JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

Course Structure and syllabi for

M.Tech-ME-Thermal Engineering

for affiliated Engineering Colleges 2017-18

I YEAR - I Semester

S. No	Course Code	Subjects	L	T	P	C
1	17D11102	Advanced Thermodynamics	4	-	-	4
2	17D11201	Advanced Heat & Mass Transfer	4	-	-	4
3	17D88101	Turbo Machines	4	-	-	4
4	17D88102	Fuels, Combustion & Environment	4	-	-	4
5	 17D88103 17D88104 17D11206	Elective-I a. Refrigeration & Air Conditioning b. Equipment design for Thermal Systems c. Optimization Techniques & its Applications	4	-	-	4
6	 17D88105 17D88106 17D88107	Elective – II FEA in Thermal Engineering Design of heat exchangers Energy resources	-	-	-	4
7	17D88108	Advanced Thermal Engineering Laboratory	-	-	3	2
			24	-	3	26

I YEAR II Semester

S. No	Course Code	Subject	L	T	P	C
1	17D11209	Advanced I.C. Engines	4	-	-	4
2	17D11204	Computational Fluid Dynamics	4	-	-	4
3	17D11108	Instrumentation for thermal Engineering	4	-	-	4
4	17D88201	Design of thermal systems	4	-	-	4
5	 17D17107 17D88202 17D88203	Elective-III a. Croyogenics Engineering b. Thermal & Nuclear Power Plants c. Jet Propulsion & Rocketry	4	-	-	4
6	 17D88204 17D88205 17D88206	Elective IV a) Environmental Engineering Pollution Control b) Alternative energy sources c) Air craft and space Propulsion	4	-	-	4
7	17D88207	Computational Fluid Dynamics Laboratory	-	-	3	2
			24	-	3	26

III SEMESTER

S.No	Subject Code	Subject	L	T	P	C
1.	17D20301 17D20302 17D20303	Elective V a) Research Methodology b) Human Values and Professional Ethics c) Intellectual Property Rights	4	-	-	4
2.	17D88301	Elective VI (MOOCS)	-	-	-	-
3.	17D88302	Comprehensive Viva – Voice	-	-	-	2
4.	17D88303	Seminar	-	-	-	2
5.	17D88304	Teaching Assignment	-	-	-	2
6.	17D88305	Project work phase – I	-	-	-	4

IV SEMESTER

S.No	Subject Code	Subject	L	T	P	C
1.	17D88401	Project work Phase – II	-	-	-	12

Project Viva Voce Grades:

A: Satisfactory

B: Not Satisfactory

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M. Tech – I year I Sem. (TE)

L	T	P	C
4	0	0	4

(17D11102) ADVANCED THERMODYNAMICS

OBJECTIVES:

- The objective of this course is to prepare students to effectively solve theoretical and applied thermodynamics problems that are directly applicable to situations faced in research and industry.
- Significant emphasis is placed on the integration of recent thermodynamics-related research into the traditional resources in order to foster critical analysis of current work as it relates to fundamental principles.

UNIT I

AVAILABILITY ANALYSIS AND THERMODYNAMIC PROPERTY

RELATIONS

Reversible work - availability - irreversibility and second – law efficiency for a closed system and steady – state control volume. Availability analysis of simple cycles. Thermodynamic potentials. Maxwell relations. Generalized relations for changes in entropy - internal energy and enthalpy - generalized relations for Cp and CV Clausius Clayperon equation, Joule – Thomson coefficient.Bridgeman tables for thermodynamic relations.

UNIT II

REAL GAS BEHAVIOUR AND MULTI – COMPONENT SYSTEMS

Different equations of state – fugacity – compressibility - principle of corresponding States - Use of generalized charts for enthalpy and entropy departure - fugacity coefficient,Lee – Kesler generalized three parameter tables. Fundamental property relations for systems of variable composition.Partial molar properties.Real gas mixtures - Ideal solution of real gases and liquid - activity - equilibrium in multi phase systems - Gibbs phase rule for non – reactive components.

UNIT III

CHEMICAL THERMODYNAMICS AND EQUILIBRIUM

Thermochemistry - First law analysis of reacting systems - Adiabatic flame temperature – entropy change of reacting systems - Second law analysis of reacting systems - Criterion for reaction equilibrium.Equilibrium constant for gaseous mixtures - evaluation of equilibrium composition.

UNIT IV

STATISTICAL THERMODYNAMICS

Microstates and Macrostates - thermodynamic probability - degeneracy of energy levels - Maxwell – Boltzman, Fermi – Diarc and Bose – Einstein statistics - microscopic interpretation of heat and work, evaluation of entropy, partion function, calculation of the Macroscopic properties from partition functions.

UNIT V

IRREVERSIBLE THERMODYNAMICS

Conjugate fluxes and forces - entropy production Onsager's reciprocity relations - thermo – electric phenomena, formulations.

OUTCOME:

1. Describe and calculate thermodynamic properties of single-phase and multi-phase systems

2. Apply the laws of statistical and classical thermodynamics to chemically reactive systems, kinetics, and combustion.

3. Relate course principles to solve problems regarding gas turbines, combustion, refrigeration, and solar energy.

4. Communicate engineering knowledge of thermodynamics through written and verbal means.

TEXT BOOKS :

1. Kenneth Wark Jt.m, Advanced Thermodynamics for Engineers, McGrew – Hill Inc., 1995.

2. Bejan, A., Advanced Engineering Thermodynamics, John Wiley and Cons, 1988.

3. Holman, J.P., Thermodynamics, Fourth Edition, McGraw – Hill Inc., 1988.

REFERENCES

1. Smith, J.M. and Van Ness., H.C., Introduction to Chemical Engineering Thermodynamics, Fourth

Edition, McGraw – Hill Inc., 1987.

2. Sonntag, R.E., and Van Wylen, G, Introduction to Thermodynamics, Classical and Statistical

Themodynamics, Third Edition, John Wiley and Sons, 1991.

3. Sears, F.W. and Salinger G.I., Thermodynamics, Kinetic Theory and Statistical

Thermodynamics, Third Edition, Narosa Publishing House, New Delhi, 1993.

