## M.TECH.(TE) - COURSE STRUCTURE

### I-SEMESTER

| Code No. | Name of the Subject | Contact hours/ week | | Credits | Scheme of Valuation | | Total Marks |
|---|---|---|---|---|---|---|---|
| | | L+T | P | | Internal | External | |
| MTME101 | Mathematical Methods in Engineering | 4 | -- | 3 | 40 | 60 | 100 |
| MTME102 | Advanced Thermodynamics | 4 | -- | 3 | 40 | 60 | 100 |
| MTME103 | Advanced Heat & Mass Transfer | 4 | -- | 3 | 40 | 60 | 100 |
| MTME104 | Advanced IC Engines | 4 | -- | 3 | 40 | 60 | 100 |
| | **ELECTIVE – I** | 4 | -- | 3 | 40 | 60 | 100 |
| MTME1051 | Advanced Fluid Mechanics | | | | | | |
| MTME1052 | Industrial and Automobile Pollution | | | | | | |
| MTME1053 | Fuels and Combustion | | | | | | |
| | **ELECTIVE – II** | 4 | -- | 3 | 40 | 60 | 100 |
| MTME1061 | Advanced Power Plant Engineering | | | | | | |
| MTME1062 | Turbo Machinery | | | | | | |
| MTME1063 | Finite Element Method for Thermal Engineering | | | | | | |
| MTME151 | Advanced Thermal Engineering Lab | -- | 3 | 2 | 25 | 50 | 75 |
| MTME152 | Technical Seminar | -- | 3 | 2 | 75 | - | 75 |
| | TOTAL | | | 22 | 340 | 410 | 750 |

LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNA DT, A.P.

**II-SEMESTER**

| Code No. | Name of the Subject | Contact hours/ week | | Credits | Scheme of Valuation | | Total Marks |
|---|---|---|---|---|---|---|---|
| | | L+T | P | | Internal | External | |
| MTME201 | Measurements in Thermal Engineering | 4 | -- | 3 | 40 | 60 | 100 |
| MTME202 | Refrigeration and Cryogenics | 4 | -- | 3 | 40 | 60 | 100 |
| MTME203 | Computational Fluid Dynamics | 4 | -- | 3 | 40 | 60 | 100 |
| MTME204 | Design of Thermal Systems | 4 | -- | 3 | 40 | 60 | 100 |
| | **ELECTIVE - III** | 4 | -- | 3 | 40 | 60 | 100 |
| MTME2051 | Energy Conservation and Management | | | | | | |
| MTME2052 | Gas Dynamics | | | | | | |
| MTME2053 | Convective Heat & Mass Transfer | | | | | | |
| | **ELECTIVE – IV** | 4 | -- | 3 | 40 | 60 | 100 |
| MTME2061 | Jet and Rocket Propulsion | | | | | | |
| MTME2062 | Renewable Energy Technology | | | | | | |
| MTME2063 | Optimization Methods in Engineering | | | | | | |
| MTME251 | Computational Methods Lab. | -- | 3 | 2 | 25 | 50 | 75 |
| MTME252 | Mini Project | -- | 3 | 2 | 75 | -- | 75 |
| | TOTAL | | | 22 | 340 | 410 | 750 |

**III & IV SEMESTERS**

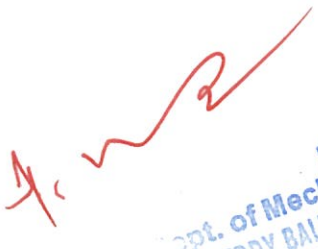
| Subject code | Name of the Subject | Contact hours/week | | Credits | Scheme of Valuation | | Total Marks |
|---|---|---|---|---|---|---|---|
| | | L+T | P | | Internal (CIE) | External (SEE) | |
| MTME351 | Dissertation | | | 40 | 50 | 150 | 200 |
| | Total | | | 40 | 50 | 150 | 200 |

LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521230., KRISHNA DT, A.P.

# I SEMESTER


LBRCE
EXAMINATION SECTION




HEAD
Dept. of Mechanical Engineering
LBREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM - 521 230., KRISHNA DT, A.P.

