analysis
- Able to gain the concept of all the cycles and its application for power generation
- Identify the key safety issues associated with nuclear power generation.
- Appreciate the advantages and disadvantages of different types of nuclear reactor for applications in a sustainable energy economy.

UNIT –I

Introduction – Sources of Energy, types of Power Plants, Direct Energy Conversion System, Energy Sources in India, Recent developments in Power Generation. Combustion of Coal, Volumetric Analysis, Gravimetric Analysis, Flue gas Analysis.

UNIT –II

Steam Power Plants: Introduction – General Layout of Steam Power Plant, Modern Coal-fired Steam Power Plants, Power Plant cycles, Fuel handling, Combustion Equipment, Ash handling, Dust Collectors.

Steam Generators: Types, Accessories, Feed water heaters, Performance of Boilers, Water Treatment, Cooling Towers, Steam Turbines, Compounding of Turbines, Steam Condensers, Jet & Surface Condensers.

UNIT - III

Gas Turbine Power Plant: Cogeneration, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion – Advantages & Disadvantages.

UNIT -IV

Nuclear Power Plants: Nuclear Physics, Nuclear Reactors, Classification – Types of Reactors, Site Selection, Methods of enriching Uranium, Applications of Nuclear Power Plants.

Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power.

UNIT -V

Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems.

UNIT - VI

Power Plant Instrumentation: Classification, Pressure measuring instruments, Temperature measurement and Flow measurement. Analysis of Combustion gases, Pollution – Types, Methods to Control.

TEXT BOOKS:

1. Power Plant Engineering / P.K. Nag / TMH.
2. Power Plant Engineering / R.K. Rajput / Lakshmi Publications.

REFERENCEBOOKS:

1. Power Plant Engineering / P.C.Sharma / Kotaria Publications.
2. Power Plant Technology / Wakil.

THERMAL MEASUREMENTS AND PROCESS CONTROLS

(Elective-IV)

SUBJECT CODE: 13MTE1018

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- To improve concept and design of different pressure measuring instruments
- To improve concept and design of different flow measuring instruments
- To improve concept and design of different temperature measuring instruments
- To improve concept and design of level measurement by using different methods

COURSE OUTCOMES:

- Able to design of different pressure measuring instruments
- Able to design of different flow measuring instruments
- Able to design of different temperature measuring instruments
- Able to design of level measurement by using different methods

UNIT-I

General concepts – fundamental elements of a measuring instrument. Static and dynamic characteristics – errors in instruments – Different methods of measurement and their analysis – Sensing elements and transducers.

UNIT-II

Measurement of pressure – principles of pressure measurement, static and dynamic pressure, vacuum and high pressure measuring – Measurement of low pressure, Manometers, Calibration methods, Dynamic characteristics- design principles.

UNIT-III

Measurement of Flow: Obstruction meters, variable area meters. Pressure probes, compressible fluid flow measurement, Thermal anemometers, calibration of flow measuring instruments. Introduction to design of flow measuring instruments.

UNIT-IV

Temperature Measurement: Different principles of Temperature Measurement, use of bimetallic thermometers – Mercury thermometers, Vapor Pressure thermometers,

Thermo positive elements, thermocouples in series & parallel, pyrometry, measurement of heat flux, calibration of temperature measuring instruments. Design of temperature measuring instruments.

UNIT-V

Level Measurement: Direct & indirect methods, manometric methods, float level meters, electrical conductivity, Capacitive, Ultrasonic, and Nucleonic Methods.

Measurement of density – Hydrometer, continuous weight method, Gamma rays, Gas impulse wheel.

Velocity Measurement – Coefficient of viscosity, Ostesld method, free fall of piston under gravity, torque method.

Measurement of moisture content and humidity. Measurement of thermal conductivity of solids, liquids and gases.

UNIT-VI

Process Control: Introduction and need for process control principles, transfer functions, block diagrams, signal flow graphs, open and closed loop control systems – Analysis of First & Second order systems with examples of mechanical and thermal systems.

Control System Evaluation – Stability, steady state regulations, and transient regulations.

TEXT BOOK:

1. Measurement System, Application & Design – E.O. Doeblin.

REFERENCE BOOKS:

1. Mechanical and Industrial Measurements – R.K. Jain – Khanna Publishers.
2. Mechanical Measurements – Buck & Beckwith – Pearson.
3. Control Systems, Principles & Design, 2nd Edition – M. Gopal – TMH.