4. DeHotf, R.T., Thermodynamics in Materials Science, McGraw – Hill Inc., 1993. Rao, Y.V.C.Postulational and Statistical Thermodynamics, Allied Publisher Limited, New Delhi, 1999

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M. Tech – I year I Sem. (TE)

L	T	P	C
4	0	0	4

(17D11201) ADVANCED HEAT AND MASS TRANSFER

OBJECTIVES:

- To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.
- To analyse the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges**.**
- To achieve an understanding of the basic concepts of phase change processes and mass transfer.

UNIT I

CONDUCTION AND RADIATION HEAT TRANSFER

One dimensional energy equations and boundary condition - three-dimensional heat conduction equations - extended surface heat transfer - conduction with moving boundaries - radiation in gases and vapour.Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media – interaction of radiation with conduction and convection.

UNIT II

TURBULENT FORCED CONVECTIVE HEAT TRANSFER

Momentum and energy equations - turbulent boundary layer heat transfer - mixing length concept - turbulence model – k Є model - analogy between heat and momentum transfer – Reynolds, Colburn, Prandtl turbulent flow in a tube - high speed flows.

UNIT III

PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER

Condensation with shears edge on bank of tubes - boiling – pool and flow boiling – heat exchanger –Є – NTU approach and design procedure - compact heat exchangers.

UNIT IV

NUMERICAL METHODS IN HEAT TRANSFER

Finite difference formulation of steady and transient heat conduction problems – discretization schemes – explicit - Crank Nicolson and fully implicit schemes - control volume formulation steady one-dimensional convection and diffusion problems - calculation of the flow field – SIMPLER Algorithm.

UNIT V

MASS TRANSFER AND ENGINE HEAT TRANSFER CORRELATION

Mass transfer - vaporization of droplets - combined heat and mass transfers - heat transfer correlations in various applications like I.C. engines - compressors and turbines.

OUTCOME:

- On successful completion of this course the student will be able to apply the law of thermodynamics to engines.

REFERENCES

1. Yunus A.Cengal, Heat and Mass Transfer – A practical Approach, 3rd edition, Tata McGraw - Hill,

2007.

2. Holman.J.P, Heat Transfer, Tata Mc Graw Hill, 2002.

3. Ozisik. M.N., Heat Transfer – A Basic Approach, McGraw-Hill Co., 1985

4. Incropera F.P. and DeWitt. D.P., Fundamentals of Heat & Mass Transfer, John Wiley & Sons,

2002.

5. Nag.P.K, Heat Transfer, Tata McGraw-Hill, 2002

6. Ghoshdastidar. P.S., Heat Transfer, Oxford University Press, 2004

7. Yadav, R., Heat and Mass Transfer, Central Publishing House, 1995.

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M. Tech – I year I Sem. (TE)

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(17D88101) TURBO MACHINES

OBJECTIVES:

- To develop the ability to use the turbo concepts for various applicants like steam nozzles, steam turbines etc.
- To achieve an understanding of the basic concepts of centrifugal, axial,rotary compressors and axial flow gas turbines.

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: Effect of back – pressure on the analysis; Design of nozzles.

Steam Turbines of C & C –D nozzles : Impulse Turbines: 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.

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 – IV:

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 – V:

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.

OUTCOME:

- On successful completion of this course the student will be able to understand the concept of turbo machines and its applications.

TEXT BOOKS:

1. Fundamentals of Turbo machines – Shephard
2. Practise on Turbomachines – G. Gopalakrishnan & D. Prithviraj, SciTech Publishers, Chennai.
3. Elements of Gas Dynamics – Yahya

REFERENCES:

1. Theory and practice of steam turbines – Kearton
2. Gas Turbines – Theory and practice – Zucrow
3. Elements of Gas Dynamics – Liepman and Roshkow
4. Elements of Gas Dynamics – Yahya
5. Turbines, Pumps, Compressors – Yahya
6. Axial Flow Compressors – Horlock.
7. Gas Turbines- Cohen, Roger & Sarvanamuttu

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(17D88102) FUELS, COMBUSTION AND ENVIRONMENT

OBJECTIVES:

- To know the concepts of stoichiometry & kinetics for Solid, Liquid & Gaseous Fuels **.**
- To achieve an understanding of the basic concepts of combustion equipments

UNIT I

CHARACTERIZATION

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation - Flue gas Analysis - Orsat Apparatus - Fuel & Ash Storage & Handling - Spontaneous Ignition Temperatures.

UNIT II

SOLID FUELS & LIQUID FUELS

(a) Solid Fuels

Types - Coal Family - Properties - Calorific Value - ROM, DMMF, DAF and Bone Dry Basis - Ranking - Bulk & Apparent Density - Storage - Washability - Coking & Caking Coals – Renewable Solid Fuels - Biomass - Wood Waste - Agro Fuels - Manufactured Solid Fuels.

(b) Liquid Fuels

Types - Sources - Petroleum Fractions - Classification - Refining - Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc, - Alcohols - Tar Sand Oil - Liquefaction of Solid Fuels.

UNIT III

GASEOUS FUELS

Classification - Composition & Properties - Estimation of Calorific Value - Gas Calorimeter. Rich & Lean Gas - Wobbe Index - Natural Gas - Dry & Wet Natural Gas - Stripped NG - Foul & Sweet NG - LPG - LNG - CNG - Methane - Producer Gas - Gasifiers - Water Gas - Town Gas - Coal Gasification - Gasification Efficiency - Non - Thermal Route - Biogas - Digesters - Reactions - Viability - Economics.

UNIT IV

COMBUSTION : STOICHIOMETRY & KINETICS

Stoichiometry - Mass Basis & Volume Basis - Excess Air Calculation - Fuel & Flue Gas Compositions - Calculations - Rapid Methods - Combustion Processes - Stationary Flame - Surface or Flameless Combustion - Submerged Combustion - Pulsating & Slow Combustion Explosive Combustion. Mechanism of Combustion - Ignition & Ignition Energy - Spontaneous Combustion – Flame Propagation - Solid, Liquid & Gaseous Fuels Combustion - Flame Temperature - Theoretical, Adiabatic & Actual - Ignition Limits - Limits of Inflammability.

