REGULATION 2015

M.TECH – THERMAL ENGINEERING

CURRICULUM AND SYLLABUS

		L T P C
SEMESTER I		
MMA 109 Mathematical Methods		3 1 0 4
MME 101 Fuels, Combustion and Emission Control		3 0 0 3
MME 103 Advanced Fluid Mechanics		3 0 0 3
MME 105 Advanced Heat Transfer		3 0 0 3
MME 107 Analysis of Thermal Power Cycles		3 0 0 3
Elective I		3 0 0 3
MME 1L1- Thermal Laboratory		0 0 3 2
	Total	**18 0 3 21**
SEMESTER II		
MME 202 Fluid Mechanics of Turbo machines		3 0 0 3
MME 204 Instrumentation		3 0 3 4
MME 206 Computational Fluid Dynamics		3 0 0 3
MME 208 Advanced I.C Engines		3 0 0 3
Elective II		3 0 0 3
Elective III		3 0 0 3
MME 2L1- Heat Transfer Laboratory		0 0 3 2
	Total	**18 0 3 21**
SEMESTER III		
MME 302 Advanced Refrigeration & Air Conditioning		3 0 0 3
MME 304 Environmental Pollution Control		3 0 0 3
Elective IV		3 0 0 3
MME 3P1 Project Work – Phase-I		0 0 0 6
	Total	**9 0 0 15**
SEMESTER IV		
MME 4P2 Project Work – Phase-II	**Total**	0 0 0 12
	Total Credits for the programme	**69**

LIST OF ELECTIVES FOR M.TECH THERMAL FULL TIME STUDENTS

S.NO.	CODE	SUBJECT NAME	L	T	P	C
1	MME E1	Analysis and Design of Pressure Vessels	3	0	0	3
2	MME E2	Energy Conservation, Management, and Audit	3	0	0	3
3	MME E5	Boiler Auxiliaries and Performance Evaluation	3	0	0	3
4	MME E6	Heat Transfer Equipment Design	3	0	0	3
5	MME E7	Installation, Testing, and Operation of Boilers	3	0	0	3
6	MME E9	Non Destructive testing and Failure analysis	3	0	0	3
7	MMEE10	Frontier Materials	3	0	0	3
8	MMEE11	Combustion Engineering	3	0	0	3
9	MMEE12	New & Renewable Sources of Energy	3	0	0	3
10		Research Methodology	3	0	0	3

NOTE: Apart from the above list of electives, any other electives offered in the university departments can be selected

SEMESTER I

MMA 109 Mathematical Methods **3 1 0 4**

OBJECTIVE:
To equip students with adequate knowledge of mathematical methods to formulate in engineering and solve them analytically and numerically

COURESE OUTCOME
CO1: To Understand the principle of calculus of variations and apply to mechanical problems
CO2: To analyze various methods of variational problems applicable to Engineers
CO3: To Analyze the various integral equations applicable to engineers.
CO4: To evaluate various partial differential equations useful for thermal engineers.
CO5: To analyze finite element methods and application of shape function to fluid flow and heat transfer problems

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M	M		S	
CO2	W		M	S	M
CO3		M		S	
CO4				S	
CO5	W			S	M

Course Assessment Method

Direct	**Indirect**
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 **12**
Calculus of variations - Euler's equation - Variational problems in parametric form - Natural Boundary condition – Conditional Extremum - Isoperimetric problems.

UNIT-2 **12**
Direct methods in Variational Problems - Euler's finite difference method - Rayleigh -Ritz Method - Galerkin's method - Kantorovich’s method.

UNIT-3 **12**
Integral equations - Conversion of BVP to integral equations using Green’s Function - Fredholm

Equation with separable kernels – Solution of Fredholm and Volterra equations by the method of Successive approximations.

UNIT-4 **12**

Finite difference scheme for elliptic, parabolic, and hyperbolic partial differential equations.

UNIT-5 **12**

Introduction to Finite Element Method - Rules for forming interpolation functions - Shape Functions Application to fluid flow and heat transfer problems.

Text book

1. GREWAL, B.S. , Higher Engineering Mathematics, Khanna Publishers.

References.

1. DESAI, C.S., and ABEL, J. P., Introduction to Finite Element Method, Van Nostrand Reinhold.
2. ELSEGOLTS, L., Differential Equations and the Calculus of Variations, Mir Publishers.
3. HILDEBRAND, P.B., Method of Applied Mathematics, Prentice Hall.
4. VENKATARAMAN, M. K., Higher Mathematics for Engineering and Science, National Publishing Company.

Total no of periods: 60

MTE 101 Fuels, Combustion and Emission Control **3 0 0 3**

Course Objectives:

The course is intended to

- Provide Students with Knowledge of Fuel Quantity and Engine Technology Effects on Emissions.
- Understand The Combustion Phenomena.
- Understand The Concept of Laminar and Turbulent Flame Propagation.
- Understand About Different Methods to Reduce Air Pollution.

Course outcomes:

Upon completion of the subject, students will be able to:

CO1: Have the knowledge of fuel thermo-chemistry and fuel quality effects on emissions, engine technologies, engine combustion-related emissions and control technologies

CO2: Extend their knowledge of fuels and engines to different situations of engineering context and professional practice.

CO3: Understand combustion in spark ignition and diesel engines.

CO4: To identify the nature and extent of the problem of pollutant formation and Control in internal combustion engines government legislation

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	W	M	S
CO2	S				M
CO3	S	M	M	W	
CO4	S				

Course Assessment Method

Direct	Indirect
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 BASICS

Types of fuels and their properties - Coal characterization - Combustion chemistry - Stoichiometry Heat of reaction - Calorific value - Adiabatic flame temperature - Equilibrium - Mass transfer.

UNIT-2 COMBUSTION MECHANISMS FOR LAMINAR FLOW 9

Chemical kinetics – Important chemical mechanisms – Simplified conservation equations for Reacting flows – Laminar premixed flames - Simplified analysis.

UNIT-3 TURBULENT FLOW 9

Factors influencing flame velocity and thickness flame stabilization – Diffusion flames – Introduction to turbulent flames.

UNIT-4 COMBUSTION OF SOLID FUELS 9

FBC – Different types of FBCs – Models for droplet and Carbon particle combustion.

UNIT-5 EMISSION CONTROL 9

Emissions - Emission index - Corrected concentrations - Control of emissions for premixed and non-premixed combustion.

Text book:

Turns, S.R., *An Introduction to Combustion - Concepts and Applications, 3rd* ed., McGraw-Hill, 2011.

