COURSE STRUCTURE
AND
DETAILED SYLLABUS

for

M.Tech course

in

Thermal Engineering

(with effect from the Academic year 2017-2018)

Department of Mechanical Engineering (ME)

SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY

(An Autonomous Institution approved by UGC and affiliated to JNTUH)

(Accredited by NAAC with 'A' Grade, Accredited by NBA of AICTE, Recipient of WBA under TEQIP I & II)

Yamnampet, Ghatkesar, Malkagiri(Medchal)-501 301.

SREENIDHI INSTITUTE OF SCIENCE & TECHNOLOGY (AUTONOMOUS)

CBCS

M.Tech. (THERMAL ENGINEERING)

Course Structure and Syllabus

For the Academic Year: 2017-2018

I Year – I Semester:

Code	Subject	L	T	P	Credits	Internal marks	External marks
6M101	Advanced Thermodynamics	3	1	--	3	25	75
6M102	Advanced I.C. Engines	3	1	--	3	25	75
6M103	Advanced Fluid Mechanics	3	1	--	3	25	75
6M104	Refrigeration & Air Conditioning	3	--	--	3	25	75
6W105	Research Methodology	2	1	--	2	25	75
	Professional Elective – I	3	1	--	3	25	75
	Professional Elective – II	3	1	--	3	25	75
6M171	Thermal Engineering Lab	--	--	4	2	25	75
6M172	Comprehensive Viva -I	--	---	--	1	50	50
6M173	Literature Review and Seminar 1	-	-	3	1	100	-
	Total Credits	20	6	7	24	350	650

L - Lectures; T = Tutorial; P = Practical; C = Credits

Code	Professional Elective – I	Code	Professional Elective – II
6M106	Non Conventional Energy Sources	6M111	Thermal and Nuclear Power Plants
6M107	Advanced Optimization Techniques & Applications	6M112	Thermal Measurements & Process Controls
6M108	Turbo Machines	6M113	Advanced Materials For Thermal Systems
6M109	Nanofluids	6M114	Energy Management
6M110	Computer Simulation of SI & CI Engine	6M115	Equipment Design For Thermal Systems

I Year – II Semester:

Code	Subject	L	T	P	Credits	Internal marks	External marks
6M216	Combustion & Environment	3	1	--	3	25	75
6M217	Computational Fluid Dynamics	3	1	--	3	25	75
6M218	Advanced Heat and Mass Transfer	3	1	--	3	25	75
6M219	Jet & Rocket Propulsion	3	1	--	3	25	75
	Professional Elective – III	3	1	--	3	25	75
	Open Elective	3	1	--	3	25	75
6M274	Computational Methods Lab	--	--	4	2	25	75
6M275	Comprehensive Viva -II	--	---	--	1	50	50
6M276	Literature Review & Seminar -2	--	--	3	1	100	--
6M277	Project Seminar-I(Abstract)	--	--	3	2	100	--
	Total Credits	18	6	10	24	425	575

L - Lectures; T = Tutorial; P = Practical; C = Credits

Code	Professional Elective – III	Code	Open Elective
6M220	Alternate Fuels	**6ZC13**	Entrepreneurship and Innovation
6M221	Cryogenic Engineering (pre req: R&AC)	**6ZC03**	Banking operations, Insurance & Risk Management
6M222	Advanced Finite Element Analysis	**6ZC09**	Total Quality Management
6M223	Convective Heat Transfer	**6H233**	Ethics, Morals, Gender Sensitizations and Yoga
		6RC17	Data Base Management Systems
		5P110	Information Retrieval System
		5PC22	Data Ware housing and Data Mining
		6RC16	Big Data Analytics

II Year - I Semester:

Code	Subject	L	T	P	Credits	Marks	
						Int.	Ext.
6M378	Project Seminar-II (Design, Construction and Development)	--	--	--	4	100	--
6M379	Project work (Part – I) (Project Status Report)	--	--	--	20	Grading	--
Total Credits		--	--	--	24	100	---

Grading: A: Excellent, B: Good, C: Satisfactory, D: Unsatisfactory

II Year - II Semester:

Code	**Subject**	**L**	**T**	**P**	**Credits**	**Marks**	
						Int.	**Ext.**
6M480	Project Seminar-III (Results Analysis)	--	--	--	2	100	--
6M481	Pre- Submission Project Seminar	---	--	--	2	100	--
6M482	Project work and Dissertation	--	--	---	20	--	Grading
Total Credits		--	--	---	24	200	--

Grading: A: Excellent, B: Good, C: Satisfactory, D: Unsatisfactory

Programme Outcomes					
1	2	3	4	5	6
M	M	H	L	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

ADVANCED THERMODYNAMICS

L	T	P	C
3	1	-	3

CODE: 6M101

Course Objective:

To learn the behavior of working fluids through various advanced relations and carry out thermodynamic study on change in state of these working fluids undergoing different thermodynamics processes both reacting -non reacting, reversible-irreversible.

Course Outcomes:

- Understand concepts like entropy, availability and fundamental relations governing properties of working fluid.
- Understand the behavior of real gas through governing relations and evaluate the properties of mixtures.
- Understand different fundamental concepts involved in thermodynamics study of combustion process.
- Understand the concept of equilibrium in chemically reacting flows and Gibbs phase change rule.
- Understand thermodynamic analysis of irreversible processes and learn Phenomenological laws, Onsaga relation.
- Understand the concept of direct energy conversion applied to various situations.

UNIT -I:

Review of Thermodynamic Laws and Corollaries: Transient flow analysis, Second law thermodynamics, Entropy, Availability and unavailability, Thermodynamic potential. Maxwell relations, Specific heat relations, Mayer's relation. Evaluation of thermodynamic properties of working substance

UNIT-II:

P.V.T Surface: Equation of state. Real gas behavior, Vander Waal's equation, Generalization compressibility factor. Energy properties of real gases. Vapour pressure, Clausius, Clapeyro equation. Throttling, Joule. Thompson coefficient. Non reactive mixtures of perfect gases. Governing laws, Evaluation of properties, Psychometric mixture properties and psychometric chart, Air conditioning processes, cooling towers. Real gas mixture.

UNIT-III:
Combustion-I: Combustion Reactions, Enthalpy of formation. Entropy of formation, Reference levels of tables. Energy of formation, Heat reaction, Adiabatic flame temperature generated product, Enthalpies,

UNIT-IV Combustion-II Chemical equilibrium of ideal gased, Effect of non reacting gases equilibrium in multiple reactions, The vent hoff's equation. The chemical potential and phase equilibrium. The Gibbs phase rule.

UNIT-V:
Power Cycles: Review binary vapour cycle, co generation and combined cycles, Second law analysts of cycles. Refrigeration cycles. Thermodynamics off irreversible processes. Introduction, Phenomenological laws, Onsaga Reciprocity relation, Applicability of the Phenomenological relations, Heat flux and entropy production, Thermodynamic phenomena, Thermo electric circuits.

UNIT-VI:
Direct Energy Conversion Introduction: Fuel cells, Thermo electric energy, Thermo ionic power generation, Thermodynamic devices magneto hydrodynamic generations, Photovoltaic cells.

REFERENCES:
1. Engineering Thermodynamics – Roges & Mayhew – Pearson.
2. Thermal Engineering / Rathore / TMH
3. Basic and Applied Thermodynamics/ P.K.Nag/ TMH
4. Applied Thermodynamics – R.K. Rajput – Laxmi Publications
5. Thermodynamics/Holman/ Me Graw Hill.
6. Thermal Engineering / Soman / PHI
7. Engg. Thermodynamics/PL.Dhar / Elsevier
8. Thermodynamics/Sonnatag & Van Wylen / John Wiley & Sons
9. Thermodynamics for Engineers/Doolittle-Messe / John Wiley & Sons
10. Irreversible Thermodynamics/HR De Groff.
11. Thermodynamics & Heat Power – Granet & Bluestein- CRC Press
12. Engineering Thermodynamics/Chatopadyaya

Programme Outcomes					
1	2	3	4	5	6
L	H	M	H	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

ADVANCED I.C. ENGINES

L	T	P	C
3	1	-	3

CODE: 6M102

Course Objective:

The main objective of the course is to give the students an introduction to reciprocating internal combustion engines with emphasis on marine and stationary applications. The focus is on explaining engine performance in terms of power, energy utilization and exhaust emissions, its relation to internal processes like combustion and gas exchange, and varying engine operating conditions.

Course Outcomes:

- Describe and explain different types of reciprocating internal combustion engines (ICE), their typical design features and performance characteristics.
- Analyze engine cycles and the factors responsible for making the cycle different from the Ideal cycle
- Apply principles of thermodynamics, fluid mechanics, and heat transfer to influence the engine's performance
- To Demonstrate the delay period and fuel injection system
- Demonstrate an understanding of the relationships between the design of the IC engine and environmental and social issues
- CI-engines. Fuel quality requirements of SI- and CI-engines.
- Describe the main components of exhaust emissions and explain the mechanisms of emission formation.
- Describe methods for reduction of exhaust emissions, and their relations to fuel quality and engine performance. .

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:

Engine Heat Transfer: Importance of heat transfer, heat transfer and engine energy balance, Convective heat transfer , radiation heat transfer, Engine operating characteristics.

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.

REFERENCES:

1. I.C. Engines / V.Ganesan/TMH
2. I.C. Engines/G.K. Pathak & DK Chevan/ Standerd Publications
3. I.C. Engines Fundamentals/Heywood/TMH
4. Dual-Fuel Diesel Engines – Ghazi A. Karim – CRC Press
5. I.C. Engines /RK Rajput/Laxmi Publications
6. Internal Combustion Engines – S.S. Thipse - Jaico
7. Computer Simulation of C.I. Engine Process/ V.Ganesan/University Press
8. Fundamentals of IC Engines/HN Gupta/PHI/2nd edition
9. I.C. Engines/Fergnson/Wiley
10. The I.C. Engine in theory and Practice Vol.I / Teylor / IT Prof. And Vol.II Computer Simulation of Spark-Ignition Engine Processes – V. Ganesan –
11. Universities Press

Programme Outcomes					
1	2	3	4	5	6
H	M	H		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

ADVANCED FLUID MECHANICS

L	T	P	C
3	1	-	3

CODE: 6M103

Course Objective:

To learn about the basic concept and importance of Gas dynamics. To understand how the flow takes place in flow and non flow systems. To understand the phenomena of shock, Fanno and Rayleigh flow.

Course Outcomes:

After studying this course, students will be able to:

- *Understand the basic laws governing fluid flow and the governing equations for continuity and momentum for inviscid fluids.*
- *Understand the effect of viscosity on fluid flow and the resultant Navier-Stokes equations governing fluid flows.*
- *Understand the effects of boundary layers in real fluid flows and the evaluation of corresponding drag coefficients for different kinds of flows.*
- *Understand the fundamental concept of turbulence and the effects of turbulence on internal and external flows.*
- *Understand the basic concepts of compressibility on flow governing equations as well as the basic concepts of Mach numbers.*
- *Understand the effects of compressible flow at different Mach numbers in applications and the resultant effects of compressible shocks.*

UNIT I:

Inviscid 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 Cartesian systems normal and tangential accelerations, Euler's, Bernouli equations in 3D– Continuity and Momentum Equations

UNIT II:

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.