UNIT V

COMBUSTION EQUIPMENTS

Coal Burning Equipments - Types - Pulverized Coal Firing - Fluidized Bed Firing - Fixed Bed &Recycled Bed - Cyclone Firing - Spreader Stokers - Vibrating Grate Stokers - Sprinkler Stokers,Traveling Grate Stokers. Oil Burners - Vaporizing Burners, Atomizing Burners - Design of Burners. Gas Burners - Atmospheric Gas Burners - Air Aspiration Gas Burners - Burners Classification according to Flame Structures - Factors Affecting Burners & Combustion.

OUTCOME:

- On successful completion of this course the student will be able to understand the concept of various fuels and combustion and effect of environment.

TEXT BOOKS :

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman, 1990

2. Bhatt, Vora Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1984

3. Blokh AG,Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn, 1988.

REFERENCES :

1. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966

2. Sharma SP, Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984

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M. Tech – I year I Sem. (TE)

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(17D88103) REFRIGERATION AND AIR CONDITIONING

(ELECTIVE I)

OBJECTIVES

- To teach the students about the methods of Refrigeration and its types, Psychrometry and its principles. Teaching the cycle analysis pertaining to various Refrigeration systems, Air-conditioning systems, cooling load calculations.

UNIT-I

Refrigerants:

Desirable properties- thermo dynamic-chemical and transport properties - designation of refrigerants - inorganic, halo carbon refrigerants - secondary refrigerants - Properties of mixtures of refrigerants.

Ozone depletion potential and global warming potential – effect of refrigerants- alternative refrigerants.

UNIT – II:

Vapour Compression Refrigeration : Analysis and Performance of Complete vapour compression Refrigeration system. Components of Vapour Compression Refrigeration System**:** The condensing unit – Evaporators – Expansion valve ; Refrigerants – Properties – ODP and GWP.

Compound Compression: Need; Compounding with external intercooling, Flash mixing Flash inter-cooling – liquid flash internal cooling – Multi Pressure-(Multistage)systems. Cascade System – Applications

UNIT - III

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

Lithium – Bromide system Three fluid system – HCOP.

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 systems: working principles of Thermo-electric Refrigeration – Vortex tube.

UNIT – IV:

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.

Cooling load Estimation: Occupants, equipments, heat gain due to- infiltration, fan load, Fresh air load (Ventilation). Summer , Winter and year round air – conditioning systems.

UNIT – V:

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 and Air Conditioning, C.P. Arora(TMH)
2. Refrigeration and Air Conditioning, Manohar Prasad
3. Refrigeration and Air Conditioning, Stoecker , Mc Graw Hill

REFERENCE BOOKS :

1. Principles of Refrigeration, Dossat (Pearson)
2. Refrigeration and Air Conditioning, Arora & Domkundwar , Dhanpat Rai
3. Refrigeration and Air Conditioning, Ananthanarayana (TMH)
4. Refrigeration and Air Conditioning, Jordan and , Prentice Hall, Preister
5 Ashrae Hand Book

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(17D88104) EQUIPMENT DESIGN FOR THERMAL SYSTEMS

(ELECTIVE I)

OBJECTIVES:

- To know the concepts of heat exchangers and basic design methods of heat exchangers
- To achieve an understanding of the basic concepts of Vaporizers, Evaporators and Reboilers, Extended Surfaces.

UNIT - I:

Classification of heat exchangers: Introduction, Recuperation and Regeneration – Tubular heat exchangers: double pipe, shell and 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.

Basic Design Methods of Heat Exchangers: 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.

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.

UNIT - II

Shell and 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 and tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers.

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

UNIT –III:

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

UNIT - IV

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.

Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb and dew point temperatures, the Lewis number, and classification of cooling towers, cooling tower internals and the roll of fill, Heat balance

UNIT - V

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.

OUTCOME:

On successful completion of this course the student will be able to understand the concept of Heat exchanger design, extended surfaces and design of cooling towersetc.

TEXT BOOKS :

1. Process Heat Transfer, D.Q. Kern, TMH.
2. Cooling Towers, J.D. Gurney
3. Heat Exchanger Design, A.P.Fraas and M.N. Ozisick. John Wiely & sons, New York.

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L	T	P	C
4	0	0	4

(17D11206) OPTIMIZATION TECHNIQUES AND ITS APPLICATIONS

(ELECTIVE I)

Objective:

- To introduce the fundamental concepts of Optimization Techniques;
- To make the learners aware of the importance of optimizations in real scenarios;
- To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.

UNIT- I*:*

Introduction: Engineering Applications of optimization- statement of an optimization problem – Classification of optimization problems.

Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods:- Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods – quadratic and cubic interpolation methods.

UNIT- II:

Multi variable non-linear unconstrained optimization: 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.

Linear Programming – Graphical method-Simplex method- Dual simplex method-Revised simplex method- Parametric linear programming- Goal Programming

Simulation- types of simulations- Applications of simulations to inventory, queuing and thermal systems.

UNIT- III:

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

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

UNIT- IV:

Geometric Programming: Posynomials – arithmetic - geometric inequality – unconstrained G.P- constrained G.P

UNIT- V

Non Traditional Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm and Traditional Methods. Simulated Annealing- Working Principle-Simple Problems. Application in production problems.

OUTCOME:-

- Formulate optimization problems;
- Understand and apply the concept of optimality criteria for various type of optimization problems;
- Solve various constrained and unconstrained problems in single variable as well as multivariable;
- Apply the methods of optimization in real life situation.

TEXT BOOKS:

1. Optimization theory and Applications,S.S.Rao,New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

REFERENCE BOOKS:

1. Operations Research, S.D.Sharma,
2. Operation Research, H.A.Taha ,TMH
3. Optimization in operations research, R.LRardin
4. Optimization Techniques, Belagundu & Chandraputla, Pearson Asia.
5. Optimization Techniques theory and practice, M.C.Joshi, K.M.Moudgalya, Narosa Publications

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4	0	0	4

(17D88105) FINITE ELEMENT ANALYSIS IN THERMAL ENGINEERING

Objective:

- To provide the fundamental concepts of the theory of the finite element method
- To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code.