Referencves:

1. Sharma, S.P. and Mohan, c., *Fuels and Combustion,* Tata McGraw-Hill, 1984.
2. Sarkar. S., *Fuels and Combustion,* Orient Longman, 2009.

Total no of periods: 45

MTE 103 Advanced Fluid Mechanics 3 0 0 3

Course Objectives:

The course is intended to

- Establish an understanding of the fundamental concepts of fluid mechanics.

- Understand and apply the potential flow equations to basic flows.
- Understand and apply the differential equations of fluid mechanics including the ability to apply and understand the impact of assumptions made in the analysis.
- Understand the boundary layer concepts with respect to fluid flow
- Understand and apply the compressible flow equations.

Course outcomes:

CO1: Ascertain basic concepts in the fluid mechanics

CO2: Analyze practical problems of fluid flow

CO3: Design compressible flow components used in Turbo machines and air- conditioning

CO4: Understand the performance of fluid flow devices in laminar and Turbulent flows

CO5: Apply the concepts in the analysis of fluid flow problems

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	S	M	S
CO3	M	S	M	M	S
CO4	S	M	S	M	S
CO5	M	M	M	M	M

Course Assessment Method

Direct	**Indirect**
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 REVIEW OF BASIC CONCEPTS **9**

Review of Basic concepts- Reynolds's transport theorem, Fluid kinematics – Physical Conservation laws – Integral and differential formulations.

UNIT-2 FLOW ANALYSIS **9**

Navier-Stokes and energy equations – Dimensionless forms and dimensionless numbers – Solution of Navier-Stokes equations.

UNIT-3 LAMINAR FLOW **9**

Two-dimensional Potential flows - Different types of flow patterns. Boundary layer theory - Blasius solution - Momentum integral approach.

UNIT-4 TURBULENT FLOW **9**

Turbulent flows – Reynolds equation – Prandtl and von Karman hypothesis- Universal velocity

Profile near a wall- flow through pipes

UNIT-5 BOUNDRY LAYER **9**

Boundary layer concept- Boundary layer thickness- prandd's equations-blassius solution-skin Friction coefficient.

Text book:

Yunus.A.CENGAL.,*fluid mechanics,2nd edition.*,McGraw-Hill,*2010*

References:

1. Currie, LG., *Fundamental Mechanics of Fluids, 4th* ed., CRC Press, 2012.
2. White, P.M., *Viscous Fluid Flow, 2nd* ed., McGraw-Hill, 1991.
3. Ockendon, H. and Ockendon, J., *Viscous Flow*, Cambridge Uni. Press, 1995.

Total no of periods: 45

MTE 105 Advanced Heat Transfer **3 0 0 3**

Course Objectives:

The course is intended to

- Impart the advances knowledge of heat transfer.
- Get analytical solutions for 2-D steady and transient heat conduction problems.
- Deep understanding on the governing equations for convection heat transfer; knowing the dimensionless parameters (influencing the convection performance).
- Aware of turbulence concept and modeling.
- Apply the concept of natural convection for electronic cooling, HVAC etc.
- Understand the boiling and condensation mechanism.
- Understand the concept of mass transfer.

Course Outcomes:

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

CO1: Understand both the physics and the mathematical treatment of the advanced topics pertaining to the modes of heat transfer

CO2: Apply principles of heat transfer to develop mathematical models for uniform and Non-uniform fins.

CO3: Employ mathematical functions and heat conduction charts in tackling two- Dimensional and three-dimensional heat conduction problems

CO4: Analyze free and forced convection problems involving complex geometries with proper boundary conditions

CO5: Apply the concepts of radiation heat transfer for enclosure analysis

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**

CO1	M	S	-	S	
CO2	S		-		W
CO3	M	M	M	M	
CO4	S		-		W
CO5	M	S	-		

Course Assessment Method

Direct	**Indirect**
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 TRANSIENT HEAT CONDUCTION 9

Transient heat conduction - Exact solution - Use of Heisler and Grober chart-Integrated method.

UNIT-2 STEADY STATE HEAT TRANSFER 9

Extended surfaces - Steady state analysis and optimization-Radial fins of rectangular and hyperbolic profiles- longitudinal fin of rectangular profile radiating to free space.

UNIT-3 CONVECTION 9

Thermal boundary layers - Momentum and energy equations -Internal and external flows- Forced convection over cylinders, spheres and bank of tubes.

UNIT-4 MASS TRANSFER 9

Heat transfer with phase change – condensation and boiling heat transfer- Heat transfer in condensation, Effect of non-condensable gases in condensing equipments. Flow boiling correlations.

UNIT-5 RADIATION 9

Radiative exchange in furnaces-Radiation characteristics of particle systems, Thermal radiation of a luminous fuel oil and gas- Soot flame- overall heat transfer in furnaces.

Text book:

Ozisik, M.N., *Heat Transfer - A Basic Approach*, McGraw-Hill, 2007.

References:

1. Incropera, P.P. and Dewitt, D.P., *Fundamentals of Heat and Mass Transfer, 5th* ed., John W iley, 2002.
2. Kakac, S. and Yener, Y., *Convective Heat Transfer*, CRC Press, 1995.
3. Kraus, A.D., Aziz, A., and Welty, J., *Extended Surface Heat Transfer*, John Wiley, 2001.

Total no of periods: 45

MTE 107 Analysis of Thermal Power Cycles **3 0 0 3**

Course objectives:
The course is intended to

- Provide analytical methods for the determination of the direction of processes from the first and second laws of thermodynamics and to Introduce methods in using equations of potentials, availability, and excergy for thermodynamic analysis
- Gain the knowledge on non-reactive mixture properties , Psychometric Mixture properties and psychometrics chart and Air conditioning processes
- Develop the ability of analyzing vapor and Gas power cycles
- Provide in depth knowledge of Direct Energy Conversion of Fuel Cells , Thermo electric energy
- Thermionic power generation ,Thermodynamic devices Magneto Hydrodynamic Generations and Photo voltaic cells
- Develop communication and teamwork skills in the collaborative course project

Course Outcomes:
At the end of the course the learners will be able to

CO1: Gain the analytical methods for the determination of the direction of processes from the first and second laws of thermodynamics and to carry out the thermodynamic analysis using equations of potentials, availability, and excergy
CO2: Apply the knowledge of adiabatic flame temperature in the design of combustion devices.
CO3: Identify the phenomenon of flame stabilization in laminar and turbulent flames.

CO4: Analyze the pollution formation mechanisms in combustion of solid, liquid and gaseous fuels.