REFERENCES:
1. Fluid Mechanics and Machines/Modi and Seth/Standard Book House
2. Fluid Mechanics – Jog – Cambridge
3. Fluid Mechanics with Engineering Applications – Finnemore & Franzini – McGrawHill
4. Fluid Mechanics and Machinery – Khan – Oxford
5. Fluid Mechanics/Cohen and Kundu/Elsevier/5th edition
6. Fluid Mechanics/Potter/Cengage Learning
7. Fluid Mechanics/William S Janna/CRC Press

Programme Outcomes					
1	2	3	4	5	6
	M	H		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	1	-	3

COE: 6M104

Course Objectives:

This course is intended to achieve the following objectives-

- Familiarize the students with the different methods of refrigeration and respective application areas.
- Familiarize the students with desirable properties of refrigerants, cause and effect of ODP and GWP, and alternative refrigerants.
- Make the students understand the construction and working of different components used inrefrigeration and air-conditioning system.
- Make the students aware about the basic principles of psychrometricsapplied in air-conditioning system.
- Familiarize students with load calculations along with elementary duct design.

Course Outcomes

After passing this course students will be able to-

1. Analyse simple and compound vapour compression refrigeration system as well as understand the ODP, GWP, alternative refrigerants
2. Understand different methods for production of very low temperature, liquefaction of gasses, production of dry ice, and vapour absorption refrigeration system.
3. Understand and analyse different variants of aircraft refrigeration system.
4. Understand Steam Jet refrigeration system along with other unconventional refrigeration system such as thermoelectric, and vortex tube.
5. Develop an understanding of different psychrometric processes as applied to HVAC systems, and estimate the cooling load.
6. Understand the measurement and control of temperature and humidity and the different components applied for the same as well as understand the air circulation systems and components.

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

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

UNIT – IV
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: Psychometric properties and processes – Construction of Psychometric 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.

REFERENCES:
1. Refrigeration & Air Conditioning /C.P. Arora/TMH
2. Basic Refrigeration & Air Conditioning – P.N. Ananthanarayanan – McGraw Hill
3. Refrigeration and Air Conditioning – Dr. S.S. Thipse - Jaico
4. Principles of Refrigeration/Dossat /Pearson
5. Refrigeration & Air Conditioning /Arora & Domkundwar/ Dhanpat Rai
6. Refrigeration and Air Conditioning /Manohar Prasad/
7. Refrigeration and Air Conditioning /Stoecker /Mc Graw Hill
8. Refrigeration and Air Conditioning /Jordan& Preister /Prentice Hall
9. Refrigeration and Air Conditioning/Dossat /Mc Graw Hill

Programme Outcomes					
1	2	3	4	5	6
	H	L		H	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

RESEARCH METHODOLOGY

L	T	P	C
2	-	-	2

CODE: 6W105

After studying this course, students will be able to:

- *Understand the basic aspects involved in a research process as well as the ethical, legal aspects of research.*
- *Understand the various steps involved in the research design and research problem solving processes.*
- *Understand the mathematical, heuristic and simulation steps involved in research modelling process.*
- *Understand the various kinds of experimentation, and the guidelines for designing and implementation of research experiments.*
- *Understand the basic concepts involved in optimization of the experimental and result analysis processes.*
- *Understand the different steps involved in the analysis, summarization, documentation and presentation of the results obtained through the research process.*

UNIT-I:Introduction:

Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of Research, Research Process and steps in it. Research Proposals – Types, contents, sponsor agent's requirements, Ethical, Training, Cooperation and Legal aspects.

UNIT-II:Research Design:

Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues of Research Design, Research Design Process – Selection of type of research,

Measurement and measurement techniques ,Selection of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research.

Research Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving

Techniques for Idea Generation – Brain storming and Delphi Method.

UNIT-III: Research Modeling:

(a) Mathematical – Classification of Models, Development of Models, Stages in Model building, Principles of Modeling, Use of Analogy, Models as Approximations, Data consideration and Testing of Models(b) Heuristics and Simulation – Definition, Applications and reasons for using Heuristics, Heuristic Methods and approaches, Meta-Heuristics;

Simulation – Meaning, Applications and Classification of Simulation Models, Process of Simulation, Steps and Features of Simulation Experiments and their Validation.

UNIT-IV: Experimentation:
Objective, Strategies, Factorial Experimental Design, Applications of Experimental Design, Basic Principles – Replication, Randomization and Blocking, Guidelines for designing experiments; Laboratory Experiments, Methods of manipulating Variables, Errors in Experiments, Steps in Design of Experiments.

UNIT-V: Process Optimization
Factorial Design principles, Two factor Factorial Design, General Factorial Design, Fitting response Curves and Surfaces, Blocking, Taguchi Approach to Parameter Design, Robust Design.

UNIT-VI : Analysis:
Analysis of Variance and Co-variance, Hypothesis Testing – Parametric. Report Writing: Pre-writing Considerations, Principles of Thesis Writing, Format of Report Writing, Format of Publication in Research Journals, Oral Presentations (Briefing)

Reference Books:

1. Krishnaswamy, K.N., Sivakumar, Appa Iyer & Mathirajan M., (2006) -Management ResearchMethodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)
2. Montgomery, Douglas C. (2004) – Design & Analysis of Experiments, 5/e. (New York, JohnWiley & Sons)
3. Kothari, C.K. (2004) – Research Methodology, Methods & Techniques, 2/e. (New Delhi, New Age International Ltd. Publishers)
4. Ross, Phillip J. (1996) – Taguchi Techniques for Quality Engineering, 2/e. (New York, McGraw Hill)
5. Rao S. S. (2004) – Engineering Optimization The ory & Practices, 3/e (New Delhi, New Age International Ltd., Publishers)
6. Handbook of Industrial Automation – Richard L. Shell & Ernest L. Hall (Marcel Decker Inc.)
7. Trochim, William M.K. (2003), - Research Methods 2/e, (New Delhi, Biztantra, Dreamtech)

Programme Outcomes					
1	2	3	4	5	6
			H	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

NON CONVENTIONAL ENERGY RESOURCES

L	T	P	C
3	1	-	3

COE: 6M106

Course Objectives:

To understand processing and limitations of fossil fuels (coal, petroleum and natural gas) and necessity of harnessing alternate energy resources such as solar, wind, nuclear, geothermal, tidal and biomass. Also, to understand and practice various characterization techniques for fuels.

Course Outcomes:

- To know the energy demand of world, nation and available resources to fulfill the demand
- To know about the conventional energy resources and their effective utilization
- To acquire the knowledge of modern energy conversion technologies
- To be able to understand and perform the various characterization techniques of fuels
- To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively.

UNIT-I

Introduction, Energy Scenario, Survey of energy resources. Classification and need for conventional energy resources.

Solar Energy: The Sun-sun-Earth relationship, Basic matter to waste heat energy circuit, Solar Radiation, Attention, Radiation measuring instruments.

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 -II

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-III

Direct Energy Conversion: Nuclear Fusion: Fusion, Fusion reaction, P-P cycle, Carbon cycle, Deuterium cycle, Condition for controlled fusion, Fuel cells and photovoltaic. Thermionic & thermoelectric generation, MHD generator.

Hydrogen Gas as Fuel: Production methods, Properties, I.C. Engines applications,

Utilization strategy, Performances.

UNIT-IV

Bio-energy: Biomass energy sources. Plant productivity, Biomass wastes, aerovic and Anaerobic bioconversion processed, Raw metrical and properties of bio-gas, Bio-gas plant technology and status, the energetic and economics of biomass systems, Biomass gasification

UNIT-V

Wind Energy: Wind, Beaufort number, Characteristics, Wind energy conversion systems, Types, Betz model. Interference factor. Power coefficient, Torque coefficient and Thrust coefficient, Lift machines and Drag machines. Matching, Electricity generation.

UNIT-VI

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.

REFERENCES:

1. Non-conventional Energy Resources – Khan – McGraw Hill
2. Energy Resources Utilization & Technologies – Y.Anjaneyulu & T. Francis – BS Publications
3. Renewable Energy Resources- Basic Principles and Applications/ G.N.Tiwari and M.K.Ghosal/ Narosa Publications
4. Renewable Energy Resources/ John Twidell & Tony Weir/Taylor & Francis/2nd edition
5. Alternative Energy Sources & Systems – Steeby – Cengage Learning
6. Biological Energy Resources/ Malcolm Fleischer & Chris Lawis/E&FN Spon
7. Renewable Energy Sourse – Tasneem & S.A. Abbasi - PHI
8. Solar Energy – Sukhatme & Nayak – McGraw Hill

Programme Outcomes					
1	2	3	4	5	6
H	M			L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

ADVANCED OPTIMIZATION TECHNIQUES AND APPLICATIONS

L	T	P/D	C
3	1	0	3

CODE: 6M107

Course Objectives:
The general objectives of the course is 1. to introduce the fundamental concepts of Optimization Techniques; 2. to make the learners aware of the importance of optimizations in real scenarios; 3. to provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.

Course Outcomes:
Upon successful completion of this course, students will be able to
1. formulate optimization problems;
2. understand and apply the concept of optimality criteria for various type of optimization problems;
3. solve various constrained and unconstrained problems in single variable as well as multivariable;
4. apply the methods of optimization in real life situation.

UNIT- I
Single Variable Non-Linear Unconstrained Optimition: One dimensional Optimization methods, Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods- quadratic & 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.

UNIT - III
Geometric Programming: Polynomials – arithmetic – geometric inequality – unconstrained G.P – constrained G.P
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 – Sensitivity 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.

REFERENCES:

1. Optimization theory & Applications/ S.S Rao/ New Age International
2. Introductory to operation research/Kasan & Kumar/Springer
3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ Narosa Publications.
4. Operation Research/H.A. Taha/TMH
5. Optimization in operations research/R.L Rardin
6. Optimization Techniques/Benugundu & Chandraputla/Person Asia
7. Optimization Techniques /Benugundu & Chandraputla / Pearson Asia

Programme Outcomes					
1	2	3	4	5	6
	M	H		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

TURBO MACHINES

L	T	P	C
3	1	-	3

COE: 6M108

Course Objectives:

The course aims at giving an overview of different types of turbomachinery used for energy transformation, such as pumps, fans, compressors, as well as hydraulic, steam and gas-turbines. It will focus on applications in power generation, transport, refrigeration and the built environment.

Outcomes:

After completing the course the student will be able to:

1. Give examples of the main applications of turbomachines
2. Recognize typical designs of turbomachines
3. Explain the working principles of turbomachines and apply it to various types of machines
4. Determine the velocity triangles in turbomachinery stages operating at design and off-design conditions
5. Apply the affinity laws to pumps such as to determine their off-design behavior Match a pump to a system and discuss various solutions of pump matching from asustainability point-of-view
6. Explain the working principle of various types of hydro turbines and know their application range Perform the preliminary design of turbomachines (pumps, compressors, turbines) on a 1- D basis Use design parameters for characterizing turbomachinery stages
7. Determine the off-design behavior of turbines and compressors and relate it to changes in the velocity triangles

UNIT-I:

Fundamentals of Turbo Machines: Classifications, Applications, Thermodynamic analysis, Isentropic flow. Energy transfer. Efficiencies, Static and Stagnation conditions, Continuity equations, Euler's flow through variable cross sectional areas, Unsteady flow in turbo machines

UNIT -II:

Steam Nozzles: Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure of analysis. Designs of nozzles.