UNIT - I:

Introduction to FEM: basic concepts, application of FEM, general description, advantages of FEM, comparison of FEM with other methods : finite difference method, variational method, Galerkin Method, basic element shapes, interpolation function. Virtual energy principle, treatment of boundary conditions, solution of system of equations,basic equations of elasticity, strain displacement relations.

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.

UNIT-II

Analysis of beams, frames – Hermite shape functions, stiffness matrix, load vector problems, analysis.

2-D problems – CST, force terms, stiffness matrix and load vector, boundary conditions, Iso-parametric element, Quadric element, shape functions, Numerical Integration, 3-D problems – Tetrahedron element, Jacobian matrix, stiffness matrix.

UNIT - III :

Axis Symmetric formulations, Finite Element Modeling- Triangular element, Problem modeling and Boundary conditions

Dynamic considerations, Dynamic equations, consistent mass matrix, Eigen values, Eigen vector, natural frequencies, mode shapes, modal analysis.

UNIT - IV:

Scalar field problems – Generalized Heat Conduction Equation – Variation Principle – Boundary Conditions – Internal heat generation, heat flux and convection - 1-D Steady state Heat conduction – Thermal load vector - 1-D fin element – Quadratic fin elements

I D unsteady state heat conduction – Thermal load vector - 2-D steady state heat conduction – Concepts of 3D heat conduction

Finite Element Formulation of Torsion, Potential flow, seepage and fluid flow in ducts.

UNIT-V

Computer Implementation : Pre-processing , mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – solutions and post processing- overview and application packages

OUTCOME:-

- To obtain an understanding of the fundamental theory of the FEA method;
- To develop the ability to generate the governing FE equations for systems governed by partial differential equations;
- To understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements; and
- To understand the application and use of the FE method for heat transfer problems.

TEXT BOOKS :

1. Finite Element Methods, Alavala, PHI
2. Introduction to finite elements in engineering , Tirupathi K. Chandrapatla and Ashok D. Belagundu.

REFERENCE BOOKS :

1. An Introduction to Finite Element Methods, S.S. Rao , Pegamon, New York.
2. The Finite element method in Engineering science, O.C. Aienkowitz, Mc. Graw Hill.
3. Concepts and applications of finite element analysis, Robert Cook.

4. Finite Element Methods in Engineering analysis, K.J. Bathe.
5. The finite element method in Heat transfer analysis- Lewis R.W, Morgan.K, Thomas H.R. and Seetharaman K.N, John Wiley, 1994

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M. Tech – I year I Sem. (TE)

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(17D88106) DESIGN OF HEAT EXCHANGERS

(ELECTIVE II)

OBJECTIVE:

- To learn the thermal and stress analysis on various parts of the heat exchangers
- To analyze the sizing and rating of the heat exchangers for various applications

UNIT I

FUNDAMENTALS OF HEAT EXCHANGER

Temperature distribution and its implications types – shell and tube heat exchangers – regenerators and recuperators – analysis of heat exchangers – LMTD and effectiveness method.

UNIT II

FLOW AND STRESS ANALYSIS

Effect of turbulence – friction factor – pressure loss – stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures.

UNIT III

DESIGN ASPECTS

Heat transfer and pressure loss – flow configuration – effect of baffles – effect of deviations from

ideality – design of double pipe - finned tube - shell and tube heat exchangers - simulation of heat exchangers.

UNIT IV

COMPACT AND PLATE HEAT EXCHANGERS

Types – merits and demerits – design of compact heat exchangers, plate heat exchangers – performance influencing parameters - limitations.

UNIT V

CONDENSERS AND COOLING TOWERS

Design of surface and evaporative condensers – cooling tower – performance characteristics.

OUTCOME

Able to design the heat exchanger based on the information provided for a particular application and do the cost economic analysis

TEXT BOOK:

1. Sadik Kakac and Hongtan Liu, Heat Exchangers Selection, Rating and Thermal Design, CRC Press, 2002

REFERENCES

1. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1988.

2. Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co. 1980.

3. Hewitt.G.F, Shires.G.L and Bott.T.R, Process Heat Transfer, CRC Press, 1994.

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(17D88107) ENERGY RESOURCES

(ELECTIVE II)

OBJECTIVES:

- To explain concept of various forms of Non-renewable and renewable energy
- To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications
- To analysis the environmental and cost economics of using renewable energy sources compared to fossil fuels.

UNIT I COMMERCIAL ENERGY

Coal, Oil, Natural Gas, Nuclear power and Hydro - their utilization pattern in the past, present and future projections of consumption pattern - Sector-wise energy consumption – environmental impact of fossil fuels – Energy scenario in India – Growth of energy sector and its planning in India.

UNIT II SOLAR ENERGY

Solar radiation at the earth's surface – solar radiation measurements – estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors – solar thermal applications - heating, cooling, desalination, drying, cooking, etc – solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells - Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc - solar PV power plant – Net metering concept.

UNIT III WIND ENERGY

Nature of the wind – power in the wind – factors influencing wind – wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications – offshore wind energy – Hybrid systems - safety and environmental aspects – wind energy potential and installation in India - Repowering concept.

UNIT IV BIO-ENERGY

Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - direct combustion – biomass gasification - pyrolysis and liquefaction – biochemical conversion - anaerobic digestion - types of biogas Plants - applications - alcohol production from biomass – bio diesel production – Urban waste to energy conversion - Biomass energy programme in India.

UNIT V OTHER TYPES OF ENERGY

Ocean energy resources - principle of ocean thermal energy conversion (OTEC) - ocean thermal power plants - ocean wave energy conversion - tidal energy conversion – small hydro – geothermal energy - geothermal power plants – hydrogen production and storage - Fuel cell – principle of working - various types - construction and applications.

OUTCOME:

- Understanding of commercial energy and renewable energy sources
- Knowledge in working principle of various energy systems
- Capability to do basic design of renewable energy systems

REFERENCES

1. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984.

2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.