CO5: Apply the knowledge of Direct Energy Conversion of Fuel Cells , Thermo electric energy, Thermionic power generation ,Thermodynamic devices Magneto Hydrodynamic Generations and Photo voltaic cells

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	M
CO2	M	S		S	
CO3	S		M		M
CO4	M	M	M	M	
CO5	M		W		M

Course Assessment Method

Direct	Indirect
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 VAPOUR POWER CYCLES 9

Steam power plant cycle – Rankin cycle – Reheat cycle – Regenerative cycle with one and more feed heaters – Types of feed heaters – Open and closed types – Steam traps types.

UNIT-2 COMBINED CYCLES 9

Cogeneration - Condensing turbines - Combined heat and power - Combined cycles - Brayton cycle Rankine cycle combinations - Binary vapour cycle.

UNIT-3 AIR STANDARD CYCLES 9

Air standard cycles – Cycles with variable specific heat – fuel air cycle – Deviation from actual cycle.

UNIT-4 AIR POWER CYCLES 9

Bray ton cycle - Open cycle gas turbine - Closed cycle gas turbine - Regeneration - Inter cooling and reheating between stages.

UNIT-5 REFRIGERATION CYCLES 9

Refrigeration Cycles - Vapor compression cycles - Cascade system - Vapour absorption cycles -GAX Cycle.

Text book:

Nag. P.K., *Engineering Thermodynamics, 3rd* ed., Tata McGraw-Hill, 2005.

References:

1. Culp, R., *Principles of Energy Conversion,* McGraw-Hill, 2000.
2. Nag. P.K., *Power Plant Engineering, 2nd* Tata McGraw-Hill, 2002.
3.Arora, C.P., *Refrigeration and Air Conditioning, 2nd* ed., Tata McGraw-Hill, 2004.

Total no of periods: 45

MTL 1L1- Thermal Laboratory 0 0 3 2

Course Objectives:

The lab is mainly intended to

- Analyze the performance and exhaust emissions of an IC engine by conducting the performance test on IC Engines.
- Evaluate the performance of the Vapor compression and Air conditioning units

- Analyze the flame propagation velocity of the gaseous fuels

COURSE OUTCOMES

CO1: Analyze the performance and exhaust emissions of an IC engine

CO2: Evaluate the performance of the Vapor compression and Air conditioning units
CO3: Analyze the flame propagation velocity of the gaseous fuels
CO4: Analyze the pollution formation mechanisms in combustion of solid, liquid and gaseous fuels.

CO5: Apply the knowledge of Direct Energy Conversion of Fuel Cells , Thermo electric energy,

Direct	**Indirect**
Observation Book	Student Exit Survey
Record Book	Faculty Survey
Model exam	Industry
Viva Voce	Alumni
End semester exam	

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	-	-	
CO2	S	S	-	-	
CO3	S		-	-	S
CO4	S	M	M	-	
CO5	S		-	M	M

Performance Test On Multi Cylinder Petrol Engine –Morse Test.

1. Performance Test On Twin Cylinder 4stroke Diesel Engine
2. Performance Test On Boilers
3. Performance Test On Turbines
4. Performance Test On Refrigeration Plant.

Total no of periods: 45

SEMESTER II

MTE 202 Fluid Mechanics of Turbo machines 3 0 0 3

Course objectives:

The course is intended to

- Understand the fundamental concepts of turbo machines.
- Apply concepts of fluid mechanics in turbo machines.
- Understand the thermodynamic analysis of steam nozzles and turbines.
- Understand the different types of compressors and evaluating their performances in the form of Velocity triangles.
- Familiarize the basic concepts of gas dynamics and analyze the performance of axial flow gas Turbines.

Course Outcomes:

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

CO1: Able to derive the basic equations used for turbo machines

CO2: Will be able to understand the concept of velocity triangles used for performance evaluation of Turbines

CO3: Able to understand the concept of degree of reaction for axial flow compressors

CO4: Will able to understand the basic concepts of gas dynamics

CO5: Analyze the performance of axial flow gas turbines

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M		M	M	S
CO2	W	M			
CO3				S	M
CO4	M	W	S		
CO5	M			M	M

Course Assessment Method

Direct	**Indirect**
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 2D CASCADES **9**

Introduction and cascades – Two-dimensional cascades – Analysis of cascade forces – Energy losses – Cascade correlation – Off design performance.

UNIT-2 POWER GENERATING MACHINES – TURBINES **9**

Power generating machine I - Axial flow turbines- Stage losses and efficiency – Soderberg's correlation – Turbine flow characteristics

UNIT-3 POWER GENERATING MACHINES – COMPRESSORS 9

Power absorbing machine I - Axial flow compressors – Three dimensional flow in axial turbo machines – theory of radial equilibrium – actuator disc approach – Secondary flows

UNIT-4 POWER GENERATING MACHINES – PUMPS & FANS 9

Power absorbing machine II - Centrifugal pumps, fans, and compressors – slip factor – optimum design of centrifugal compressor inlet choking in a compressor stage.

UNIT-5 POWER GENERATING MACHINES

Power generating machine II - Radial flow turbines, Loss coefficients – off design operating condition – clearance and windage losses 90 deg IFR turbines.

Text book:

1. Csanady, G.T., *Theory of Turbo machines,* McGraw Hill, 1964.

References:

1. Dixon, S.L., *Fluid Mechanics and Thermodynamics of Turbo machinery, 5th* ed., Butterworths Heinemann, 2005.
2. Prithvi Raj, D. and Gopalakrishnan, G., *A Treatise on Turbo machines,* SciTech Publication, 2003.

Total no of periods: 45

MTE 204 INSTRUMENTATION 3 0 3 4

Course Objectives:

The course is intended to

- 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

CO1: Making the student conversant with different working principles of various instruments

CO2: Making the student to learn in the transduction of the signals

CO3: Student can be able to analyze the behavior of an instrument in the measurement process

CO4: Be able to analyze and design an instrumentation system, dealing with the concepts of dynamic range, signal noise ratio, and error budget

CO5: Build, program, calibrate and use a microprocessor-based instrumentation system

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M		W	-	
CO2		W		-	
CO3	M		W	-	M
CO4		M		M	
CO5	W		M	-	W

Course Assessment Method

Direct	**Indirect**
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 DISPLACEMENT **9**

Generalized instrumentation system – Error theory – Calibration of instruments – Range – Resolution – Span – Linearity, Sensitivity- Signal conditioning systems.

UNIT-2 INSTRUMENTATION SYSTEM **9**

Static and dynamic characteristics of instruments zero order, first order, second order instruments.

UNIT-3 ERROR ANALYSIS **9**

Error analysis - Uncertainty propagation – Oscilloscope for analysis of dynamic and transient Events.