Steam Turbines: Impulse turbines, Compounding, Work done and Velocity triangle, Efficiencies, Constant reactions, Blading, Design of blade passages, Angle and height, Secondary flow. Leakage losses, Thermodynamic analysis of steam turbines.

UNIT-III:
Gas Dynamics: Fundamental thermodynamic concepts, isentropic conditions, mach numbers and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Super sonic flow, oblique shock waves. Normal shock recoveries, Detached shocks, Aerofoil theory.

UNIT-IV:
Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuserand pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach numbers, Pre whirl, 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: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT-VI:
Axial Flow Gas Turbines: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, Off design performance.

REFERENCES:
1. Principles of Turbo Machines/DG Shepherd / Macmillan
2. Fundamentals of Turbomachinery/William W Perg/John Wiley & Sons
3. Element of Gas Dynamics/Yahya/TMH
4. Principles of Jet Propulsion and Gas Turbine/NJ Zucrow/John Wiley & Sons/Newyork
5. Turbines, Pumps, Compressors/Yahya/TMH
6. Practice on Turbo Machines/ G.Gopal Krishnan & D. Prithviraj/ Sci Tech Publishers, Chennai
7. Theory and practice of Steam Turbines/ WJ Kearton/ELBS Pitman/London
8. Gas Turbines Theory and Practice/Zucrow/John Wiley & Sons/Newyork
9. Element of Gas Dynamics/Liepeman and Roshkow/ Dover Publications

Programme Outcomes					
1	2	3	4	5	6
M	H			L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

NANOFLUIDS

L	T	P	C
3	1	-	3

CODE: 6M109

Course objective:

To introduce the application of nanotechnology in the area of fluids and thermal engineering.

Course outcomes:

- Understanding of superior thermo physical properties of nano fluids
- Understanding of synthesis of nano fluids
- Comparison of heat transfer using nano fluids with conventional fluids
- Understanding of convection and boiling heat transfer
- Research on this new topic to design modern mini and micro channel heat exchangers with nano fluids exhibiting much higher thermal efficiency and saving energy.

UNIT-I:

Introduction to nanofluids, nano structured materials, base fluids, dispersion, sanitation and stable suspension. Various types of nanofluids-volumetric concentration. Thermo physical properties: Density; principles of measurement and apparatus. Theoretical equations and new empirical correlations to determine the density of different nanofluids. Viscosity: principles of measurement and apparatus. Andrade's and other theoretical equations and new empirical correlations to determine the viscosity of different nanofluids. Effect of volumetric concentration and temperature. Effect of subzero temperature on nano fluid viscosity.

UNIT-II:

Thermal conductivity: principles of measurement and apparatus. Hamilton-Crosser and other theoretical equations and new empirical correlations to determine the thermalconductivity of different nanofluids. Effect of volumetric concentration and temperature

UNIT-III:

Effect of Brownian motion on enhancing the thermal conductivity. Specific heat: principles of measurement and apparatus. Buongeorno's thermal equilibrium equation and other theoretical equation sand new empirical correlations to determine the specific heat of different nanofluids. Effect of volumetric concentration and temperature.

UNIT-IV:

Combined effects of thermo physical properties of nanofluids on the thermal diffusivity, the Prandtl number, the Reynolds number and the Nusselt number. Basic understanding of their effects on frictional loss and Heat transfer. Convective heat transfer: Single-phase fluid equations, laminar flow, entry length and fully developed friction factor and heat transfer coefficient. Graetz number effect in the entry region. Correlations for friction factor and

Nusselt number for nanofluids. Turbulent flow: Single phase fluid fully developed flow Dittus-Boelter and Glienilski equations. Blasius and other turbulent friction factor correlations. Their comparison with nanofluids data. New correlations for turbulent friction factor and Nusselt number for nanofluids.

UNIT-V:

Principles of measurement and apparatus for the nanofluid convective heat transfer coefficient. Recent empirical relations for convection coefficient of various types of nano fluids. Effect of particle Peclet number. Effect of volumetric concentration. Application of nano fluids to various types of industrial heat exchangers. Heating capacity, mass flow, heat exchanger surface area, LMTD and pumping power for nano fluids versus conventional heat transfer fluids.

UNIT-VI:

Application to building heating and cooling Comparison of nano fluids performance with glycol solution in hydronic coils. Application to automobile radiators. Comparison of the performance of nano fluids under arctic and sub-arctic temperatures with glycol solutions. Introduction to electronic cooling in micro channels with nano fluids.

REFERENCE BOOKS:

1. Microscale and Nanoscale Heat Transfer by C. Sobhan and G. Peterson, First edition, CRC Press
2. Fluid Mechanics by F. M. White, 5th Edition, McGraw-Hill
3. Heat Transfer by A. Bejan 2nd Edition, John Wiley
4. Handbook of Nanostructured Materials and Nanotechnology Vol. I and II - H.S.Nalwa, I edition, American Scientific Publishers
5. Springer Handbook of Nanotechnology by Bharat Bhushan, 1st edition, Springer-Verlag Publication

Programme Outcomes					
1	2	3	4	5	6
	M	M	H	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –I Sem

COMPUTER SIMULATION OF CI & SI ENGINES

L	T	P	C
3	1	-	3

CODE: 6M110

UNIT-I

Computer Simulation and Thermodynamics of Combustion:

Introduction, Heat of reaction, complete combustion in C/H/O/N Systems, Constant volume adiabatic combustion, constant pressure adiabatic combustion. Calculation of adiabatic flame temperature.

UNIT-II

SI Engine Simulation With Fuel-Air as Working Medium: Deviation between actual and air standard cycles of operation-problems, SI engine simulation with adiabatic constant volume combustion with fuel and air being considered, calculation of temperature drop due to fuel vaporization, calculation of mean effective pressure, torque and thermal efficiency at full throttle, part throttle and supercharged conditions.

UNIT-III

Actual Cycle Simulation in SI Engines: Progressive combustion; gas exchange process, heat transfer process, friction .

UNIT-IV

Procedure of validating computer code with experimental data based on performance parameters and pressure crank angle diagram.

UNIT-V

Simulation of 2-Stroke SI Engine: Simulation of the process, determination of the pressure-crank angle variation, computation of performance parameters.

UNIT-VI

Diesel Engine Simulation: Main difference between SI and CI engine simulation, differences between ideal and actual cycles, mathematical combustion model for diesel engine, heat transfer and gas exchange processes.

REFERENCE BOOKS:

1. Ganesan, V. - *Computer Simulation of Spark Ignition Engine Process,* Universities Press (I) Ltd, Hyderabad - 1996.
2. Ganesan. V, *Computer Simulation of Compression Ignition Engine Process,* Universities Press (I) Ltd, Hyderabad-2000.
3. Ashley Campbel , *Thermodynamic Analysis of Combustion Engine* - John Wiley and Sons, New York - 1986.
4. Benson.R.S., Whitehouse. N.D., - *Internal Combustion Engines*- Pergamon Press, oxford - 1979.

Programme Outcomes					
1	2	3	4	5	6
			H	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Semester

THERMAL AND NUCLEAR POWER PLANTS

L T P C
3 1 - 3

CODE: **6M111**

Course Objectives:

To understand the different energy sources, recent developments in energy industry.
To be knowledgeable about steam, gas turbine and nuclear power plants and steam generators
To be familiar with performance characteristics and operating cost of power plants
To understand various measuring instruments of power plants

Course Outcomes:

After completing the subject, students will be able to:

- Understand the various sources of energy, recent developments in power generation, different types of power plants, concept of steam power plant and various power plant handling equipments
- Understand the concepts of steam generator, steam turbine and describe the cooling towers and condensers.
- Understand the concept of gas turbine plant, nuclear power plant and know about combined cycle power plants
- Understand the operating cost, depreciation and performance parameters of various power plants
- Know about various measuring instruments which are mostly used in power plants

UNIT -I

Introduction: Sources of energy, Type of Power plants. Direct energy conversion system, Energy sources in India, Recent developments in power generation, Combustion of coal, Volumetric analysis, Gravimetric analysis. Fuel gas analysis. Steam power plant: Introduction. General layout of steam power plant, Modern coal. Fired Steam, Steam power plant. Power plant cycle, Fuel Handling, Combustion equipment, Ash handling, Dust collectors.

UNIT-II

Steam Generators: Types, Accessories. Feed water heaters, Performance of boiling, Water treatment, Cooling towers. Steam turbines. Compounding of turbines, Steam condensers, Jet and surface condensers.

UNIT-III

Gas Turbine Power Plant: Cogeneration. Combined cycle power plant, Analysis, Waste heat recovery, IGCC power plant, Fluidized bed, Combustion, Advantages, Disadvantages

UNIT-IV

Nuclear Power Plant: Nuclear physics, Nuclear Reactor, Classification, Types of reactors, Site selection. Method of enriching uranium. Application of nuclear power plant. Nuclear Power Plant Safety: Bi-Product of nuclear power generation, Economics of nuclear power plant, Nuclear power plant in India, Future of nuclear power.

UNIT-V

Economics of Power Generation: Factors affecting the economics, Loading factors, Utilization factor, Performance and operating characteristics of power plant, Point economic load sharing, Depreciation. Energy rate, Criteria for optimum loading. Specific economic energy problem

UNIT-VI

Power Plant Instrumentations: Classification, Pressure measuring instrument, Temperature measurement and Flow Measurement, Analysis of combustion gases, Pollution types, Methods of control.

REFERENCES:

1. Power Plant Engineering by P.K.Nag (TMH Publications)
2. Power Plant Engineering by R.K.Rajput (Lakshmi Publications)
3. Power Plant Engineering by P.C.Sharma (Kotearia Publications)
4. Power Plant Engineering by Arora and Domakundwar (Dhanpat Rai & Sons)
5. Power Plant Technology by MM El-Wakil (McGraw-Hill Publications)

Programme Outcomes					
1	2	3	4	5	6
M	H			L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

THERMAL MEASUREMENTS & PROCESS CONTROLS

L	T	P	C
3	1	-	3

CODE: 6M112

Course Objectives:

- Educate the student with operating principles and function of measuring instruments used in Engineering and process industries
- Make the student conversant with various working principles of instruments • Understand and analyze the behavioral characteristics of instruments
- Make the student learn about calibration procedure the instrument
- Educate the student about the fundamental aspects of control systems and their use in the context of industry applications

Course Outcomes:

At the end of the course the learners will be able to

- Making the student conversant with different working principles of various instruments
- Making the student to learn in the transduction of the signals
- Student can be able to analyze the behavior of an instrument in the measurement process
- Be able to analyze and design an instrumentation system, dealing with the concepts of dynamic range, signal noise ratio, and error budget
- Build, program, calibrate and use a microprocessor-based instrumentation system

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.

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-II

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

UNIT-III

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-IV

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.

UNIT-V

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, transient regulations.

REFERENCES:

1. Mechanical Measurements – Beckwith, Leinhard & Marangoni - Pearson
2. Measurement System, Application & Design – E.O. Doeblin.
3. Mechanical and Industrial Measurements – R.K. Jain – Khanna Publishers.
4. Mechanical Measurements – Buck & Beckwith – Pearson.
5. Control Systems, Principles & Design, 2nd Edition – M. Gopal – TMH.
6. Principles of Measurement Systems – John Bentley - Pearson

Programme Outcomes					
1	2	3	4	5	6
H				L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem.