3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012

4. Peter Gevorkian, Sustainable Energy Systems Engineering, McGraw Hill,2007

5. Kreith, F and Kreider, J. F., Principles of Solar Engineering, McGraw-Hill, 1978.

6. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford

University Press, U.K, 1996.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Tech – I year I Sem. (TE)	**L**	**T**	**P**	**C**
	0	**0**	**3**	**2**

(17D88108) ADVANCED THERMAL ENGINEERING LABORATORY

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 rig.
7. Performance analysis of Air conditioning unit.
8. Performance analysis of heat pipe.
9. Solar Flat Plate Collector Performance
10. Evacuative tube concentrator Performance
11. Calibration of temperature measurement apparatus.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Tech – I year II Sem. (TE)

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(17D11209) ADVANCED I.C. ENGINES

OBJECTIVES:

- **To understand the underlying principles of operation of different IC Engines and components.**
- **To provide knowledge on pollutant formation, control, alternate fuel etc.**

UNIT I

SPARK IGNITION ENGINES

Spark ignition Engine mixture requirements – Fuel – Injection systems – Monopoint, Multipoint

injection, Direct injection – Stages of combustion – Normal and abnormal combustion – factors

affecting knock – Combustion chambers.

UNIT II

COMPRESSION IGNITION ENGINES

States of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers – Fuel spray behaviour – spray structure, spray penetration and evaporation – air motion – Introduction to Turbo charging.

UNIT III

POLLUTANT FORMATION AND CONTROL

Pollutant – Sources – Formation of carbon monoxide, Unburnt hydrocarbon, NOx, Smoke and

Particulate matter – Methods of controlling Emissions – Catalytic converters and Particulate Traps – Methods of measurements and Introduction to emission norms and Driving cycles.

UNIT IV

ALTERNATIVE FUELS

Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas- Properties, Suitability, Merits and

Demerits as fuels, Engine Modifications.

UNIT V

RECENT TRENDS

Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition engines – Plasma Ignition – Measurement techniques – laser Doppler, Anemometry.

OUTCOME:

- Upon completion of this course, the students can able to compare the operations of different IC Engine and components and can evaluate the pollutant formation, control, alternate fuel

TEXT BOOK

1.K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications, 2002.

REFERENCE BOOKS

1. R.B.Mathur and R.P. Sharma, Internal combustion Engines.

2. V. Ganesan, Int. Combustion Engines, II Edition, TMH, 2002.

3. Duffy Smith, auto fuel Systems, The Good Heart Willox Company, Inc., 198

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M. Tech – I year II Sem. (TE)

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(17D11204) COMPUTATIONAL FLUID DYNAMICS

OBJECTIVES:

- To develop finite difference and finite volume discredited forms of the CFD equations.
- To formulate explicit & implicit algorithms for solving the Euler Eqns & Navier Stokes Eqns.

UNIT I

GOVERNING DIFFERENTIAL EQUATION AND FINITE

DIFFERENCE METHOD

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II

CONDUCTION HEAT TRANSFER

Steady one-dimensional conduction, Two and Three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

UNIT III

INCOMPRESSIBLE FLUID FLOW

Governing Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and spalding, Computation of Boundary layer flow, Finite difference approach.

UNIT IV

CONVECTION HEAT TRANSFER AND FEM

Steady One-Dimensional and Two-Dimensional Convection – Diffusion, Unsteady one-dimensional convection – Diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – Solution of steady heat conduction by FEM – Incompressible flow – Simulation by FEM.

UNIT V

TURBULENCE MODELS

Algebraic Models – One equation model, K - Models, Standard and High and Low Reynoldsvnumber models, Prediction of fluid flow and heat transfer using standard codes.

OUTCOME:

- At the end of the course student will able to formulate explicit & implicit algorithms for solving the Euler Eqns & Navier Stokes Eqns.

REFERENCES

1. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa

Publishing House, New Delhi, 1995.

2. Ghoshdasdidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw HillPublishing Company Ltd., 1998.

3. Subas, V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation,1980.

4. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier Stock Equation",Pineridge Press Limited, U.K., 1981.

5. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanic and Heat

Transfer " Hemisphere Publishing Corporation, Newyork, USA, 1984.

6. Fletcher, C.A.J. “Computational Techniques for Fluid Dynamics 1” Fundamental and GeneralTechniques, Springer – Verlag, 1987.

7. Fletcher, C.A.J. “Computational Techniques for Fluid Dynamics 2” Specific Techniques forDifferent Flow Categories, Springer – Verlag, 1987.

8. Bose, T.X., “Numerical Fluid Dynamics” Narosa Publishing House, 1997.

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M. Tech – I year II Sem. (TE)

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(17D11108) INSTRUMENTATION FOR THERMAL ENGINEERING

OBJECTIVES:

- To provide knowledge on various measuring instruments.
- To provide knowledge on advance measurement techniques.
- To understand the various steps involved in error analysis and uncertainty analysis.

UNIT I

MEASURMENT CHARACTERISTICS

Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

UNIT II

MICROPROCESSORS AND COMPUTERS IN MEASURMENT

Data logging and acquisition – use of sensors for error reduction, elements of micro computer

interfacing, intelligent instruments in use.

UNIT III

MEASURMENT OF PHYSICAL QUANTITIES

Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow, use of sensors for physical variables.

UNIT IV

ADVANCE MEASURMENT TECHNIQUES

Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, heat flux sensors, Telemetry in measurement.

UNIT V

MEASURMENT ANALYSERS

Orsat apparatus, Gas Analysers, Smoke meters, gas chromatography, spectrometry.

TEXT BOOKS :

1. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 1988.

2. Barnery, Intelligent Instrumentation, Prentice Hall of India, 1988.

3. Prebrashensky, V., Measurements and Instrumentation in Heat Engineering, Vol. 1 and 2, MIR Publishers, 1980.

OUTCOME:

- At the end of the course student will able to understand the various steps involved in error analysis and uncertainty analysis.

REFERENCES

1. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw- Hill, New Delhi, 1983.

2. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 1958.