UNIT-4 MEASUREMENT SYSTEM **9**

Principles and analysis of measurement systems used for measurement of flow, power, pressure, And temperature.

UNIT-5 CONTROL SYSTEM **9**

Basics of control system - Types of control – proportional control, Derivative control, Integral Control, PID control-Programmable logic controllers.

Text book:

1. Doebelin, E.O., *Measurement Systems - Application and Design, 5th* ed., McGraw-Hill, 2007.

References:

1. Beckwith, T.G., Buck, L., and Marangoni, R.D., *Mechanical Measurements*, Narosa Pub.

House, 1987.
2. Hewlett Packard, *Practical Temperature Measurements* - Application Note 290, 1995.

PRACTICAL **15**

Use of oscilloscope for measurement of dynamic parameters - PV diagram of compressors and I engines - Comparison of flow measuring instruments - Measurement of static and dynamic characteristics of instruments.

Total no of periods: 60

MTE 206 COMPUTATIONAL FLUID DYNAMICS **3 0 0 3**

Course Objectives:

The course is intended to

- Understand the basics of computational fluid dynamics (CFD).
- Differentiate between finite difference and finite volume methods applied in CFD.
- Provide the necessary background in discretization methods, accuracy, stability and convergence aspects of numerical solutions.
- Develop an understanding of the capabilities and limitations of various numerical and mathematical models of fluid flow.
- Introduce some of the models required to compute turbulent and incompressible fluid flow problems
- Apply CFD to heat transfer problems.

Course Outcomes:

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

CO1: Derive the basic governing equations applied for fluid flow problems

CO2: Apply the differential equations to fluid flow problems

CO3: Understand the concept of discretization.

CO4: Solve simple algorithms for incompressible fluid flow

CO5: Apply the basics of CFD to heat transfer problems.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	-	S	M
CO2	S	S	-	S	
CO3	M		-	S	S
CO4	S	M	M		
CO5	M		-	M	S

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Course Assessment Method

Direct	Indirect
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 CLASSIFICATION OF PDE & FDF **9**

Classification of partial differential equations – Discretization methods – finite difference and finite volume formulations –classificatrion of PDES.

UNIT-2 ELLIPTICAL EQUATIONS & LINEAR SYSTEMS **9**

Numerical solution of elliptical equations – Linear system of algebraic equations – Iterative solution of system of linear equation.

UNIT-3 MODEL & WAVE EQUATION **9**

Model Equations – Wave equations – Numerical solution of parabolic equations – Stability analysis– Advanced shock capturing schemes.

UNIT-4 CONVECTION HEAT TRANSFER **9**

Solutions of convection - Diffusion equation – Conservative and non-conservative schemes – concept of artificial viscosity and Numerical Diffusion.

UNIT-5 NAVIER-STROKE EQUATION & GRID GENERATION **9**

Navier-Stokes equations and algorithms; Basics of grid generation- Numerical solution of hyperbolic equations - Burgers equation generation.

Text book:

Hoffman, K.A. and Chiang, S.T., *Computational Fluid Dynamics for Engineers,* Engineering Education Systems, 2000.

References:

1. Tannehill, J.c., Anderson, D.A., and Pletcher, R.H., *Computational Fluid Mechanics and Heat Transfer, 3rd* ed., Taylor & Francis, 1997.
2. Peyret, R. and Taylor, T. D., *Computational Methods for Fluid Flow*, Springer- Verlag, 1983.

Total no of periods: 45

MTE 208 ADVANCED IC ENGINES **3 0 0 3**

Course objectives:

The course is intended to

- 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
- Understand the delay period and fuel injection system
- Become aware of the relevance of environmental and social issues on the design process of internal combustion engines

Course Outcomes:

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

CO1: Analyze engine cycles and the factors responsible for making the cycle different from the Ideal cycle

CO2: Apply principles of thermodynamics, fluid mechanics, and heat transfer to influence the engine's performance

CO3: To Demonstrate the delay period and fuel injection system

CO4: Demonstrate an understanding of the relationships between the design of the IC engine and environmental and social issues

CO5: Analyze problems involving steady state heat conduction in simple geometries

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	M	M	S	S	
CO3	S		S		M
CO4	S	M	S	M	S

Course Assessment Method

Direct	**Indirect**
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 OPERATING PARAMETERS & THERMO CHEMISTRY 9

Engine design and operating parameters – Thermo chemistry of fuel air mixtures- properties of working fluids.

UNIT-2 ENGINE CYCLES & CYCLE ANALYSIS 9

Ideal model of engine cycles – cycle analysis with constant specific heats – Volumetric efficiency– Super charging and Turbo charging

UNIT-3 FUEL INTAKE & INJECTION SYSTEM 9

Fuel intake systems and combustion in SI and CI engines – Carburetor an fuel injection systems –Squish prechamber engine flows.

UNIT-4 POLLUTANT FORMATION & CONTROL 9

Pollutant formation and control in IC engines - Types of diesel combustion system – Fuel spray behavior – Ignition delay.

UNIT-5 ENGINE OPERATING CHARATERISTICS 9

Engine friction and lubrication – measurement of friction – fluid mechanics based multi dimensional models – Engine operating characteristics.

Text book:

1. Heywood, J.B., *Internal Combustion Engine Fundamentals,* McGraw-Hill, 1988.
2. Ganesan, V., *Internal Combustion Engines, 2nd* ed., Tata McGraw-Hill, 2003.

References:

Taylor, C.P., *The Internal Combustion Engines in Theory and Practice,* Vol-2, MIT press, 1985.

Total no of periods: 45

MTL 2L1- Heat Transfer Laboratory 0 0 3 2

Course Objectives

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

Upon successful completion of this course, the student will be able to:

CO1: Understand the basic laws of heat transfer and Account for the consequence of heat transfer in thermal analyses of engineering systems

CO2: Analyze problems involving steady state heat conduction in simple geometries

CO3: Obtain numerical solutions for conduction and radiation heat transfer problems and understand the fundamentals of convective heat transfer process.
CO4: Evaluate heat transfer coefficients for natural convection ,forced convection inside ducts, forced convection over exterior surfaces

CO5: Analyze heat exchanger performance by using the method of log mean temperature difference.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	S	-	M	
CO2	S		-		
CO3	M		M		
CO4	S		-		
CO5	M	S	-		

LIST OF EXPERIMENTS

1. Thermal conductivity of insulating materials
2. Heat transfer through composite wall
3. Heat transfer from fins-natural and forced convection
4. Test on Pinfin apparatus
5. Heat balance test on twin cylinder 4 stroke diesel engine

Total no of periods: 45

SEMESTER III

MTE 302 ADVANCED REFRIGERATION AND AIR CONDITIONING 3 0 0 3

Course objectives:
The course is intended to

- Familiarize students with the terminologies associated with refrigeration & air conditioning
- Cover the basic principles of psychometric and applied psychometrics
- Familiarize students with system analysis
- Familiarize students with load calculations and elementary duct design
- Familiarize students with refrigerants; vapor compression refrigeration and multi-stage vapor compression systems
- Understand the components of vapor compression systems and other types of cooling systems.