ADVANCED MATERIALS FOR THERMAL SYSTEMS

L	T	P	C
3	1	-	3

CODE: 6M113

Course Objectives:

- To understand the mechanical properties and heat treatment of steels and cast iron
- To know about nuclear and thermal power plants, their related materials and properties
- To understand the materials in fuel cells, solar cells and bio-fuels

Course Outcomes:

After completing the subject, students will be able to:

- Understand the various mechanical properties, heat treatment and micro-structural features and its applications
- Understand the nuclear and thermal power plants, their related materials and properties
- Understand the concept of materials in fuel cells, solar cells, sensors and bio-fuels

UNIT – I:

Review of Mechanical Properties: Fundamentals And Tensile, Hardness, And Impact Testing: The Tensile Test: Use of the Stress – Strain Diagram, True Stress and True Strain, The Bend Test for Brittle Materials, Hardness of Materials, Strian Rate effects and Impact Behaviour Heat Treatment of Steels and Cast Irons: Designations and Classification of Steels, Simple Heat treatments, Isothermal Heat treatments, Quench and Temper Heat treatments, Surface treatments, Weldability of Steel. Fracture Mechanics, Fatigue, And Creep Behaviour: Fracture Mechanics, The Importance of Fracture Mechanics, Micro-structural Features of Fracture in Metallic Materials., Microstructural Features of Fracture in Ceramics, Glasses, and Composites, Fatugue, Result of the Fatigue test, Application of Fatigue test, Creep, Stress Ruptur, and Stress Corrosion, Evaluation of creep Behaviour

UNIT-II:

Nuclear Power Plant and Their Materials: Nuclear reactor, pressurized reactor, breeder reactor. Materials for fuel, control rods, coolant, moderator, shielding. Effects of Radiation on Materials Properties:

UNIT-III:

Effects of α,β,γ rays on creep, fatigue, tensile, and other properties of metals, alloys, ceramics, polymers, rubbers etc. Effects on electrical, electronic and magnetic behaviour of materials, Effects on crystal structure, grain size etc.

UNIT-IV:

Materials in Fuel cells and Solar Cells Electrocatalyst materials for low temperature fuel cells, Conductive membranes for low-temperature fuel cells, Materials for high temperature fuel cells, silicon, quantum dots for solar energy, nanomaterials for solar thermal energy and photovoltaic.

UNIT-V:

Materials in Thermal Power Generation Superalloys, steels, ceramics, TBC, hydrogen membrane materials, sensor and sensor materials, biomass, coal, flyash,etc.

UNIT-VI:

Energy storage-Artificial photosynthesis/solar to fuels, CO2 separation and utilization, Safer nuclear waste disposal, biofuels production, biological fuel cell technologies, reduction of energy use in manufacturing processes, Improved grid technologies, sustainable energy economy

REFERENCE BOOKS:

1. Introduction to Nuclear Science, Bryan, J. C., CRC Press.
2. Fundamentals of Radiation Materials Science, G.S. Was, Springer
3. Nuclear Reactor Materials and Applications, B.M. Ma, Van Nostrand Reinhold Company.
4. Nuclear Reactor Materials, C.O. Smith, Addison-Wesley Publishing Company.
5. Fundamentals Aspects of Nuclear Fuel Elements, D.R. Olander,
6. Structural Materials in Nuclear Power Systems, J. T. A. Roberts, Plenum Press.
7. Handbook of Fuel Cells, Wolf Vielstich, Arnold Lamm, Hubert A. Gasteiger, and Harumi Yokokawa, John Wiley and Sons, Inc.
8. Advanced power plant materials, design and technology, Edited by D Roddy, Woodhead Publishing Series in Energy No. 5 and CRC Press.

Programme Outcomes					
1	2	3	4	5	6
			H	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –I Sem

ENERGY MANAGEMENT

L	T	P	C
3	1	-	3

CODE: 6M114

Course Objectives:

- Demonstrate the importance and role of energy management in the functional areas like Manufacturing Industry, Process Industry,. Commerce and Government
- Enable the students to understand the basic energy conversion and management principles and to identify sources of energy loss and target savings
- Enable students in carrying out budgeting and risk analysis
- Analyze the performance of the wind turbine
-

Course Outcomes:

At the end of the course the learners will be able to

- Develop the concepts of energy management which is essential in the functional areas like Manufacturing Industry, Process Industry,. Commerce and Government
- Understand the basic energy conversion and management principles and to identify sources of energy loss and target savings
- Carry out budgeting and risk analysis • Analyze the performance of the wind turbine

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 organizations. Initiating, Organizing 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. Energy Conservation: Technologies for energy conservation, Design for conservation of energy materials, Energy flow networks. Critical assessment of energy usage. Formulation of objectives and constrains, Synthesis of alternative options and technical analysis of options. Process integration.

UNIT-III

Economic Analysis: Scope, Characterization of an investment project. Types of depreciation, Time value of money. Budget considerations, Risk analysis.

UNIT-IV

Methods of Evaluation of Projects: Payback, Annualized costs, Investor's rate of return, Present worth, Internal rate of return, Pros and cons of the common method of analysis, Replacement analysis.

UNIT-V

Alternative Energy Sources: Solar Energy: Types of devices for solar energy collections, Thermal storage system, Control systems.

UNIT-VI

Wind Energy, Availability, Wind Devices, Wind Characteristics, performance of turbines and systems.

REFERENCES:

1. Energy Management Hand Book / W.C. Turner (Ed)
2. Energy Management Principles / CB Smith/ Pergamon Press
3. Energy Management / W.R.Murthy and G.Mc.Kay / BS Publication
4. Management / H.Koontz and Cyrill Donnel / McGraw Hill
5. Financial Management / S.C.Kuchhal / Chaitanya Publishing House

Programme Outcomes					
1	2	3	4	5	6
	M	H		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –I Sem

EQUIPMENT DESIGN FOR THERMAL SYSTEMS

L	T	P/D	C
3	1	0	3

CODE: 6M115

Course Objectives:

The course is designed to give fourth year engineering students the design concepts and fundamental aspects of industrial thermal system simulation and optimization. Examination of optimum design criteria, their application and scrutiny of engineering decision.

Course outcomes:

1. Basic principles of design
2. Learning the cost analysis
3 Basic modelling knowledge about subjects of applied thermodynamics and heat transfer such as heat exchangers, evaporators, condensers, boilers, condensation of binary mixtures and turbo machinery
4. Ability of constructing the simulation of thermal systems
5. Learning the basic of optimum system design

UNIT -I:

Classification of Heat Exchangers: Introduction, Recuperation & regeneration, Tabular 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 Tabular 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 of shell & tube heat

exchangers, Flow arrangements for increased heat recovery, the calculation of 2-4 exchangers.

UNIT-IV:

Condensation of Single Vapours: Calculation of horizontal condenser, Vertical condenser, De-Super heater condenser, Vertical condenser-sub-Cooler, Horizontal Condenser-Sub cooler, Vertical reflux type condenser. Condensation of steam.

UNIT-V:

Vaporizers, Evaporators and Reboilers: Vaporizing processes, Forced circulation vaporizing exchanger, 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, Deign of cooling towers, Determination of the number of diffusion units, Calculation of cooling tower performance.

REFERENCES:

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

Programme Outcomes					
1	2	3	4	5	6
H				L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem

THERMAL ENGINEERING LABORATORY

L	T	P	C
-	-	4	2

CODE: 6M171

Course outcomes

1. Students will acquire hands on experience on the various test-rigs, Experimental set up.
2. Students should able to measure the various technical parameters by instrument and by mathematical relationship.
3. Students will able to identify the effect of various parameters on the system and able to co- relate them.

LIST OF EXPERIMENTS

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

Programme Outcomes					
1	2	3	4	5	6
H		H			
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem

COMPREHENSIVE VIVA-I

L	T	P	C
-	-	-	1

CODE: 6M172

Max. Marks: 100

Course Objective:

1. The main objective of this course is to prepare the students to face interview both at the academic and the industrial sector.

2. To. Exhibit the strength and grip on the fundamentals of the subjects studied in I year Isem

The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is aimed to assess the students' understanding in various subjects he/she studied during the M.Tech. I year I sem course of study. The Comprehensive Viva-Voce is valued for 50 marks for internal and 50 marks for externals by the Committee. A candidate has to secure a minimum of 50% to be declared successful.

Programme Outcomes					
1	2	3	4	5	6
	H				
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – I Sem

LITERATURE REVIEW & SEMINAR-I

L	T	P	C
-	-	3	1

CODE: 6M173

Max. Marks: 100

Course Objective:

To give sufficient technical life long skills to learn impact various engineering solutions in global products and process industries.

Course Out comes: After studying this course, the students will be able to

1. Identify a research topic
2. Collect literature
3. Present seminar
4. Discuss the queries

There shall be three seminar presentations during I year I semester and I year II Semester. For 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, which shall consist of the Head of the Department, a senior Faculty Member and the Supervisor and will jointly evaluate the report and presentation. For each Seminar there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% to be declared successful.

In the First semester the report must be in the form of the review paper with a format used by IEEE / ASME etc. In the Second semester Technical Seminar in the form of Independent Review Paper must be of high quality fit for publication in a reputed conference / journal.

The evaluation format for seminar is as follows:

- Day to day evaluation by the Supervisor : 20 marks
- Final Report : 20 marks
- Presentation : 60 marks (20 Abstract seminar +40 Final Presentation)

The presentation includes content (5) + Participation (5) + Presentation (10) for a total of 20 marks and double for 40 marks for final presentation.

A Student has to concentrate on the following sections while writing technical paper or presenting seminar.

Contents:

- Identification of specific topic
- Analysis
- Organization of modules
- Naming Conventions
- Writing style
- Figures
- Feedback
- Miscellaneous

REFERENCES:

Teach Technical Writing in Two Hours per Week by Norman Ramsey

For Technical Seminar the student must learn few tips from sample seminars and correcting himself, which is continues learning process

REFERENCE LINKS:

I. http://www.cs.dartmouth.edu/~scot/givingTalks/sld001.htm
II. http://www.cse.psu.edu/~yuanxie/advice.htm
III. http://www.eng.unt.edu/ian/guides/postscript/speaker.pdf

NOTE: A student can use any references for this process, but must be shared in classroom.

Programme Outcomes					
1	2	3	4	5	6
	M	M	H	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

COMBUSTION AND ENVIRONMENT

L	T	P	C
3	1	-	3

CODE: 6M216

Course Objective:

Combustion drastically oxidizes fuel and makes substantial heat. Engineering operates an engine or heats up an object by using this heat. The other side, a large quantity of burned gas is emitted when the enormous heat is formed by combustion. Therefore, air pollutant is emitted in great quantity. Under these backgrounds, you will learn the fundamentals of combustion and then understand a method for reducing air pollutant in this course.

Course Outcome:

Students will

1. Understand precisely a difference between premixed combustion and diffusion combustion.
2. Learn combustion mechanisms of gaseous, liquid and solid fuels.
3. Learn chemiluminescence phenomena of flame and the prevention method of air pollutant.