3. Barney, Intelligent Instrumentation, Prentice Hall of India, 1988

4. Prebrashensky. V., Measurement and Instrumentation in Heat Engineering, Vol.1 and MIRPublishers, 1980.

5. Raman, C.S. Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems,

6. Tata McGraw-Hill, New Delhi, 1983.

7. Doeblin, Measurement System Application and Design, McGraw-Hill, 1978.

8. Morris. A.S, Principles of Measurements and Instrumentation Prentice Hall of India, 1998

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M. Tech – I year II Sem. (TE)

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(17D88201) DESIGN OF THERMAL SYSTEMS

OBJECTIVE:

- To learn basic principles underlying piping, pumping, heat exchangers; modeling and optimization in design of thermal systems.
- To develop representational modes of real processes and systems.
- To optimization concerning design of thermal systems.

UNIT I

DESIGN CONCEPTS

Design Principles, Workable Systems, Optimal Systems, Matching of System Components, Economic Analysis, Depreciation, Gradient Present Worth factor.

UNIT II

MATHEMATICAL MODELLING

Equation Fitting, Nomography , Empirical Equation , Regression Analysis , Different Modes of

Mathematical Models , Selectio n, Computer Programmes for Models.

UNIT III

MODELLING THERMAL EQUIPMENTS

Modelling Heat Exchangers , Evaporators , Condensers , Absorption and Rectification Columns Compressors , Pumps , Simulation Studies , Information Flow Diagram , Solution Procedures.

UNIT IV

OPTIMIZATION

Objective Function Formulation, Constraint Equations, Mathematical Formulation, Calculus Method, Dynamic Programming, Search Methods, ANN and Genetic Algorithm.

UNIT V

DYNAMIC BEHAVIOUR

Steady state Simulation, Laplace Transformation, Feedback Control Loops, Stability Analysis, Non- Linearities.

OUTCOME:

On successful Completion of this course the student will understand modeling and optimization of Thermal systems.

TEXT BOOKS:

1. Stoecker W. F., Design of Thermal Systems, McGraw Hill Edition, 1989.

2. Bejan A., George Tsatsaronis , Michael J. Moran , Thermal Design and Optimization, Wiley ,1996.

REFERENCE:

1. Kapur J. N., Mathematical Modelling , Wiley Eastern Ltd , New York , 1989.

2. Yogesh Jaluria , Design and Optimization of Thermal Systems , CRC Press , 2007.

3. Rao S. S., Engineering Optimization Theory and Practice, New Age Publishers, 2000.

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M. Tech – I year II Sem. (TE)

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4	0	0	4

(17D17107) CRYOGENICS ENGINEERING
(Elective-III)

Objectives

- Impart basic knowledge of low temperature generation, difficulties in maintaining low temperature and solutions
- Understand applications of cryogenic refrigeration
- Understand storage of cryogenic liquids and equipments, instruments used

UNIT I

INTRODUCTION

Insight on Cryogenics, Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures. Applications of Cryogenics in Space Programs, Superconductivity, Cryo Metallurgy, Medical applications.

UNIT II

LIQUEFACTION CYCLES

Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve – Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claudes Cycle Dual Cycle, Ortho- Para hydrogen conversion, Eollins cycle, Simpson cycle, Critical Components in Liquefaction Systems.

UNIT III

SEPARATION OF CRYOGENIC GASES

Binary Mixtures, T-C and H-C Diagrams, Principle of Rectification, Rectification Column Analysis - McCabe Thiele Method. Adsorption Systems for purification.

UNIT IV

CRYOGENIC REFRIGERATORS

J.T.Cryocoolers, Stirling Cycle Refrigerators, G.M.Cryocoolers, Pulse Tube Refrigerators

Regenerators used in Cryogenic Refrigerators, Dilution refrigerators, Magnetic Refrigerators

UNIT V

HANDLING OF CRYOGENS

Cryogenic Dewar, Cryogenic Transfer Lines. Insulations used in Cryogenic Systems, Instrumentation to measure Flow, Level and Temperature.

Outcomes:

Upon the completion of the course student will be able to understand the use of cryogenic systems, real-time difficulties in storing cryogenic liquids

REFERENCES:

1. Klaus D. Timmerhaus and Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989

2. Randall F. Barron, Cryogenic Systems, McGraw-Hill, 1985.

3. Scott R.B., Cryogenic Engineering, Van Nostrand and Co., 1962.

4. Herald Weinstock, Cryogenic Technology, 1969.

5.Robert W. Vance, Cryogenic Technology, Johnwiley & Sons, Inc., New York, London.

WEB REFERENCES

1. www.nasa.gov

2. www.cryogenicsociety.org/

3. www.iifiir.org/

4. www.linde.com

5. www.airliquide.com/

6. www.cern.ch

7. www.nist.gov

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M. Tech – I year II Sem. (TE)

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(17D88202) THERMAL AND NUCLEAR POWER PLANTS

(ELECTIVE III)

Objective:

- To impart knowledge about various components and equipments used in a thermal and nuclear power plant, their maintenance and performance analysis and economic analysis.

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.

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.

Unit - II:

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

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

Unit -III:

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 -IV:

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 - V:

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

OUTCOME:-

The students will have a good understanding about the components used, their operation and maintenance and performance of it.

TEXT BOOKS:

1. Power Plant Technology, El Wakil.
2. Power Plant Engineering, P.C.Sharma, Kotaria Publications.
3. Power Plant Engineering, P.K. Nag, TMH.

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M. Tech – I year II Sem. (TE)

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(17D88203) JET PROPULSION AND ROCKETRY (ELECTIVE III)

Objective

- Analyze thermodynamics of an aircraft jet engine and calculate the performance measures, such as thrust and specific fuel consumption in terms of design requirement.
- .Be able to estimate the best possible engine performance as a function of principal design parameters, such as maximum engine temperature, pressure ratio, and flight speed
- Analyze the internal mechanisms of gas turbine engine components and understand the factors that limit the practical performance of inlets, combustion chambers, and nozzles

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.

Principles of Jet Propulsion and Rocketry: Fundamentals of jet propulsion, Rockets and air breathing jet engines – Classification – turbo jet , turbo fan, turbo propulsion, rocket (Solid and Liquid propellant rockets) and Ramjet engines.

UNIT-II

Nozzle: Theory and Characteristics and 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 - III:

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 - IV:

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 - V:

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.