REFRIGERATION AND AIR CONDITIONING
(Elective-IV)

SUBJECT CODE: 13MTE1019

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

This course deals with the design and implementation of refrigeration and air conditioning systems.

- To understand the principles of refrigeration and air conditioning.
- To calculate the cooling load for different applications.
- To select the right equipment for a particular application.
- To design and implement refrigeration and air conditioning systems using standards.
- Energy Conservation and Management.

COURSE OUTCOMES:

- Students will demonstrate ability to analysis psychrometric processes and cycles of air conditioning systems.
- Students will demonstrate an ability to estimate the energy requirements of cooling and heat equipment for simple air conditioning applications.
- Students will demonstrate an ability to estimate energy requirements for simple air conditioning processes.
- Students will demonstrate an ability to apply principles of air conditioning to perform energy analysis of simple air conditioning applications.

UNIT – I

Vapour Compression Refrigeration : Performance of Complete vapor compression system. **Components of Vapor Compression System:** The condensing unit – Evaporators – Expansion valve – Refrigerants – Properties – ODP & GWP - Load balancing of vapor compression Unit.

UNIT – II

Compound Compression

Flash inter-cooling – flash chamber – Multi-evaporator & Multistage systems.

UNIT – III

Production of low temperature – Liquefaction system ;Cascade System – Applications.– Dry ice system.

Vapor absorption system – Simple and modified aqua – ammonia system – Representation on Enthalpy –Concentration diagram.

Lithium – Bromide system Three fluid system – HCOP.

UNIT – IV

Air Refrigeration : Applications – Air Craft Refrigeration -Simple, Bootstrap, Regenerative and Reduced ambient systems – Problems based on different systems.

Steam Jet refrigeration system

Representation on T-s and h-s diagrams – limitations and applications.

Unconventional Refrigeration system – Thermo-electric – Vortex tube & Pulse tube – working principles.

UNIT – V

Air –conditioning: Psychrometric properties and processes – Construction of Psychrometric chart. Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective Temperature. Summer , Winter and year round air – conditioning systems.

Cooling load Estimation: Occupants, equipments, infiltration, duet heat gain fan load, Fresh air load.

UNIT – VI

Air –conditioning Systems: All Fresh air , Re-circulated air with and without bypass, with reheat systems – Calculation of Bypass Factor, ADP,RSHF, ESHF and GSHF for different systems.

Components: Humidification and dehumidification equipment – Systems of Air cleaning – Grills and diffusers – Fans and blowers – Measurement and control of Temperature and Humidity.

TEXT BOOKS :

1. Refrigeration & Air Conditioning – C.P. Arora(TMH)
2. Refrigeration & Air Conditioning – Arora & Domkundwar – Dhanpat Rai

REFERENCE BOOKS :

1. Refrigeration and Air Conditioning :Manohar Prasad
2. Refrigeration and Air Conditioning : Stoecker – Mc Graw Hill
3. Principles of Refrigeration – Dossat (Pearson)
4. Refrigeration and Air Conditioning : Ananthanarayana (TMH)
5. Refrigeration and Air Conditioning : Jordan and – Prentice Hall, Preister
6. Refrigeration and Air Conditioning : Dossat – Mc Graw Hill

JET PROPULSION AND ROCKETRY

(Elective-IV)

SUBJECT CODE: 13MTE1020

L	P	C	INT	EXT
4	0	3	40	60

COURSE OBJECTIVES:

- Given the basic geometry and idealized component performance, to be able to estimate the thrust and specific impulse of a gas turbine and a rocket engine from fluid and thermodynamic principles.

COURSE OUTCOMES:

- An understanding of the generation of thrust in air-breathing engines and rockets
- An ability to carry out simple performance analysis of subsonic and supersonic inlets
- An ability to carry out overall performance calculations of turbojets, turbofans and turboprops
- An elementary understanding of combustors, afterburners, and exhaust nozzles
- An understanding of axial flow compressors and turbines, and an ability to carry out flow and performance calculations for these
- An ability to carry out simple flight performance calculations for rockets
- An understanding of the fundamentals of chemical rocket performance
- An understanding of how liquid and solid propellant rockets work.