COURSE OUTCOMES

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

CO1: Understand physical and mathematical aspects of refrigeration and air- Conditioning systems and to HVAC technology, engineering, research, systems, system designs, energy impacts, and overall goals

CO2: Apply theoretical and mathematical principles to simple, complex vapor Compression and vapor absorption refrigeration systems

CO3: Understand conventional and alternate refrigerants and their impact on environment and Develop understanding of the principles and practice of thermal comfort

CO4: Review heat transfer and solar energy engineering and develop techniques for the analysis of building envelope loads

CO5: Design air-conditioning systems and Develop generalized psychometrics' of moist air and apply to HVAC processes

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1			M		M
CO2	M	M		S	
CO3	S		S		M
CO4	S	M	S	M	S
Co5	S	W	M	M	M

Course Assessment Method

Direct	**Indirect**
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 VAPOUR COMPRESSION SYSTEM 9

Actual vapor compression system – Multipressure vapour compression system – Environment Friendly refrigerants – cascade system.

UNIT-2 VAPOUR ABSORPTION SYSTEM 9

Absorption refrigeration system – Three fluid absorption system – comparison of absorption with Compression system - Analysis of multistage systems

UNIT-3 PSYCHROMETRY & COOLING LOAD CALCULATIONS 9

Advanced psychrometric calculations - Cooling load calculations – Determination of U factor – Short method calculation

UNIT-4 CRYOGENICS 9

Low temperature refrigeration – Joule Thompson coefficient – liquefaction of air – hydrogen – Helium – Applications of cryogenics.

UNIT-5 DUCTS **9**

Room air distribution – Friction losses in ducts - Duct design, Air filters clean rooms – Air Curtain

Text book:

Arora, c.P., *Refrigeration and Air Conditioning, 2nd* ed., Tata McGraw-Hill, 2004.

References:

1. Stoeker, W.P. and Jones, J.W., *Refrigeration and Air Conditioning, 2nd* ed., Tata McGraw-Hill , 1982.
2. Manohar Prasad, *Refrigeration and Air Conditioning,* New Age International, 1996.
3. Gosney, W.B., *Principles of Refrigeration,* Cambridge Uni. Press, 1982.

Total no of periods: 45

MTE 304 ENVIRONMENTAL POLLUTION AND CONTROL 3 0 0 3

Course objectives:

The course is intended to

- Learn the principles of air and water pollution, effect of these pollutants on the environment and the methods available to control them.
- Familiar with technical and scientific methods for treating, controlling or safely disposing of air and water emissions, which could pose a threat to the environment

Course Outcomes:

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

CO1: Design of mechanical systems and interdisciplinary engineering applications and business solutions using suitable optimization technique

CO2: Apply numerical or iterative techniques in power systems for optimal power flow solutions

CO3: Optimize the parameters in control systems for desired steady state or transient response

CO4: Optimize the cost function in deciding economic factors of power systems

CO5: Design of electrical systems optimally using suitable techniques like un variety method, steepest descent method etc

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M			-	W
CO2		M	S	-	W
CO3	M			M	M
CO4			S	M	M

CO5	S	M	M	W	-

Course Assessment Method

Direct	Indirect
Internal Test	Student Exit Survey
Assignments	Faculty Survey
Seminar	Industry
Online Test	Alumni
End Semester Examination	

UNIT-1 AIR POLLUTION **9**

Air pollution – Classification and properties of Air pollutants – Sampling and analysis of air pollutants –Control of air pollution.

UNIT-2 AIR POLLUTION MODEL & CONTROL **9**

Dispersion of air pollutants - Gaussian plume model- Control of gaseous pollutants - Volatile organic compounds - Control of gaseous emission - Air pollution laws and standards.

UNIT-3 WATER POLLUTION **9**

Water pollution - Sampling and analysis of waste treatment – Advanced waste water treatments by physical, chemical, biological and thermal methods - Effluent quality standards.

UNIT-4 WASTE MANAGEMENT **9**

Solid waste management - Classification and their sources - Health hazards - Handling of toxic and radioactive wastes - Incineration and verification.

UNIT-5 APPLICATION OF POLLUTION CONTROL METHODS **9**

Pollution control in process industries namely Cement, Paper, Petroleum and petrochemical, Fertilizers and distilleries, thermal power plants and automobiles.

References:

1. Manster, G.M., *Introduction to Engineering and Science, 2nd* ed., Pearson Publishers, 2004.
2. Rao, E.S., *Environmental Pollution Control Engineering,* Wiley Eastern Ltd., 1991.
3. Mahajan, S.P., *Pollution Control in Process Industries,* Tata McGraw-Hill, 1985.
4. Crawford, M., *Air Pollution Control Theory,* TMH, 1976.

Total no of periods: 45

ELECTIVES

MTE E1 ANALYSIS AND DESIGN OF PRESSURE VESSELS **3 0 0 3**

UNIT-1 DESIGN CONDITION FOR PRESSURE VESSELS 9

Establishment of design conditions – Fracture Mechanics – Heads, Basic shell thickness - Reinforcement of openings – Special components like flange, tube plate, supports.

UNIT-2 THICK CYLINDERS 9

Cylindrical shells – Thick cylinders- Lame's solution - Theories of breakdown of elastic action – Unrestrained solution – Lateral loading – General loading. Axisymmetric loading - Membrane solutions - Edge bending solutions - Flexibility matrix.

UNIT-3GENERAL ANALYSIS 9

Application of general analysis – Flat closure plates –conical heads and reducers – hemispherical and torispherical, ellipsoidal heads.

UNIT-4 FAILURE MODES 9

Development of cracks - Fracture mechanics - Corrosion - Selection of working stress for ductile and brittle materials.

UNIT-5 FEA IN PRESSURE VESSELS 9

Finite element analysis for high pressure and high temperature components.

Text book:

1. Bickell, M.B. and Ruiz, c., *Pressure Vessel Design and Analysis,* MacMillan, London, 1967.

References:

1. Den Hartog, J.P., *Advanced Strength of Materials,* McGraw-Hill, 1949.
2. Timoshenko, S., *Strength of Materials,* Van Nostrand, 1986.