OUTCOME:-

- Student will be able to Understand the operating characteristics of compressors and turbines in terms of given blade shapes, angles, and direction of rotation
- Design a gas turbine engine using the understanding of the relationship between components, at least at the level of selecting the number of spools and stages
- Understand the broader context of aircraft propulsion technology, including the environmental and economic issues

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 and Propulsive Systems, Khajuria & Dubey (Dhanpatrai)
3. Rocket propulsion, Bevere
4. Jet propulsion, Nicholas Cumpsty

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M. Tech – I year II Sem. (TE)

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(17D88204) ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL
(ELECTIVE IV)

OBJECTIVES:

- To impart knowledge on the atmosphere and its present condition, global warming and ecolegislations.
- To detail on the sources of air, water and noise pollution and possible solutions for mitigating their degradation.
- To elaborate on the technologies available for generating energy from waste.

UNIT I

INTRODUCTION

Global atmospheric change – green house effect – Ozone depletion - natural cycles - mass andenergy transfer – material balance – environmental chemistry and biology – impacts – environmental. Legislations.Pollutants - sources and effect – air pollution meteorology – atmospheric dispersion – indoor airquality - control methods and equipments - issues in air pollution control – air sampling and measurement.

UNIT III

WATER POLLUTION

Water resources - water pollutants - characteristics – quality - water treatment systems – waste water treatment - treatment, utilization and disposal of sludge - monitoring compliance with standards.

UNIT IV

WASTE MANAGEMENT

Sources and Classification – Solid waste – Hazardous waste - Characteristics – Collection andTransportation - Disposal – Processing and Energy Recovery – Waste minimization.

UNIT V

OTHER TYPES OF POLLUTION FROM INDUSTRIES

Noise pollution and its impact - oil pollution - pesticides - instrumentation for pollution control – water pollution from tanneries and other industries and their control – environment impact assessment for various projects – case studies.

OUTCOME:

On successful Completion of this course the student will be understand detail on the sources of air, water and noise pollution and possible solutions for mitigating their degradation.

TEXT BOOKS:

1. G.Masters (2003): Introduction to Environmental Engineering and Science Prentice Hall of India Pvt Ltd, New Delhi.

2. H.S.Peavy, D.R..Rowe, G.Tchobanoglous (1985):Environmental Engineering McGraw- Hill BookCompany, NewYork.

REFERENCES:

1. H.Ludwig, W.Evans (1991): Manual of Environmental Technology in Developing Countries, International Book Company, Absecon Highlands, N.J.

2. Arcadio P Sincero and G. A. Sincero, (2002): Environmental Engineering – A Design Apporach, Prentice Hall of India Pvt Ltd, New Delhi.

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M. Tech – I year II Sem. (TE)

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(17D88205) ALTERNATIVE ENERGY SOURCES (ELECTIVE IV)

Objective:

To create awareness about the availability of various non-conventional energy sources, their conversion technology.

Unit-I:

Solar Energy Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy & Environment. Various Methods of using solar energy – Photothermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy. Hybrid wind energy systems - wind + diesel power, wind + conventional grid, wind + Photovoltaic system etc.

Unit-II:

Biomass: Generation and utilization, Properties of biomass, Agriculture Crop & Forestry residues used as fuels. Biochemical and Thermo-chemical Conversion, Combustion, Gasification, Biomass gasifiers and types etc. Applications of Gasifiers to thermal power and Engines, Biomass as a decentralized power generation source for villages Concept of Bio-energy: Photosynthesis process, Bio-fuels, Biomass resources Bio based chemicals and materials Thermo-chemical Conversion: Pyrolysis, Combustion, Gasification, Liquification. Bio-Chemical Conversion: Aerobic and Anaerobic conversion, Fermentation etc. Bio-fuels: Importance, Production and applications. Bio-fuels: Types of Bio-fuels, Production processes and technologies, Bio fuel applications, Ethanol as a fuel for I.C. engines, Relevance with Indian Economy. Bio-based Chemicals and Materials: Commercial and Industrial Products, Biomass, Feed stocks, Chemicals, Plastics, Fibres etc.

Unit-III:

Biomethanation:- Importance of biogas technology, Different Types of Biogas Plants. Aerobic and anaerobic bioconversion processes, various substrates used to produce Biogas (cow dung, human and other agricultural waste, municipal waste etc.) Individual and community biogas operated engines and their use. Removal of CO2 and H2O, Application of Biogas in domestic, industry and vehicles. Bio-hydrogen production. Isolation of methane from Biogas and packing and its utilization.

Unit-IV:

Wind Energy: Basics & Power Analysis, Wind resource assessment, Power Conversion Technologies and applications, Wind Power estimation techniques, Principles of Aerodynamics of wind turbine blade, Various aspects of wind turbine design,

Unit-V

Wind Turbine Generators: Induction, Synchronous machine, constant V & F and variable V & F generations, Reactive power compensation. Site Selection, Concept of wind form & project cycle, Cost economics & viability of wind farm,

OUTCOME:-

Students will get an idea about the availability of Non- conventional energy sources, their conversion technologies, utilization, etc

Reference Books :

1. Biomass Renegerable Energy – D.O.hall and R.P. Overeed (John Wiley and Sons, New york, 1987) 12

2. Biomass for energy in the developing countries – D.O.Hall, G.W.barnard and P.A.Moss (Pergamon Press Ltd. 1982)

3. Thermo chemical processing of Biomass, Bridgurater A V.

4. Biomass as Fuel – L.P.White (Academic press1981)

5. Biomass Gasification Principles and Technology, Energy technology review No. 67, - T.B. Read (Noyes Data Corp. , 1981)

6. Wind energy Conversion Systems – Freris L.L. (Prentice Hall1990)

7. Wind Turbine Technology: Fundamental concepts of wind turbine technology Spera D.A. (ASME Press, NY, 1994)

8. Wind Energy Systems – G.L. Johnson (Prentice Hall, 1985)

9. Wind Energy Explained – J.F.Manwell, J.G. McGowan and A.L. Rogers (John Wiley & Sons Ltd.)

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M. Tech – I year II Sem. (TE)

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(17D88206) AIR CRAFT AND SPACE PROPULSION
(ELECTIVE IV)

OBJECTIVES:

- To gain insight on the working principle of rocket engines, different feed systems, propellants and their properties and dynamics of rockets.