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 analysis – 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 – Pulverized 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.

REFERENCES:

1. Combustion Fundamentals / Roger A Strehlow / Mc Graw Hill
2. Fuels and combustion / Sharma and Chander Mohan/ Tata Mc Graw Hill
3. Combustion Engineering and Fuel Technology / Shaha A.K./ Oxford and IBH.
4. Principles of Combustion / Kanneth K.Kuo/ Wiley and Sons.
5. Combustion / Sarkar / Mc. Graw Hill.
6. An Introduction to Combustion / Stephen R. Turns/ Mc. Graw Hill International Edition.
7. Combustion Engineering / Gary L. Berman & Kenneth W. Ragland/ Mc. Graw Hill International Edition.

Programme Outcomes					
1	2	3	4	5	6
M	M	H		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	1	-	3

CODE: 6M217

Course Objective:

To understand the subject of Computational Fluid Dynamics and know how to use it as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems. This will also create the base and interest among the students to carry out the Future Research.

Course Outcome:

After completion of this course the student should be:

- familiar with the differential equations for flow phenomena and numerical methods for their solution
- able to use and develop flow simulation software for the most important classes of flows in engineering and science.
- able to critically analyze different mathematical models and computational methods for flow simulations
- able undertake flow computations using current best practice for model and method selection, and assessment of the quality of results obtained.

UNIT - I

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.
Solution methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination.

UNIT – II

Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT – III

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT - IV

Formulations of Incompressible Viscous Flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods. Treatment

of compressible flows: potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT - V

Finite Volume Method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT - VI

Standard Variational Methods: Linear fluid flow problems, steady state problems, Transient problems.

REFERENCES:

1. Introduction to Computational Fluid Dynamics – Niyogi, Chakrabartty & Laha – Pearson
2. Introduction to Computational Fluid Dynamics – Anil W. Date – Cambridge
3. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
4. Computational Fluid Dynamics – Tu, Yeoh and Liu - Elsevier
5. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press,2002.
6. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985
7. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.
8. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications
9. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
10. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford University Press/2nd Edition

Programme Outcomes					
1	2	3	4	5	6
M		H		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

ADVANCED HEAT AND MASS TRANSFER

CODE: 6M218

L	T	P	C
3	1	-	3

Course Objective:

To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

Course Outcome:

- Ability to understand and solve conduction, convection and radiation problems
- Ability to design and analyze the performance of heat exchangers and evaporators
- Ability to design and analyze reactor heating and cooling systems

UNIT-I:

Brief Introduction to Different Modes of Heat Transfer: Conduction: General heat Conduction equation-initial and boundary conditions.

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: ID & 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 geometries 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.

Boiling and condensation: Boiling curve-correlations-Nusselts theory of film condensation on a vertical plate-assumptions & correlations of film condensation for different geometries.

UNIT-V:

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

UNIT-VI

Mass Transfer: Concepts of mass transfer-diffusion & convective mass transfer analogies-significance of non-dimensional numbers.

REFERENCES:

1. Convective Heat & Mass Transfer – Ghiaasiaan – Cambridge
2. Fundamentals of Heat & Mass Transfer – Thirumaleshwar – Pearson
3. Heat Transfer – Gregory Nellis & Sanford Klein – Cambridge University Press
4. Principals of Heat Transfer/Frank Kreith/Cengage Learning
5. Elements of Heat Transfer/E. Radha Krishna/CRC Press/2012
6. Heat Transfer/RK Rajput/S.Chand
7. Introduction to Heat Transfer/SK Som/PHI
8. Engineering Heat & Mass Transfer/Mahesh Rathore/Lakshmi Publications
9. Heat Transfer / Necati Ozisik / TMH
10. Heat Transfer / Nellis & Klein / Cambridge University Press / 2012.
11. Heat Transfer/ P.S. Ghoshdastidar/ Oxford Press
12. Engg. Heat & Mass Transfer/ Sarit K. Das/Dhanpat Rai
13. Heat Transfer/ P.K.Nag /TMH

Programme Outcomes					
1	2	3	4	5	6
	H	M		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

JET & ROCKET PROPULSION

L	T	P	C
3	1	-	3

CODE: 6M219

Course Objective:

To understand the thrust equation and how it used in aircraft and rocket propulsion in an efficient way.

Course Outcome:

At the end of the course, the student will be able to

CO1: Explain the working of jet engines and rocket propulsion systems.

CO2: Describe liquid propellant rocket engines.

CO3: Discuss solid propellant rocket engines and explain rocket motor design approach.

CO4: Classify solid propellants and discuss the characteristics.

CO5: Explain the working of hybrid propellant rockets

CO6: select the process for rocket propulsion systems.

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.

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, Ac / At 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.

UNIT - V

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.

REFERENCES:

1. Mechanics and Dynamics of Propulsion/ Hill and Peterson/John Wiley & Sons
2. Rocket propulsion elements/Sutton/John Wiley & Sons/8th Edition
3. Gas Turbines/Ganesan /TMH
4. Gas Turbines & Propulsive Systems/Khajuria & Dubey/Dhanpat Rai & Sons
5. Rocket propulsion/Bevere/
6. Jet propulsion /Nicholas Cumpsty/

Programme Outcomes					
1	2	3	4	5	6
		M	H	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

ALTERNATIVE FUELS

CODE: 6M220

L	T	P	C
3	1	-	3

Course Objective:

Student understands the preparation, properties and applications of synthetic fuels from renewable sources and from unconventional sources of liquid and gaseous hydrocarbons. Student is familiar with the production, storage and use of hydrogen, biofuel production from biomass and waste.

Course Outcomes:

Describe the production, handling, infrastructure requirements, advantages, and disadvantages of each of the following transportation fuel options:

1. Gaseous fuels (LPG and Natural Gas). 8. Alcohol and synthetic fuels.
2. Biodiesel fuels.
3. Dedicated electric vehicles.
4. Transesterification

UNIT-I :

Need for alternate fuel : Availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources. Like EV, hybrid, fuel cell and solar cars.

UNIT-II :

Alcohols: Properties as engine fuel, alcohols and gasoline blends, performance in SI engine, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, DME, DEE properties performance analysis, performance in SI & CI Engines.

UNIT-III :

Natural Gas, LPG, Hydrogen and Biogas: Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG using LPG in SI & CI engines, performance and emission of LPG. Hydrogen; storage and handling, performance and safety aspects.

UNIT-IV:

Technical Background of Diesel/Bio-diesel fuels-Oil feed stocks- Transesterification-Bio-diesel production from Vegetable oils and waste cooking oil-High blend levels of bio-diesel-

Testing , Bio diesel-Oxidation stability-Performance in Engines, Properties of bio-fuels and their importance in the context of IC Engines.

UNIT-V

Vegetable Oils: Various vegetable oils for engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics

UNIT-VI :

Electric, Hybrid, Fuel Cell And Solar Cars: Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar powered vehicles.

Reference Books:

1. Alternate Fuels - Dr. S. S. Thipse - Jaico Publications
2. Richard.L.Bechfold, Alternative Fuels Guide BooK, SAE International Warrendale - 1997.
3. Maheswar Dayal, Energy Today & tomorrow, -1 & B Horishr India-1982.
4. Nagpal, Power Plant Engineering, Khanna Publishers, 1991.
5. Alcohols as motor fuels progress in technology, Series No. 19 - SAE Publication USE - 1980.
6. SAE paper nos. 840367, 841333, 841334, 841156, Transactions, SAE, USA
7. Alternative Fuels Guidebook - Bechtold R.

Programme Outcomes					
1	2	3	4	5	6
		M		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

CRYOGENIC ENGINEERING

L	T	P	C
3	1	-	3

CODE: 6M221

Course Objective:

To have a detailed study of the basics of cryogenic systems, its cycle and application in aerospace engineering.

Course Outcomes

After learning the course the students should be able to:
Properties of material at low temperature.
Pressure, temperature, flow, fluid quality and liquid level measurement at low temperature.
Different types of cryogenic insulations.
Different cryogenic applications.
Low temperature hazard

UNIT -I:

Introduction to Cryogenic Systems: Mechanical Properties at low temperatures. Properties of Cryogenic Fluids.

Gas Liquefaction: Minimum work for liquefaction. Methods to protect low temperature. Liquefaction systems for gages other than Neon. Hydrogen and Helium.

UNIT II:

Liquefaction Systems for Neon, Hydrogen and Helium: Components of Liquefaction systems. Heat exchangers. Compressors and expanders. Expansion valve, Losses in real machines.

UNIT-III:

Gas Separation and Purification Systems: Properties of mixtures, Principles of mixtures, Principles of gas separation, Air separation systems.

UNIT-IV:

Cryogenic Refrigeration Systems: Working Medium, Solids, Liquids, Gases, Cryogenic fluid storage & transfer.

UNIT-V:

Cryogenic storage systems, Insulation, Fluid transfer mechanisms, Cryostat, Cryo Coolers

UNIT-VI:

Applications: Space technology, In-Flight air separation and collection of LOX, Gas industry, Biology, Medicine, Electronics.

REFERENCES:

1. Cryogenic Systems/ R.F.Barren/ Oxford University Press
2. Cryogenic Research and Applications: Marshal Sitting/ Von Nostrand/ Inc. New Jersey
3. Cryogenic Heat Transfer/ R.F.Baron
4. Cryogenic Engineering Edit / B.A. Hands/ Academic Press, 1986
5. Cryogenic Engineering/ R.B.Scottm Vin Nostrand/ Inc. New Jersey, 1959
6. Experimental Techniques in Low Temperature Physics- O.K. White, Oxford Press, 1968
7. Cryogenic Process Engineering/ K.D. Timmerhaus & TM Flynn/ Plenum Press, 1998
8. Hand Book of Cryogenic Engineering – J.G.Weisend –II, Taylor and Francis, 1998

Programme Outcomes					
1	2	3	4	5	6
H		M		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

ADVANCED FINITE ELEMENT ANALYSIS

L	T	P	C
3	1	-	3

CODE: 6M222

Course Objective:

- Gain a fundamental understanding of the finite element method for solving boundary value problems .

Course Outcomes:

- Learn important concepts of variational form, minimum potential energy principles, and method of weighted residuals.
- Study one dimensional problems such as truss, beam, and frame members, two-dimensional problems such as plain stress and plain strain elasticity problems, torsion problem.
- Learn finite element analysis of static and dynamic problems and heat transfer problems.
- Provide the student with some knowledge and analysis skills in applying basic laws in mechanics and integration by parts to develop element equations and steps used in solving the problem by finite element method.

UNIT-I

Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin's Methods. 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-II

1-D Structural Problems: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.
Analysis of Trusses : Plane Trusses and Space Truss elements and problems
Analysis of Beams : Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT-III

2-D Problems: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration.

UNIT-VI

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. 3-D Problems: Tetrahedran element – Jacobian matrix – Stiffness matrix.

UNIT-V

Scalar Field Problems: 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems – Introduction to Torsional problems.