Total no of periods: 45

MTE E2 ENERGY CONSERVATION, MANAGEMENT, AND AUDIT 3 0 0 3

Course objectives:

The course is intended to

- 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

CO1: Explain the fundamentals of energy management and its influence on environment and to Develop the concepts of energy management which is essential in the functional areas like Manufacturing Industry, Process Industry,. Commerce and Government

CO2: Understand the basic energy conversion and management principles and to identify sources of energy loss and target savings and Describe methods of energy production for improved utilization

CO3: Carry out budgeting and risk analysis and Apply the principles of thermal engineering and energy management to improve the performance of thermal systems.

CO4: Analyze the performance of the wind turbine Assess energy projects on the basis of economic and financial criteria

CO5: Apply the principles of thermal engineering and energy management to improve the performance of thermal systems.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M			-	W
CO2		M	S	-	W
CO3	M			M	M
CO4			S	M	M
CO5	S	M	M	1	-

ASSESSMENT METHOD:

DIRECT		**INDIRECT**	
1	Internal Test	**1.**	Student exit survey
2	Assignment	**2.**	Faculty Survey
3	Seminar	**3.**	Industry
4	Online Test	**4.**	Alumni
5	End Semester Exam		

UNIT-1 BASICS OF ENERGY **9**

Energy Scenario - Basics of Energy and its various forms - Energy Management and -Audit - Material and Energy Balance -Energy Action Planning-Financial Management -Project Management -Energy Monitoring and Targeting -Global Environmental Concerns

UNIT-2 COMBUSTION OF FUELS & BOILERS **9**

Energy Efficiency in Thermal Utilities – Fuels and Combustion-Boilers-Steam System-Furnaces –Insulation and Refractory –FBC Boilers –Cogeneration –Waste heat recovery

UNIT-3 ELECTRICAL SYSTEMS 9

Energy Efficiency in Electrical Utilities-Electrical Systems-Electric Motors-Compressed Air System-HVAC and Refrigeration System-Fans and Blowers-Pumps and Pumping System-Cooling Tower-Lighting System-Diesel Generating System-Energy Efficient Technologies in Electrical Systems

UNIT-4 ENERGY AUXILITY 9

Energy Performance Assessment for Equipment and Utility systems -Boilers-Furnaces-Cogeneration, Turbines (Gas, Steam)- Heat Exchangers-Electric Motors and Variable Speed

UNIT-5 RENEWABLE ENERGY SOURCES & WASTE MINIMIZATION 9

Drives-Fans and Blowers-Water Pumps-Compressors
HVAC Systems-Lighting Systems-Performing Financial Analysis-Applications of Non-Conventional and Renewable Energy Sources-Waste Minimization and Resource Conservation

Text book:

Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of energy efficiencies, 2005.

Total no of periods: 45

MTE E5 BOILER AUXILIARIES AND PERFORMANCE EVALUATION 3 0 0 3

UNIT-1 BOILER TYPES & EFFICIENCY 9

Boiler types - Efficiency calculation - Balance diagram – Boiler start up calculations –Boiler turbine matching – Power Plant balance diagram

UNIT-2 FUEL & ASH HANDLING EQUIPMENTS 9

Fuel and Ash handling Equipment – Crushers and Mills - Drum internals - Specification and selection.

UNIT-3 PUMPS & FANS 9

Feed pumps – Different types, Specifications, Operation and maintenance aspects - Fans, blowers– Applications – Performance requirements, Selection, Operation and maintenance.

UNIT-4 DUST CLEANING EQUIPMENTS 9

Dust cleaning equipment – Selection criteria – Design, operation and maintenance of electro static precipitators, Bag filters.

UNIT-5 SOOT BLOWERS 9

Soot blowers – Various types and their constructional features – Specifications – Selection –

Operation and Maintenance.

Text book:
Shields, C.D., *Boilers, Types Characteristics and Functions,* McGraw-Hill, 1961.

References:
1. *Modern Power Station Practice,* CEGB London, Pergamon Press, 1991.
2. Eck, B., *Fans,* Pergamon Press, 1973.

Total no of periods: 45

MTE E6 HEAT TRANSFER EQUIPMENT DESIGN 3 0 0 3

Course objectives:
The course is intended to

- Design and analyses the heat exchangers parallel flow, counter flow, multipass and, cross flow heat exchanger
- Design and analyze the Shell and tube heat exchanger
- Enable to carry out the performance of heat exchanger with the extended surfaces.
- Design and analyses the cooling towers.

Course Outcomes:
At the end of the course the learners will be able to
CO1: Design and analyze the parallel flow, counter flow, multi-pass and, cross flow heat exchangers

CO2: Develop the Shell and tube heat exchanger

CO3: Optimize the performance of heat exchanger

CO4: Design and analyze the cooling towers

CO5: Apply the concepts of radiation heat transfer for enclosure analysis

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	-	M	S
CO2	S	M	-	M	M
CO3	S	M	-	M	M
CO4	S	W	-	M	S
CO5	S	M	-	W	M
CO6	S	W	-	W	M

ASSESSMENT METHOD:

DIRECT		**INDIRECT**	
1	Internal Test	**1.**	Student exit survey

2	Assignment	**2.**	Faculty Survey
3	Seminar	**3.**	Industry
4	Online Test	**4.**	Alumni
5	End Semester Exam		

UNIT-1 INTRODUCTION **9**

Classification of heat transfer equipment – Design of shell and tube heat exchanger – Finned Surface heat exchanger –Heat exchangers for special services – Fired heaters

UNIT-2 HEAT EXCHANGER & HEAT PIPES **9**

Plate and spiral plate heat exchanger – plate heat exchanger for Dairy industry – Heat Pipes

UNIT-3 DESIGN OF AUXILLARY SYSTEMS **9**

Thermal design of heat exchange equipments such as Air pre-heaters , Economizer – Super heater and condensers.

UNIT-4 HEAT EXCHANGER SELECTION **9**

Selection of compact heat exchangers.

UNIT-5 COOLING TOWERS DESIGN AND ANALYSIS **9**

Analysis and design of cooling towers.

Text book:

Ganapathy, v., *Applied Heat Transfer,* Pennwell Books, 1982.

References:

1. Kays, W.M. and London, A.L., *Compact Heat Exchangers*, McGraw-Hill, 1998.
2. Dunn, P. and Reay, D.A., *Heat Pipes*, Pergamon, 1994.
3. Kakac, S. and Liu, H., *Heat Exchangers,* CRC Press

MTE E7 INSTALLATION, TESTING, AND OPERATION OF BOILERS **3 0 0 3**

Objective:

To impart knowledge regarding insulation of boilers, ducts and dampers, insulation of boilers, boiler commissioning testing inspection and cleaning of boilers.