UNIT I

GAS DYNAMICS

Wave motion - Compressible fluid flow through variable area devices – Stagnation state Mach

Number and its influence and properties, Isentropic Flow, Rayleigh and Fanno Flow. Deflagration and Detonation – Normal shock and oblique shock waves.

UNIT II

THERMODYNAMICS OF AIRCRAFT ENGINES

Theory of Aircraft propulsion – Thrust – Various efficiencies – Different propulsion systems –

Turboprop – Ram Jet – Turbojet, Turbojet with after burner, Turbo fan and Turbo shaft. Variable thrust- nozzles – vector control.

UNIT III

PERFORMANCE CHARACTERISTICS OF AIRCRAFT ENGINES

Engine - Aircraft matching – Design of inlets and nozzles – Performance characteristics of Ramjet, Turbojet, Scramjet and Turbofan engines.

UNIT IV

ROCKET PROPULSION

Theory of rocket propulsion – Rocket equations – Escape and Orbital velocity – Multi-staging of

Rockets – Space missions – Performance characteristics – Losses and efficiencies.

UNIT V

ROCKET THRUST CHAMBER

Combustion in solid and liquid propellant classification – rockets of propellants and Propellant

Injection systems – Non-equilibrium expansion and supersonic combustion – Propellant feed systems – Reaction Control Systems - Rocket heat transfer.

OUTCOME:

On successful completion of this course the student will be able to understand the working of different types of aircraft and rocket propulsion systems and their performance characteristics.

REFERENCES

1. Philip G. Hill and Carl R. Peterson, Mechanics and Thermodynamics of Propulsion, Second

Edition, Addition – Wesley Publishing Company, New York, 2009.

2. Zucrow N.J. Principles of Jet Propulsion and Gas Turbines, John Wiley and Sons New York,

1970.

3. Zucrow N.J. Aircraft and Missile Propulsion, Vol. I and Vol. II, John Wiley and Sons Inc, New York, 1975.

4. S. M.Yahya, Fundamentals of Compressible Flow. Third edition, New Age International Pvt Ltd, 2003.

5. Bonney E.A. Zucrow N.J. Principles of Guided Missile Design, Van Nostranc Co., 1956.

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(17D88207) COMPUTATIONAL FLUID DYNAMICS LABORATORY

1. Simulation of Plane Poiseuille flow through long Parallel and Stationary Plates and Plotting Velocity Contours and Velocity Variation along the horizontal central line . Take the distance between the plates as 4 cm. Properties of fluid are v=0.000217 m^2/s p=800 kg/m^2
2. Simulation of Couette flow when the upper plates is moving with a velocity of 40 m/s. Take the distance between the plates as 4 cm properties of fluid are v=0.000217 m^2/s, p=800 kg/m^3 . Make simulations for a pressure gradient of 0-30000 $N/m^2/m$ and 20000 N m^2/m and report the variation of velocity contours for each case.
3. Simulation of a channel flow (Tube flow) for a tube of diameter. 5 cm and take the fluid as water at 30^0C at the entry of the tube of length 0.7m. A heat flux of 3000 W/m^2 is imposed along a wall. Obtain the contours of velocity and temperature along the length of the tube and also obtain the centre line temperature and velocity of fluid.
4. Simulation of a channel flow (Tube flow) for a tube of diameter 5 cm and take the fluid as water at 30^0C at the entry of the tube length 0.7m . A Constant wall temperature of 300^0C is imposed along the wall. Obtain the contours of Velocity and temperature along the length of the tube and also obtain the centre line temperature and velocity of fluid.
5. Unsteady simulation of compressible flow of air through 2D a convergent – Divergent nozzle, with inlet and outlet of 0.2m size and both are joined by a throat section where the flow area is reduced by 10% and is of sinusoidal shape. Air enters the nozzle at a pressure of 0.9 bar and leaves at 0.73 bar. Obtain the contours of velocity, pressure and Mach number.
6. Simulation of flow over a circular cylinder of size 5 cm for different Reynold's number values of air and plotting the contours of velocity and vorticity
7. Simulation of temperature counters for a square plate of size 0.2m subjected to different types of boundary conditions.
8. Simulation of temperature counters for a pin fin in natural and forced convective conditions.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech III semester (TE)

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(17D20301) RESEARCH METHODOLOGY

(Elective V-OPEN ELECTIVE)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text Books:

1. Research Methodology:Methods And Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.
2. Research Methodology: A Step By Step Guide For Beginners- Ranjit Kumar, Sage Publications (Available As Pdf On Internet)
3. Research Methodology And Statistical Tools – P.Narayana Reddy And G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.

REFERENCES:

1. Scientists Must Write - Robert Barrass (Available As Pdf On Internet)

2. Crafting Your Research Future –Charles X. Ling And Quiang Yang (Available As Pdf On Internet)

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M.Tech III semester (TE)

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(17D20302) HUMAN VALUES AND PROFESSIONAL ETHICS

(Elective V-OPEN ELECTIVE)

Unit I:

HUMAN VALUES:Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

Unit II:

ENGINEERING ETHICS: Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg‟s theory- Gilligan‟s theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

Unit III :

ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering As Social Experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.

UNIT IV:

ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK: Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing riskSafety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).

UINIT V:

GLOBAL ISSUES: Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics .

Text Books :

1. “Engineering Ethics includes Human Values” by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.

2. “Engineering Ethics” by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

3. “Ethics in Engineering” by Mike W. Martin and Roland Schinzinger – Tata McGrawHill– 2003.

4. “Professional Ethics and Morals” by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications.

5. “Professional Ethics and Human Values” by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran , Laxmi Publications.

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M.Tech III semester (TE)

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(17D20303) INTELLECTUAL PROPERTY RIGHTS

(Elective V-OPEN ELECTIVE)

UNIT – I

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

UNIT – II

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT – III

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.

Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

UNIT – IV

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.

Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT – V

New Development Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits.

International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS & REFERENCES:

1. Intellectual Property Right, Deborah. E. Bouchoux, Cengage Learing.

2. Intellectual Property Right – Nleashmy The Knowledge Economy, Prabuddha Ganguli,

Tate Mc Graw Hill Publishing Company Ltd.,