UNIT-VI

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

REFERENCES:

1. Finite Element Method – Dhanraj & Nair – Oxford
2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Applied Finite Element Analysis – Segerlind – Wiley India
4. The Finite Element Methods in Engineering / SS Rao / Pergamon.
5. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
6. Finite Element Modeling and Simulation with ANSYS Workbench – Chen & Lui - CRC
7. Finite Element Method – Zincowitz / Mc Graw Hill
8. Introduction to Fininte element analysis- S.Md.Jalaludeen,Anuradha Publications, print-2012
9. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
10. Finite Element Analysis – Theory & Programming – Krishna Moorthy / McGraw Hill
11. Finite Element Analysis – Bathe / PHI

Programme Outcomes					
1	2	3	4	5	6
M		H		L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

CONVECTIVE HEAT TRANSFER

L	T	P	C
3	1	-	3

CODE: 6M223

Course Objective:

This course is designed to introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes. A knowledge-based design problem requiring the formulations of solid conduction and fluid convection and the technique of numerical computation progressively elucidated in different chapters will be assigned and studied in detail. As well, to gain experience in designing experiments for thermal systems, the design, fabrication, and experimentation of a thin film heat flux gage will be attempted as part of laboratory requirements.

Course Outcomes:

1. Understand the basic laws of heat transfer.
2. Account for the consequence of heat transfer in thermal analyses of engineering systems.
3. Understand the fundamentals of convective heat transfer process.
4. Evaluate heat transfer coefficients for natural convection.
5. Evaluate heat transfer coefficients for forced convection inside ducts.
6. Evaluate heat transfer coefficients for forced convection over exterior surfaces.

UNIT-I:

Introduction to 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.

REFERENCES:

1. Convective Heat & Mass Transfer/ Ghiaasiaan / Cambridge
2. Introduction to Convective Heat Transfer Analysis/ Patrick H. Oosthuigen & David Naylor /McGraw Hill
3. Convective Heat & Mass Transfer /Kays & Crawford/TMH
4. Fundamentals of Heat & Mass Transfer – Thirumaleshwar – Pearson
5. Heat Transfer – Gregory Nellis & Sanford Klein - Cambridge

Programme Outcomes					
1	2	3	4	5	6
				L	H
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

ENTREPRENEURSHIP AND INNOVATION

(Open Elective)

L	T	P	C
3	1	-	**3**

CODE: 6ZC13

Course Objective:

The objective of the course is to make students understand the nature of entrepreneurship, and to motivate the student to start his/her own enterprise with innovative skills.

Course Out Comes :

After studying this course, the students will be able to

Unit1 : Acquire qualities of an Entrepreneur

Unit2 : Understand how to set up an organization

Unit3 :Carry out SWOT analysis for setting up small business unit

Unit4 :Acquire decision making managerial behavior

Unit5 : Develop knowledge on getting financial support from various funding agencies

Unit6 :Buildup strategies for a successful business

Unit – I:

Nature of Entrepreneurship: Characteristics, Qualities and skills of an Entrepreneur, functions of entrepreneur, Entrepreneur scenario in India and Abroad. Forms of Entrepreneurship: Small Business, Importance in Indian Economy, Types of ownership, sole trading, partnership, Joint Stock Company and other forms. First-Mover disadvantages, Risk Reduction strategies, Market scope strategy, Imitation strategies, and Managing Newness.

Unit – II:

Aspects of Promotion: Generation of new entry opportunity, SWOT Analysis, Technological Competitiveness, legal regulatory systems, patents and trademarks, Intellectual Property Rights- Project Planning and Feasibility Studies- Major steps in product development.

Unit – III: Management Of Small Business:

Pre feasibility study - Ownership - budgeting - project profile preparation - Feasibility Report preparation - Evaluation Criteria- Market and channel selection- Product launching - Monitoring and Evaluation of Business- Effective Management of Small business.

Unit – IV: Support Systems For Entrepreneurs:

Institutional Support, Training institution, Financial Institutions and Aspects: Sources of raising Capital, Debt-Equity, Financing by Commercial Banks, Government Grants and Subsidies, Entrepreneurship Promotion Schemes of Department of Industries (DIC), KVIC, SIDBI, NABARD, NSIC, APSFC, IFCI and IDBI. New Financial Instruments. Research and Development – Marketing and legal aspects, Taxation benefits, Global aspects of Entrepreneurship.

Unit – V: Introduction To Innovation:

Meaning of innovation, sources of innovative opportunity, 7 sources of innovative opportunity, Principles of innovation, the enablers of innovation, business insights, insights for innovation, technical architecture for innovation, focus on the essence of innovation.

Unit – VI: Process And Strategies For Innovation:

Process of innovation, the need for a conceptual approach, Factors contributing to successful technological innovation, Strategies that aim at innovation, impediments to value creation and innovation.

TEXT BOOKS:

1. Robert D Hisrich, Michael P Peters, Dean A Shepherd: Entrepreneurship, TMH, 2009
2. Bholanath Dutta: Entrepreneurship – Text and cases, Excel, 2009.

REFERENCE BOOKS:

1. Vasanth Desai: Entrepreneurship, HPH, 2009
2. H. Nandan: Fundamentals of Entrepreneurship, PHI, 2009.
3. Barringer: Entrepreneurship, Pearson,2009.
4. Peter Drucker (1993), “Innovation and Entrepreneurship”, Hyper Business Book.
5. C.K. Prahalad, M.S. Krishnan, The new age of Innovation – TATA McGRAW-HILL Edition 2008.

Programme Outcomes					
1	2	3	4	5	6
				L	H
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

BANKING OPERATIONS, INSURANCE AND RISK MANAGEMENT

(Open Elective)

L	T	P	C
3	1	**-**	**3**

CODE: 6ZC03

Course Objective:

The objective of the course is to make students understand the fundemental basis for deposit and credit, corporate and consumer loan services, credit cards and electronic banking services, letter of credits and international bill receiving, colleteral and letter of assurance.

Course Out Comes :

After going through course, the student will be able to

1.know the introduction to Banking Business
2. know the Banking Reforms and Regulation
3. know about Insurance
4. know Insurance Business Environment
5.know the Risk and it's Analysis
6. know the Risk Return criteria

Unit – I: Introduction To Banking Business:

Banking Sectors- Retail, Corporate, Rural, and International; Non-banking financial intermediaries; Types of advances and deposits in a bank, New Dimensions and Products. - Credit, Debit and Smart Cards, and e-Banking Structure of the Indian Banking System's. Commercial Banks – Public and Private Sector and Foreign Banks. Cooperative Banks.

Unit – II: Banking Reforms and Regulation:

Banking Regulation Act, 1949, Reserve Bank of India Act 1934, and Reserve Bank's Instruments of Credit Control. Deficiencies in Indian Banking including Problems Accounts and Non-Performing Assets, Banking Sector Reforms.

Unit – III: Insurance:

Need for and importance of insurance, branches of insurance (life and general insurance) policy and procedure.

Unit – IV: Insurance Business Environment:

Mathematical basis of life insurance, reinsurance coverage, regulatory and legal frame work governing the insurance, business and economics of insurance, need for changing mindset; Latest trends.

Unit – V: Risk Analysis:

Firm risk and Market risk: Portfolio related Risk measure, Mean variance and portfolio construction. Port folio theory and capital Budgeting CAPM.Risk Management: Option

valuation; Derivatives: managing financial Risk Options and option contracts; credit risk management; introduction, risks and credit risk management.

Unit – VI: Risk And Return:

Return and Risk, measuring internal risk, measuring Historical return and measuring historical risk measuring expected return and risk .Derivatives and Risk Management: Risk management Forwards and Futures, options; Interest rates and currency swaps

TEXT BOOKS :

1. Varshney, P.N., Banking Law and Practice, Sultan Chand & Sons, New Delhi.
2. General principles of Insurance - Harding and Evanly
3. Investment Analysis and Port folio Management: Prasanna Chandra 2/e

REFERENCE BOOKS :

1. Read, E. W., Commercial Bank Management, Harper and Row Publishers, New York
2. Lectures on Banking Law - Gilbert J.N.
3. Dr. Shrikrishna Laxman Karve, Principles of Life Insurnace, Himalaya publishing house.
4. P.K. Gupta, Principles and practice of non life insurance, Himalaya publishing house

Programme Outcomes					
1	2	3	4	5	6
				L	H
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

TOTAL QUALITY MANAGEMENT

L	T	P	C
3	1	-	3

CODE:6ZCO9

Course Objective: The objective of the course is to equip with the skills and knowledge necessary to implement a successful TQM program in their company, an understanding of the history, purpose and fundamentals of TQM, the tools and techniques that can improve operations, product quality, process quality, customer satisfaction.

UNIT I

INTRODUCTION: The basic Management concepts, Quality and Total Quality Management, Principles and Philosophies of Quality Management, Quality and Business performance, attitude and involvement of Top management.

UNIT II

MANAGEMENT OF PROCESS QUALITY AND CUSTOMER FOCUS AND SATISFACTION: Definition of quality, Quality Control, a brief history, Quality Gurus, Product Inspection Vs., Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling. Process Vs. Customer, Internal Customer Conflict, Quality Focus, Customer Satisfaction, Role of Marketing and Sales, Buyer - Supplier relationships.

UNIT III

ORGANIZING FOR TQM: The systems approach, Organizing for Quality Implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Bench Marketing: Evolution of Bench Marketing; Meaning of Bench Marking, Benefits of Bench marking, the Bench marking process, pitfalls of bench marking.

UNIT IV

PRODUCTIVITY, QUALITY AND REENGINEERING: The leverage of Productivity and Quality, Management systems V s. Technology, Measuring Productivity, Improving Productivity Re-engineering.

UNIT V

THE COST OF QUALITY: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

UNIT VI

IS0 9000: Universal Standards of Quality: ISO around the world, The IS0 9000 ANSl /ASQCQ-90. Series Standards, benefits of IS09000 certification, the third party audit, Documentation IS0 9000 and services, the cost of certification implementing the system.

Books Recommended:

- Shridhara Bhat K, TQM – Text & Cases, First Edition 2002,. Himalaya Publications
- "Total Quality Management" by Joel E.Ross.

Reference:

- A.R.Aryasri, Management Science, TATA Mc,Graw Hill
- TQM – Sundararajan
- Poornima M Charantimoth, TQM, Pearson Education, First Indian Reprint 2003
- Rose JE, TQM , Kogan Pak India Pvt. Hyderabad 1993
- "Statistical Quality Control" by E.L.Grant.

Programme Outcomes					
1	2	3	4	5	6
				L	H
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

ETHICS, MORALS, GENDER SENSITIZATION AND YOGA

Open Elective

L	T	P	C
3	1	-	**3**

CODE: 6H233

Course Objective:

To develop students' sensibility with regard to issues of gender in contemporary India, provide a critical perspective on the socialization of men and women, introduce students to information about some key biological aspects of genders, expose the students to debates on the politics and economics of work and help students reflect critically on gender violence. Identify the core values that shape the ethical behavior of an engineer, to create an awareness on professional ethics and Human Values and to appreciate the rights of others.

Course Outcomes: Students will be able to

1. To develop students' sensibility with regards to issues of gender in contemporary India and to help the students appreciate the essential complimentarity between 'VALUES and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To provide a critical perspective on the socialization of men, women and transgenders, to acknowledge women's role at home and at work and to have a wider understanding of Ethics.
3. To help students reflect critically on gender violence, understand engineering ethics and an engineer's responsibility for safety and risk.
4. Perceive gender literacy and understand the importance of gender perspective.
5. Understand rules and principles set by the society in a customary way.
6. Understand and appreciate the importance of personality development through yoga for a holistic life.