Program outcomes:

CO1: Can install boilers with all safety measures

CO2: Can provide insulation of boilers

CO3: Can commission a boiler

CO4: Can estimate life of very old boilers

CO5: Can do performance test on boilers.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	S	M	-	M	S
CO2	S	M	-	M	M
CO3	S	M	-	M	M
CO4	S	W	-	M	S
CO5	S	M	-	W	M

ASSESSMENT METHOD:

DIRECT		**INDIRECT**	
1	Internal Test	**1.**	Student exit survey
2	Assignment	**2.**	Faculty Survey
3	Seminar	**3.**	Industry
4	Online Test	**4.**	Alumni
5	End Semester Exam		

UNIT-1 INSTALLATION OF BOILERS 9

Installation of boilers – Supporting structures, Sequence of Erection, HSFC Bolts – Drum lifting alignment - Provision for expansion of water walls

UNIT-2 DUCTS & DAMPERS 9

Erection of Ducts - ESP - APH - and fans- Alignment. Erection of ducts and dampers – Cold pull.

UNIT-3 INSULATION OF BOILERS 9

Lining and Insulation – Material characteristics and selection - Procedure for mounting Gaskets for erection of boilers.

UNIT-4 BOILER COMMISSIONING 9

Boiler commissioning activities – Drying out –Boiling out – Chemical cleaning initial operation – Abnormal operations – precautions –shutting down

UNIT-5 TESTING,INSPECTION & CLEANING 9

Codes for Testing, Inspection and cleaning – Boiler pressure parts – Life estimation for very old boilers – Thermal performance test and capacity restoration.

References:

1. *Erection of Boilers and Auxiliary Equipment,* Manuals Prepared by B.H.E.L., Tiruchirappalli, 1990.

Total no of periods: 45

MTE E9 NON DESTRUCTIVE TESTING AND FAILURE ANALYSIS 3 0 0 3

Objectives

1. To understand the principles behind various NDT techniques
2. To study about NDT equipments and accessories
3. To learn working procedures of various NDT techniques

COURSE OUTCOMES:

CO1: Demonstrate good grounding in the area of NDT

CO2: To select proper NDT Method for his application

CO3: Understand the utilization of test and measurement appropriate to the area of his study/problem

CO4: Comparison and selection of different NDT methods

CO5: design and material Improvements derived from case studies

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M	M	-	M	S
CO2	M	M	-	M	M
CO3	M	M	-	M	M
CO4	M	W	-	M	S
CO5	M	M	-	W	M

ASSESSMENT METHOD:

DIRECT		INDIRECT	
1	Internal Test	**1.**	Student exit survey
2	Assignment	**2.**	Faculty Survey

3	Seminar	**3.**	Industry
4	Online Test	**4.**	Alumni
5	End Semester Exam		

UNIT-1 **9**

NDT Vs destructive testing – advantages and limitations – different types of NDT

UNIT-2 **9**

Detailed discussion of LPT, MPT and radiography

UNIT-3 **9**

Eddy current and ultrasonic techniques

UNIT-4 **9**

Comparison and selection of different NDT methods – statistical significance – reliability aspects – Need for multiple NDT procedures in critical components – concept of NDE

UNIT-5 **9**

Concept of failure analysis – methodology, approaches and tools – design and material Improvements derived from case studies – fracture mechanics approach

References:

1. Baldev Raj, Jayakumar, Thavasimuthu. M., *Practical Non destructive testing*, Narosa Publishing, 1997.
2. Das. A.K., Metallurgy of failure analysis, Tata McGraw Hill, 1992.

Total no of periods: 45

MTE E10 FRONTIER MATERIALS **3 0 0 3**

Objectives:

- To impart knowledge regarding various types of smart materials and steels

Outcomes:

CO1: Understand the mechanical behavior such as tensile, fatigue and creep of ductile and brittle materials

CO2: Analyze Failure of various components

CO3: Understand Materials characterization techniques

CO4: Analyze different types of steels

CO5: Analyze different types of smart material like shape memory alloys

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M	M	-	M	S
CO2	M	M	-	M	M
CO3	M	M	-	M	M
CO4	M	W	-	M	S
CO5	M	M	-	W	M
CO6	M	W	-	W	M

ASSESSMENT METHOD:

DIRECT		INDIRECT	
1	Internal Test	**1.**	Student exit survey
2	Assignment	**2.**	Faculty Survey
3	Seminar	**3.**	Industry
4	Online Test	**4.**	Alumni
5	End Semester Exam		

UNIT-1 INTRODUCTION **9**

Trends and developments in materials – historical perspective – challenging applications

UNIT-2 TOP DOWN – BOTTOM DOWN APPROACHES **9**

Need for microstructurally engineering materials – top down and bottom up approaches in Assemblage of materials / particles

UNIT-3 METALLIC GLASSES **9**

Detailed discussion on specific material systems – metallic glasses – processing conditions – bulk metallic glasses

UNIT-4 STEELS & ALLOYS OF STEELS **9**

Stainless steel and special steels – low-density high strength alloys – super alloys – cryogenic Materials

UNIT-5 SMG, FGM **9**

Shape memory alloys – FGM's – biomaterials – nano materials

Text book:

Leslie. V. C., *Physical Metallurgy of steels*, McGraw Hill, 1982.

References:

Polmear. I. J., *Light Alloys, Metallurgy of Light Metals*. 3rd edition, Arnold 1995.

MTE E11 COMBUSTION ENGINEERING 3 0 0 3

OBJECTIVE:
To impart knowledge regarding nature and mechanism of combustion phenomena and relate combustion with engine performance

COURSE OUTCOMES:
CO1: Apply thermodynamic analysis to IC engines and describe combustion phenomena In spark ignition and compression ignition engines

CO2: Describe the working of major systems used in conventional and modern engines

CO3: Summarize the methods used to improve engine performance and estimate Performance parameters

CO4: Describe engine emission control techniques and implement viable alternate fuels

CO5: Describe Fluidization fundamentals, combustion in bubbling bed, atmospheric fluidized bed combustion systems.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO-PO MAPPING: CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M	-	S	-	-
CO2	S	S	S	S	S
CO3	W	S	S	S	W
CO4	-	-	S	S	S

ASSESSMENT METHOD:

DIRECT		**INDIRECT**	
1	Internal Test	**1.**	Student exit survey
2	Assignment	**2.**	Faculty Survey
3	Seminar	**3.**	Industry
4	Online Test	**4.**	Alumni
5	End Semester Exam		