UNIT - I

Turbo Jet Propulsion System:

Gas turbine cycle analysis – layout of turbo jet engine. Turbo machinery- compressors and turbines, combustor, blade aerodynamics, engine off design performance analysis

Flight Performance:

Forces acting on vehicle – Basic relations of motion – multi stage vehicles.

UNIT - II

Principles of Jet Propulsion and Rocketry:

Fundamentals of jet propulsion, Rockets and air breathing jet engines – Classification – turbo jet , turbo fan, turbo prop, rocket (Solid and Liquid propellant rockets) and Ramjet engines.

UNIT - III

Nozzle Theory and Characteristics Parameters:

Theory of one dimensional convergent – divergent nozzles – aerodynamic choking of nozzles and mass flow through a nozzle – nozzle exhaust velocity – thrust, thrust coefficient, A_c / A_t of a nozzle, Supersonic nozzle shape, non-adapted nozzles, summer field criteria, departure from simple analysis – characteristic parameters – 1) characteristic velocity, 2) specific impulse 3) total impulse 4) relationship between the characteristic parameters 5) nozzle efficiency, combustion efficiency and overall efficiency.

UNIT - IV

Aero Thermo Chemistry of the Combustion Products:

Review of properties of mixture of gases – Gibbs – Dalton laws – Equivalent ratio, enthalpy changes in reactions, heat of reaction and heat of formation – calculation of adiabatic flame temperature and specific impulse – frozen and equilibrium flows.

Solid Propulsion System:

Solid propellants – classification, homogeneous and heterogeneous propellants, double base propellant compositions and manufacturing methods. Composite propellant oxidizers and binders. Effect of binder on propellant properties. Burning rate and burning rate laws, factors influencing the burning rate, methods of determining burning rates.

UNIT - V

Solid propellant rocket engine – internal ballistics, equilibrium motor operation and equilibrium pressure to various parameters. Transient and pseudo equilibrium operation, end burning and burning grains, grain design. Rocket motor hard ware design. Heat transfer considerations in solid rocket motor design. Ignition system, simple pyro devices.

Liquid Rocket Propulsion System:

Liquid propellants – classification, Mono and Bi propellants, Cryogenic and storage propellants, ignition delay of hypergolic propellants, physical and chemical characteristics of liquid propellant. Liquid propellant rocket engine – system layout, pump and pressure feed systems, feed system components. Design of combustion chamber, characteristic length, constructional features, and chamber wall stresses. Heat transfer and cooling aspects. Uncooled engines, injectors – various types, injection patterns, injector characteristics, and atomization and drop size distribution, propellant tank design.

UNIT - VI

Ramjet and Integral Rocket Ramjet Propulsion System:

Fuel rich solid propellants, gross thrust, gross thrust coefficient, combustion efficiency of ramjet engine, air intakes and their classification – critical, super critical and sub-critical operation of air intakes, engine intake matching, classification and comparison of IIRR propulsion systems.

TEXT BOOKS

1. Mechanics and Dynamics of Propulsion – Hill and Peterson
2. Rocket propulsion elements – Sutton

REFERENCES BOOKS

1. Gas Turbines – Ganesan (TMH)
2. Gas Turbines & Propulsive Systems – Khajuria & Dubey (Dhanpatrai)
3. Rocket propulsion – Bevere
4. Jet propulsion – Nicholas Cumpsty

COMPUTATIONAL METHODS LABORATARY

SUBJECT CODE: 13MTE1102

L	P	C	INT	EXT
0	4	2	40	60

COURSE OBJECTIVES:

- Provide students with an understanding of the principles of fluid mechanics, heat transfer and the numerical procedures in CFD.
- Provide students with knowledge of scientific programming (in C/C++).
- Develop programming skills to solve some specific CFD problems.

COURSE OUTCOMES:

- Able to solve problems related to thermal engineering, fluid mechanics and heat transfer field
- Able to design the problems like 2D and 3D meshing with GAMBIT
- Able to run the mesh files of 2D and 3D problems by using FLUENT

C programming for problem solving.

Solving Thermal Engineering problems using available packages such as T K Solver,

ANSYS, CFX, STARCD, MATLAB, FLUENT etc…