UNIT I: HUMAN VALUES AND MORALS

Why Value Education, Understanding Social Factors, System, Structure and Source of Generic Values; Morals, Values and Ethics; Integrity; Work Ethics; Service Learning-Civic Virtue-Respect for Others-Living Peacefully-Caring-Sharing; Honesty; Courage; Value Time; Cooperation; Commitment; Empathy; Self Confidence; Spirituality; Character; Loyalty; Confidentiality

UNIT II: ENGINEERING ETHICS AND PERSONALITY DEVELOPMENT

Ethical Principles, Ethical Theories, , Use of Ethical Theories, Types of Inquiry, Engineering and Ethics, Engineering Ethics, Moral Autonomy of Engineers, Professional Ethics, Consensus and Controversy, Ethics in Business, Global business, Understanding Factors of Success, Human Aspirations, Personality and Our Identity, Understanding SELF, Happiness and Self-Interest, Positive Thinking, Custom and Religion, Understanding responsibility toward society, Understanding National and cultural Ethos; Professionalism

UNIT III:ENGINEERING AS SOCIAL EXPERIMENTATION

Comparison with Standard Experiments; Knowledge Gained; Learning from the Past; Engineer as Manager, Consultants and leaders and responsible social Experimenter; Engineers personality Trait, Big Five Personality model, Conscientiousness ,Accountability-Roles of Codes-Codes and Experimental Nature of Engineering; Engineer's Responsibility for safety and Risk, Concept of Safety-Types of Risks

UNIT IV: GLOBAL PERSPECTIVE

Distinguish between Bribes and Gifts; Occupational Crimes; Globalization- Cross-Cultural Issues; Environmental Ethics; Internet and Computer Codes of Ethics

Case Study:

Ethics in Military and Weapons Development-Ethics in Research work

UNIT V: GENDER SENSITIZATION

Introduction to Gender Study; Introduction to Gender Spectrum; Point of view; Gender and Structure of Knowledge; Contribution of Women in growth and development as Technologist, Scientist, R&D, GDP, Social Life, National Development, International Perspective"- Life Exemplary Madame Curie, Durga bai Deshmukh, Kalpana Chawla, Chanda Kochar, Mary Kom, Indra Gandhi, Mother Teresa, Indra Nooyi, Golda Meir, Margaret Thatcher and other achievers

UNIT VI: **YOGA**

Introduction to Yoga in India; Origin and Development; Theoretical understanding of yoga; Stress Management : Modern and Yogic perspectives ; Tackling ill-effects of Frustration, Anxiety and Conflict through modern and Yogic methods; Meditation Techniques; Suryanamaskar; Pranayama.

TEXT BOOKS:

1. *Indian Culture Values And Professional Ethics(For Professional Students) by Prof.P.S.R.Murthy ; B.S.Publications.*
2. *Professional Ethics and Human Values* by M. Jayakumar, Published by University Science Press,

3. Telugu Academy, Hyderabad, 2015, *Towards A World of Equals*, A Bilingual Text Book on Gender.

REFERENCE BOOKS:

1. ***The Yoga Sutras of Patanjali*** by Swami Satchitananda
2. ***The Secret Power of Yoga*** by Nischala Joy Devi
3. ***Light on Pranayama*** by B.K.S. Iyengar
4. ***Books on the Art of Living*** *by Poojya Sri Sri Ravi Shanker*
5. ***Making It Relevant: Mapping the meaning of women's studies in Tamilnadu*** by Anandi S and Swamynathan P
6. ***Feminism is for Everybody; Passionate Politics*** by Bell Hooks
7. ***Gender*** by Geetha V
8. ***"Growing up Male" in what is worth teaching*** by K Kumar
9. ***The Lenses of Gender: Transforming the Debate on Sexual Inequality*** - Sandra Lipsitz Bem
10. ***The Lenses Of Gender*** - by ANNE MURPHY

Programme Outcomes					
1	2	3	4	5	6
				L	H
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

DATA BASE MANAGEMENT SYSTEMS

(Open Elective)

L	T	P	C
3	1	**-**	**3**

CODE: 6RC17

Course objective:

Understand the working of the database management systems. Design the optimal queries using relational algebra, structured and unstructured query languages like SQl and PL/SQL. Also understand the data structures for database storage for effective retrieval.

Course Outcomes:

1 Explain importance, significance, models, Database languages, architecture and design of Data Base Systems.

2 Describe Relational Model's – Integrity Constraints, Querying fundamentals, Logical data base Design and Views of databases along with application of Relational Algebra.

3 Apply queries in SQL Query using Nested Queries Set, Comparison Operators, Aggregative Operators, Logical connectivity's with Joins statements and develop applications.

4 Describe and apply Schema refinement through all forms of Normalization to eliminate database redundancy.

5 Describe Transaction Concept and apply Atomicity, Durability, Concurrent and integrity in order to ensure reliability and Recovery and Backup of databases.

6 Describe External Storage Organization mechanisms and apply Indexing in databases for optimizing Query operation to enhance system performance.

UNIT I :

Data base System Applications, data base System VS file System – View of Data – Data Abstraction – Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base System Structure – Storage Manager – the Query Processor, History of Data base Systems. Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model – Conceptual Design for Large enterprises.

UNIT II :

Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying /altering Tables and Views.

Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus.

UNIT III:

Form of Basic SQL Query – Examples of Basic SQL Queries – Introduction to Nested Queries – Correlated Nested Queries Set – Comparison Operators – Aggregative Operators – NULL values – Comparison using Null values – Logical connectivity's – AND, OR and NOT – Impact on SQL Constructs – Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers and Active Data bases.

UNIT IV :

Schema refinement – Problems Caused by redundancy – Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join Decomposition – Dependency preserving Decomposition – Schema refinement in Data base Design – Multi valued Dependencies – FORTH Normal Form.

UNIT V :

Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability – Implementation of Isolation – Testing for serializability- Lock – Based Protocols – Timestamp Based Protocols- Validation- Based Protocols – Multiple Granularity, Recovery and Atomicity – Log – Based Recovery – Recovery with Concurrent Transactions – Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- Remote Backup systems.

UNIT VI :

Data on External Storage – File Organization and Indexing – Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing – Comparison of File Organizations – Indexes and Performance Tuning- Intuitions for tree Indexes – Indexed Sequential Access Methods (ISAM) – B+ Trees: A Dynamic Index Structure.

TEXT BOOKS :

1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
2. Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition.

REFERENCES :

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education
3. Introduction to Database Systems, C.J.Date Pearson Education

Programme Outcomes					
1	2	3	4	5	6
			H	L	M
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

INFORMATION RETRIEVAL SYSTEM

(Open Elective)

L	T	P	C
3	1	-	**3**

CODE: 6P110

Course Objectives:

On completion of this course you should have gained a good understanding of the foundation concepts of information retrieval techniques and be able to apply these concepts into practice. Specifically, the student should be able to:

- To use different information retrieval techniques in various application areas
- To apply IR principles to locate relevant information large collections of data
- To analyze performance of retrieval systems when dealing with unmanaged data sources
- To implement retrieval systems for web search tasks.

UNIT I

Boolean retrieval. The term vocabulary and postings lists. Dictionaries and tolerant retrieval. Index construction. Index compression.

UNIT II

Scoring, term weighting and the vector space model. Computing scores in a complete search system. Evaluation in information retrieval. Relevance feedback and query expansion.

UNIT III

XML retrieval. Probabilistic information retrieval. Language models for information retrieval. Text classification.

UNIT IV

Vector space classification. Support vector machines and machine learning on documents

UNIT V

Flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing.

UNIT VI

Web search basics, Web crawling and indexes, Link analysis.

TEXT BOOKS:

1. Introduction to Information Retrieval , Christopher D. Manning and Prabhakar

2. Raghavan and Hinrich Schütze, Cambridge University Press, 2008.

Programme Outcomes					
1	2	3	4	5	6
			H		M
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year – II Sem.
DATA MINING AND DATA WAREHOUSING
(Open Elective)

L	T	P	C
3	1	-	3

CODE: 6PC22

UNIT I

Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Issues in Data Mining.

Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

UNIT II

Data Warehouse and OLAP Technology for Data Mining: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Usage of Data Warehousing Online Analytical Processing and Mining

UNIT III

Data Cube Computation: Efficient Methods for simple Data Cube Computation (Full Cube, Iceberg Cube, Closed Cube and Shell Cube), Discovery Driven exploration of data cubes, Attribute-Oriented Induction for data characterization and its implementation

UNIT IV

Mining Frequent Patterns, Associations and Correlations: Basic Concepts, The Apriori algorithm for finding frequent itemsets using candidate generation, Generating association rules from frequent itemsets, Mining frequent itemsets without candidate generation, Mining various kinds of Association Rules, Correlation Analysis

UNIT V

Classification and Prediction: Description and comparison of classification and prediction, preparing data for Classification and Prediction

Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Backpropagation

Prediction, linear and non-linear regression, evaluating accuracy of a Classifier or a Predictor

UNIT VI

Cluster Analysis: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, k-means and k-mediods methods, CLARANS, Agglomerative and divisive hierarchical clustering, chameleon dynamic modeling, clustering based on density distribution function, wavelet transformation based clustering, conceptual Clustering, Constraint-Based Cluster Analysis, Outlier Analysis.

TEXT BOOKS:

1. Data Mining – Concepts and Techniques - Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, 2nd Edition, 2006.
2. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson education.

M.Tech. (CAD/CAM) I Year – II Sem.

BIG DATA ANALYTICS

(Open Elective)

L	T	P	C
3	1	**-**	**3**

CODE: 6RC16

PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
			X		**X**

Course Outcomes:

The students must able to understand

1) The big Data platform, Challenges of Conventional Systems, Predictive Analytics, Data Mining, and Real Time Analysis by providing an advanced, practical background that allows the students to lead and participate in Big Data and Data Analytics projects.

2): Regression Modeling - Multivariate Analysis - Bayesian Modeling and Time series analysis.

3) The course incorporates a deep-dive into Big Data, the Data Analytics lifecycle, Machine Learning (ML), Hadoop (MapReduce, HDFS) and Tez, as well as the Apache projects Zookeeper, Storm, Kafka, Cassandra, HBase, and Mahout. Various Machine Learning algorithms are scrutinized and actual cases studies are conducted to solve comprehensive Big Data problems.

UNIT I

INTRODUCTION TO BIG DATA: Introduction to BigData Platform – Traits of Big data -Challenges of Conventional Systems - Web Data – Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - ReSampling - Statistical Inference - Prediction Error.

UNIT II

DATA ANALYSIS : Regression Modeling - Multivariate Analysis - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction - Neural Networks: Learning And Generalization - Competitive Learning - Principal Component Analysis and Neural Networks - Fuzzy Logic: Extracting Fuzzy Models from Data - Fuzzy Decision Trees - Stochastic Search Methods.

UNIT III

MINING DATA STREAMS : Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT IV

FREQUENT ITEMSETS AND CLUSTERING : Mining Frequent Itemsets - Market Based Model – Apriori Algorithm – Handling Large Data Sets in Main Memory – Limited Pass Algorithm – Counting Frequent Itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means – Clustering High Dimensional Data – CLIQUE And PROCLUS – Frequent Pattern based Clustering Methods – Clustering in NonEuclidean Space – Clustering for Streams and Parallelism.