UNIT I CHEMICAL REACTIONS 9

Fuels and combustion, Theoretical and actual combustion processes, Enthalpy of formation and enthalpy of combustion, First law analysis of Reacting systems, Adiabatic flame temperature, Entropy change of reacting systems, Second law analysis of reacting systems, problems

UNIT II COMBUSTION OF GASEOUS AND VAPORIZED FUELS 9

Review of types of fuels, Types of flames, Energy balance and furnace efficiency, Burner type, Emissions from gas-fired furnaces, Emissions control, Chamber design, Detonation

UNIT III COMBUSTION OF LIQUID FUELS 9

Spray combustion in furnace, spray formation and droplet behaviour, Gas turbine operating parameters, combustor design, ignition delay, and detonation of liquid fuel sprays

UNIT IV COMBUSTION OF SOLID FUELS 9

Drying of solid fuels, devolatilization of solid fuels, stoker-fired boilers, Refuse and biomass fired boilers, Pulverized coal-burning systems, Pulverized coal combustion, Emission from pulverized coal, Problems

UNIT V FLUIDIZED BED COMBUSTION 9

Fluidization fundamentals, combustion in bubbling bed, atmospheric fluidized bed combustion systems, are circulating fluidized beds, pressurized fluidized bed combustion, problems.

References:

1. *Gary.L.Borman, Combustion Engineering-McGraw Hill international Edition,1998*
2. *Roger.A.Strehlow-Combustion fundamentals- McGraw Hill international Edition,1989*
3. *Yunus.A.Cengel-Thermodynamics-International edition,2006*

TOTAL NO. OF PERIODS: 45

MTE E13 NEW AND RENEWABLE SOURCES OF ENERGY 3 0 0 3

Course objectives:

The course is intended to

- Provide a fundamental treatment of fluid flows controlled by viscous or turbulent stress gradients and the subsequent heat transfer between fluids and solid surfaces.
- Provide analytical solutions to the momentum and energy conservation equations for both laminar and turbulent flows will be considered.
- Provide solid foundation for the engineering practitioner engaged in single phase convective thermal transport.
- Provide solid foundation for further studies in multiphase convective transport.

Course Outcomes:

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

CO1: Identify the renewable energy sources and their utilization

CO2: Understand the basic concepts of the solar radiation and analyze the solar Thermal systems for their utilization

CO3: Understand the principle of working of solar cells and their modern Manufacturing techniques

CO4: Understand the concepts of the ocean thermal energy conversion systems and their applications

CO5: Outline the methods of energy storage and identify the appropriate methods of Energy storage for specific applications

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak					
CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	M	M
CO2	M	S	M	M	S
CO3	M	S	M	M	W
CO4	M	S	W	M	W
CO5	M	S	M	M	W

ASSESSMENT METHOD:

DIRECT		**INDIRECT**	
1	Internal Test	**1.**	Student exit survey
2	Assignment	**2.**	Faculty Survey
3	Seminar	**3.**	Industry
4	Online Test	**4.**	Alumni
5	End Semester Exam		

UNIT I WIND ENERGY 9

Introduction-Location of Wind Generators-Types of Windmills-Induction and Synchronous Systems

UNIT II SOLAR ENERGY 9

Principle of Conversion of Solar Radiation into Heat, Types of Solar Thermal Collectors- Flat Plate and Concentrating Collectors (Parabolic, Trough, Minor Strip, Fresnel Lens and Compound

Parabolic Concentrator), Comparison of Collectors, Selective Absorber Coatings, Solar Thermal Power Plant

UNIT III SOLAR ENERGY STORAGE AND APPLICATION 9

Solar energy storage systems- thermal, electrical, chemical, mechanical and electromagnetic, solar pond. Application of solar energy- solar thermoelectric conversion- solar photo voltaics, solar heating and cooling of buildings, solar distillation, solar pumping and solar cookers. System of solar cell power plant- direct grid connection through electronic control devices

UNIT IV BIO- MASS 9

Sources Of Bio-Mass Energy- Wood And Agricultural Waste- Municipal Waste- Animal Waste- Energy Conservation Systems- Biogas Generation From Animal Waste- Wood Gasification- Downdraft And Fluidized Bed Systems- Alcohol Fuels

UNIT V OTHERSOURCES 9

Wave Energy- Scope and Simple Systems for Power Generation, Tidal Power- Scope and Applications, Otec-Scope, Fundamental Principles and Operating System for Power Generation

References:

1. *David M.Eggleston and Forrest S.Stoddard,Wind Turbine Engineering Designing- Van Noustrand 1987*
2. *Rai,G.D. Non – Conventional Sources of Energy, Khanna publications, 4th edition 2004*
3. *Le Gouries.D, Wind Power Plants, Theory and Design –permagon press,1982.*
4. *F.S.seiler, Alternate Energy Vehicle Information, Wind Book Inc.,1977*
5. *Barbara Keiler, Energy Alternatives,Luscentr Books,1990*
6. *T.Nejat Veziroygal, Alternative Energy Sources-III,Hemisphre Publishing co.,1989.*

TOTAL NO OF PERIODS-45

RESEARCH METHODOLOGY

Objectives

- To Get adequate knowledge about research concepts
- To describe mathematical modeling and simulation
- To understand experimental modeling
- To get knowledge about the interpretation of result

Course Outcomes after successful completion of this course, the students should be able to

CO 1: To describe research concepts.

CO 2: To Get adequate knowledge about mathematical modeling

CO 3: To describe experimental modeling

CO 4: To understand analysis of results.

CO 5: To know about report writing

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak							
COs	Programme Outcomes(POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M				M	M
CO2	S	M				M	M
CO3	S	M				M	M
CO4	S	M				M	M
CO5	S	M				M	M

ASSESSMENT METHOD:

DIRECT		**INDIRECT**	
1	Internal Test	**1.**	Student exit survey
2	Assignment	**2.**	Faculty Survey
3	Seminar	**3.**	Industry
4	Online Test	**4.**	Alumni
5	End Semester Exam		

1. RESEARCH CONCEPTS 9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of

Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION 9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3 EXPERIMENTAL MODELING 9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4 ANALYSIS OF RESULTS 9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5 REPORT WRITING 9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis", Himalaya Publication.
2. Schank Fr.,"Theories of Engineering Experiments", Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, "Design of Experiments", Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, "Statistical Quality Control: An Introduction for Management", Reinhold Pub Corp, 1959.

3. Cochran and Cocks, „Experimental Design", John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education", PHI Publication.
5. Adler and Granovky, "Optimization of Engineering Experiments", Meer Publication.
6. S. S. Rao, „Optimization Theory and Application", Wiley Eastern Ltd., New Delhi, 1996.