UNIT V

FRAMEWORKS AND VISUALIZATION : MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques;

UNIT VI:

Systems and Analytics Applications - Analytics using Statistical packages-Approaches to modeling in Analytics – correlation, regression, decision trees, classification, associationIntelligence from unstructured information-Text analytics-Understanding of emerging trends and technologies-Industry challenges and application of Analytics

TEXT BOOKS:

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
2. AnandRajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
4. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007
5. Pete Warden, “Big Data Glossary”, O’Reilly, 2011.
6. Jiawei Han, MichelineKamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008.

Programme Outcomes					
1	2	3	4	5	6
H				L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem
COMPUTATIONAL METHODS LABORATARY

L	T	P	C
-	-	4	2

CODE: 6M274

Course Objectives:
The lab is mainly intended to,
- Familiarize the usage of CFD software package.
- Reduce the time for solving different fluid flow problems.
- Model the heat transfer problems where fluid flow is present in CFD software package such as ansys and gambit.
- Analyze the different thermal systems for variable fluid flow properties such as mass flow rate, Reynolds number etc.
- Analyze the thermal systems under different flow conditions such as turbulent flow etc.
- Correlating the results obtained using different software with theoretical knowledge.
- Identify the critical situation where the fluid flow can affect the thermal system.

Course Outcomes:
At the end of the lab the learners will be able to,
- Understand the basics on how to use CFD software package for fluid flow problems.
- Understand how a software package can reduce time to solve a fluid flow problem.
- Model the different thermal systems used in real world. • Analyze the thermal systems by varying the fluid flow properties of the system.
- Identify the critical situations of the thermal system. • To handle projects related to fluid flow

C programming for problem solving.

Solving Thermal Engineering problems using available packages such as

ANSYS, CFX, MATLAB, FLUENT etc…

Programme Outcomes					
1	2	3	4	5	6
H				L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

COMPREHENSIVE VIVA-VOCE -II

L	T	P	C
-	-	-	1

CODE: 6M275

Max. Marks: 100

Course Objective:

1. the main objective of this course is to prepare the students to face interview both at the academic and the industrial sector.
2. to. Exhibit the strength and grip on the fundamentals of the core and elective subjects studied in I year II sem

The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is aimed to assess the students' understanding in various subjects he/she studied during the M.Tech. I year II sem course of study. The Comprehensive Viva-Voce is valued for 50 marks for internal and 50 marks for externals by the Committee. A candidate has to secure a minimum of 50% to be declared successful.

Programme Outcomes					
1	2	3	4	5	6
	H			L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

LITERATURE REVIEW & SEMINAR-2

L	T	P	C
-	-	3	1

CODE: 6M276

Max. Marks: 100

After studying this course, the students will be able to

1. Identify a research topic
2. Collect literature
3. Write technical review paper
4. Present seminar
5. Discuss the queries and Publish research paper

There shall be three seminar presentations during I year I semester and I year II Semester. For 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, which shall consist of the Head of the Department, a senior Faculty Member and the Supervisor and will jointly evaluate the report and presentation. For each Seminar there will be only internal evaluation of 25 marks. A candidate has to secure a minimum of 50% to be declared successful.

In the First semester the report must be in the form of the review paper with a format used by IEEE / ASME etc. In the Second semester Technical Seminar in the form of Independent Review Paper must be of high quality fit for publication in a reputed conference / journal.

The evaluation format for seminar is as follows:

- Day to day evaluation by the Supervisor : 20 marks
- Final Report : 20 marks
- Presentation : 60 marks (20 Abstract seminar +40 Final Presentation)

The presentation includes content (5) + Participation (5) + Presentation (10) for a total of 20 marks and double for 40 marks for final presentation.

A Student has to concentrate on the following sections while writing technical paper or presenting seminar.

Contents:

- Identification of specific topic, Analysis
- Organization of modules, Naming Conventions
- Writing style, Figures

- Feedback
- Miscellaneous

REFERENCES:
Teach Technical Writing in Two Hours per Week by Norman Ramsey

For Technical Seminar the student must learn few tips from sample seminars and correcting himself, which is continues learning process

REFERENCE LINKS:
I. http://www.cs.dartmouth.edu/~scot/givingTalks/sld001.htm
II. http://www.cse.psu.edu/~yuanxie/advice.htm
III. http://www.eng.unt.edu/ian/guides/postscript/speaker.pdf

NOTE: A student can use any references for this process, but must be shared in classroom.

Programme Outcomes					
1	2	3	4	5	6
	H			L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) I Year –II Sem

PROJECT SEMINAR-I (Abstract)

L	T	P	C
-	-	3	2

CODE: 6M277

Max. Marks: 100

In I year II semester, a project seminar shall be conducted for 100 marks and for 2 credits (there is no external evaluation). The evaluation for the project seminar shall be done in two stages, i.e. in the middle of the semester and at the end of the semester. The mid-semester seminar evaluation shall carry 10 marks and the end semester seminar evaluation shall carry 15 marks. The report for the mid-semester project seminar will carry 5 marks and remaining marks shall be for presentation and discussion. The report for end semester project seminar shall be for 5 marks and the remaining marks shall be for presentation and discussion. A candidate shall secure a minimum of 50% to be declared successful.

Programme Outcomes					
1	2	3	4	5	6
	H				
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) II Year –I Sem

PROJECT SEMINAR-II

(DESIGN, CONSTRUCTION AND DEVELOPMENT)

L	T	P	C
-	-	-	4

CODE: 6M378

Max. Marks: 100

In II year I semester, a project seminar shall be conducted for 100 marks and for 4 credits (there is no external evaluation). The evaluation for the project seminar shall be done in two stages, i.e. in the middle of the semester and at the end of the semester. The mid-semester seminar evaluation shall carry 20 marks and the end semester seminar evaluation shall carry 30 marks. The report for the mid-semester project seminar will carry 5 marks and remaining marks shall be for presentation and discussion. The report for end semester project seminar shall be for 10 marks and the remaining marks shall be for presentation and discussion. A candidate shall secure a minimum of 50% to be declared successful.

Programme Outcomes					
1	2	3	4	5	6
H	H	M	L	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) II Year –I Sem

PROJECT WORK (PART-I)

(PROJECT STATUS REPORT)

CODE: 6M379

L	T	P	C
-	-	-	20

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

A Project Review Committee (PRC) shall be constituted comprising of Heads of all the Departments which are offering the M.Tech programs and three other senior faculty members concerned with the M.Tech. programme.

Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the previous semesters and after obtaining the approval of the PRC.

After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the PRC for its approval. Only after obtaining the approval of PRC the student can initiate the Project work. This process is to be completed within four weeks of commencement of II year I semester.

The student shall submit a project report at the end of II year I semester, and the same shall be evaluated at the end of that semester by the PRC as Excellent/Good/Satisfactory/Unsatisfactory. In the case of Unsatisfactory declaration, the student shall re-submit the Project report after carrying out the necessary modifications / additions in the Project work, within the specified time as suggested by the PRC.

Programme Outcomes					
1	2	3	4	5	6
	H				
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) II Year –II Sem

PROJECT SEMINAR – III

(Result Analysis)

L	T	P	C
-	-	-	2

CODE : 6M480

Max. Marks: 100

A project seminar shall be conducted for 100 marks and for 2 credits (there is no external evaluation). The evaluation for the project seminar shall be done in two stages, i.e. in the middle of the semester and at the end of the semester. The mid-semester seminar evaluation shall carry 20 marks and the end semester seminar evaluation shall carry 30 marks. The report for the mid-semester project seminar will carry 5 marks and remaining marks shall be for presentation and discussion. The report for end semester project seminar shall be for 20 marks and the remaining marks shall be for presentation and discussion. A candidate shall secure a minimum of 50% to be declared successful.

Programme Outcomes					
1	2	3	4	5	6
	H				
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) II Year –II Sem

PRE SUBMISSION PROJECT SEMINAR

L	T	P	C
-	-	-	2

CODE: 6M481

Marks: 100

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

A Project Review Committee (PRC) shall be constituted comprising of Heads of all the Departments which are offering the M.Tech programs and three other senior faculty members concerned with the M.Tech. programme.

Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the previous semesters and after obtaining the approval of the PRC.

After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the PRC for its approval. Only after obtaining the approval of PRC the student can initiate the Project work. This process is to be completed within four weeks of commencement of II year I semester.

The student shall submit a project report at the end of II year I semester, and the same shall be evaluated at the end of that semester by the PRC as Excellent/Good/Satisfactory/Unsatisfactory. In the case of Unsatisfactory declaration, the student shall re-submit the Project report after carrying out the necessary modifications / additions in the Project work, within the specified time as suggested by the PRC.

Programme Outcomes					
1	2	3	4	5	6
H	H	M	L	L	
H: High		M: Medium		L: Low	

M.Tech. (THERMAL ENGINEERING) II Year –II Sem

PROJECT WORK AND DISSERTATION

L	T	P	C
-	-	-	20

CODE: 6M482

By the end of this course, students will be able to

1. Critically and theoretically analyze the systems/products they are going to design or develop.
2. Apply the theoretical knowledge gained to bring out innovative products.
3. Effectively communicate in a variety of forms including written, visual, verbal, online and technical literacy.
4. Work and participate as effective members in a group within a professional environment.
5. Develop an ongoing critical awareness of learning needs in the application of appropriate technologies.
6. Gain as much knowledge and experience in areas of the area of Digital Systems and Computer Electronics

A candidate is permitted to submit Project Dissertation only after successful completion of PG subjects (theory and practical), seminars, Comprehensive viva-voce, PG Project Part–I, and after the approval of PRC, 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 Head of the Department and shall make an oral presentation before the PRC. Along with the draft thesis the candidate shall submit draft copy of a paper in standard format fit for publication in Journal / Conference, based on the project thesis, to the Head of the Department with due recommendation of the supervisor.

- Four copies of the Project Dissertation certified by the Supervisor and Head of the Department shall be submitted to the College.

- The dissertation shall be adjudicated by one examiner selected by the College. For this, Head of Department shall submit a panel of 3 examiners, who are eminent in that field, with the help of the PRC. The Chief Superintendent of the college in consultation with the college academic committee shall nominate the examiner.

- If the report of the examiner is not favorable, the candidate shall revise and resubmit the Dissertation, in the time frame as prescribed by PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate can re-register only once for conduct of project and evaluation of Dissertation, and will go through the entire process as mentioned above. The total duration for the M. Tech program is limited to four years.

If the report of the examiner is favorable, viva-voce examination shall be conducted by a Board consisting of the Head of the Department, Supervisor and the Examiner who adjudicated the Dissertation. The Board shall jointly report the student's performance in the project work as – (a) Excellent, or (b) Good, or (c) Satisfactory, or (d) Unsatisfactory, as the case may be. In case, the student fails in the viva-voce examination, or gets the Unsatisfactory grade, he can re-appear only once for the viva-voce examination, as per the recommendations of the Board. If he fails at the second viva-voce examination, the candidate can re-register only once for conduct of project and evaluation of Dissertation, and will go through the entire process as mentioned above. The total duration for the M. Tech program is limited to four years.

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