## MTME101 - MATHEMATICAL METHODS IN ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs. |

---

**UNIT - I**

**Solution of Simultaneous Linear Algebraic Equations:** Introduction, Gauss Elimination Method, Gauss-Jordan method to find inverse, LU Decomposition Method, Gauss-Jacobi Iteration Method, Gauss-Seidel Iteration Method, Simultaneous Linear Equations, Homogeneous Equations.

**UNIT - II**

**Solution of Matrix Eigen value Problem:** Introduction, Conversion of General Eigen value Problem to Standard Form, Finding Eigen value using Power Method, Solution of the Characteristic Polynomial Equations, Cayley Hamilton Theorem

**UNIT - III**

**Numerical Differentiation:** Introduction, Definition of the Derivative, Basic Finite-Difference Approximations, Difference Operators, Approximation of Derivatives Using Difference Operators.

**Numerical Integration:** Introduction, Trapezoidal rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Weddle's Rule, Romberg Integration.

**UNIT - IV**

**Differential Equations:** Finite Difference Method and Boundary Value Problems, Solving Partial Differential Equations using Method of Separation of Variables.

**UNIT – V**

**Solution of Partial Differential Equations by Numerical Methods:** Classification of Partial Differential Equations, Solving of Elliptic (Standard 5-point formula, Diagonal 5-point formula), Parabolic (Bender Schmidt, Crank Nicolson Method) and Hyperbolic (implicit and explicit) Equations using finite difference method.

**TEXT BOOKS:**


1. Dr. B.S. Grewal , "Higher Engineering Mathematics", Khanna Publishers.42nd edition
2. E. Ward Cheney, David R. Kincaid, "Numerical Methods and Applications" Cengage Learning, 2010.
3. S. S. Sastry, "Introductory Methods of Numerical Analysis". Prentice Hall of India, 5th Edition, 2005.


**REFERENCES:**


1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical methods for scientific and engineering computation, New Age international publication 5th ed., 2007.
2. Francis Scheid , Numerical Analysis , Schaum`s Series,1999 (2nd edition)
3. M.R.Spiegel , Advanced Mathematics for Engineers & Scientists, Mc.graw Hill publishers, New Delhi, 2010.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM - 521 230., KRISHNA DT, A.P.

## MTME102 - ADVANCED THERMODYNAMICS

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs. |

---

**UNIT - I**

**BASIC CONCEPTS:** Thermodynamics - Temperature and Zeroth law of thermodynamics - First law of thermodynamics-Applications - Limitations of first law - Concept of internal energy - Second law of thermodynamics-Applications - concept of entropy-Third law of Thermodynamics.

**UNIT - II**

**THERMODYNAMIC RELATIONS :** Introduction – Reciprocity and cyclic relations – The Maxwell's relations – The Gibbs and Helmholtz relations - The Clapeyron Equation – Applications, Joule –Kelvin effect ,General relations for du, dh, ds - Co-efficient of volumetric expansion - Isothermal compressibility-Applications.

**EXERGY:** Introduction – Energy transfer by heat, work and mass - Availability of a closed system - Availability function of the closed system - Availability of steady flow system - Availability function of open system- Applications.

**UNIT - III**

**IRREVERSIBILITY:** Introduction - Irreversibility for closed and open system - Steady flow process – Effectiveness-Applications

**THERMODYNAMICS OF COMPRESSIBLE FLOW:** Introduction - Stagnation properties, Speed of Sound and Mach number, 1-D Isentropic flow and property relations for isentropic flow for perfect gases-Applications.

**UNIT – IV**

**NON REACTIVE GAS MIXTURES:** Introduction - Basic definitions for gas mixtures - PVT relationship for mixtures of ideal gases - Properties of mixtures of ideal gases - Entropy change due to mixing - Mixtures of perfect gases at different initial pressure and temperatures -Applications.

**REACTIVE GAS MIXTURES**: Introduction- Fuels and Combustion-theoretical and actual combustion processes- Enthalpy of formation and Enthalpy of reaction- First and Second law analysis of reacting systems- Applications.

**UNIT – V**

**VAPOR POWER CYCLES**: - Second law analysis of vapor power cycles, Cogeneration, Binary vapor cycles, combined gas and vapor power cycles-Applications.

**GAS POWER CYCLES:** - Ideal jet propulsion cycles -Modifications to Turbo jet engines- Second law analysis of gas power cycles-Applications.

LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNA DT, A.P.

**REFERENCES:**


1. Sonntag, Borgnakke, Van Wyllan, Fundamentals of Thermodynamics: 5th Edition John Wiley and Sons, 2010.
2. Yunus A.Cengel & Michael Boles, Thermodynamics (An Engineering Approach) 7th Edition 2011, TMH
3. E.Rathakrishnan, Fundamentals of Engineering Thermodynamics: 2nd Edition, EEE, PHI Publishers, 2010.
4. P.K.Nag, Engineering Thermodynamics: 4th Edition 2008, TMH
5. J.P.Holman, Thermodynamics, 9th Edition, 2012, TMH


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LBR.REDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNA DT, A.P.

## MTME103 - ADVANCED HEAT AND MASS TRANSFER

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs. |

---

**UNIT-I**

**INTRODUCTION**: Brief introduction to different modes of Heat transfer- General heat conduction equation for plane, cylinder, sphere – Boundary conditions – Steady simplified heat transfer in Cartesian coordinates –1-D Heat transfer with internal heat generation. Finned surfaces.

**UNIT-II**

**TRANSIENT HEAT CONDUCTION**: Lumped system analysis – Heisler charts – Semi infinite solid – Product solution- 2-D Steady state heat conduction – Use of conduction shape factors- - Transient heat conduction – Analytical solution- Finite Difference methods for Heat Conduction Problems- 1-D & 2-D Steady state and Unsteady heat conduction – Implicit and Explicit methods.

**UNIT-III**

**FORCED CONVECTION**: Concept of boundary layer- Hydrodynamic and Thermal boundary layer concepts-Equations of Motion and Energy-Methods to determine heat transfer coefficient- Dimensional Analysis –Importance of Non – Dimensional numbers –Analogies between Heat and Momentum Transfer-External flows and integral methods for flow over a flat plate-Application of empirical relations to various geometrics.

**FREE CONVECTION**: Dimensionless parameters of Free convection-An approximate analysis of Laminar Free Convection on a flat vertical plate-Free convection on a horizontal plate, Cylinder and Sphere- Combined free and forced convection.

**UNIT-IV**

**BOILING AND CONDENSATION**: Boiling curve – Correlations – Nusselt's theory of film condensation on a flat vertical plate – Assumptions & correlations of film condensation for different geometrics.

**RADIATION**: Concept of view factor- Methods of determining view factors-Radiant heat exchange in Grey, Non- Grey bodies with Transmitting, Reflecting and Absorbing media-Specular surface, Gas radiation –Radiation from flames.

**UNIT – V**

**MASS TRANSFER**: Introduction- Analogy between heat and mass transfer-Mass diffusion-Fick's law of diffusion-Boundary conditions-Steady mass diffusion through a wall-Mass convection-Analogy between friction, Heat transfer and Mass transfer coefficients-Significance of Non – dimensional numbers.

**REFERENCE BOOKS:**


1. Necati Ozisik, Heat Transfer –TMH, 1985
2. Yunus Cengel, Heat Transfer A Practical Approach –TMH, 2012
3. J.P.Holman,Heat Transfer – TMH, 2010
4. P.K Nag, Heat & Mass Transfer TMH
5. Incropera, F. P. and De Witt, D. P., Fundamentals of Heat and Mass Transfer, 5th Edition, John Wiley & Sons, New York, 2006.

## MTME104 - ADVANCED IC ENGINES

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs. |

### UNIT - I

**Engine Types and Their Operation:**
Introduction and Historical perspective – Engine classifications - Engine components – Two stroke and four stroke engines , comparison of Two stroke and four stroke engines – S.I. Engine operation – C.I. Engine operation, comparison of S.I Engines and C.I Engines ,applications of I.C engines, Engine design and operating parameters ,First law analysis of engine cycle-energy balance.
**SUPERCHARGING**: Supercharging and scavenging of I.C. engines, supercharging limits.
**TURBOCHARGING**: Turbo charging – Turbo charging methods

### UNIT – II

**Modern Developments in I.C. Engines:**
Lean burn engines, ceramic and adiabatic engines, working principle of dual fuel engines, factors affecting the combustion in dual fuel engines, MPFI engines – operation, engines characteristics of multi fuel engines. Introduction to working of stratified charged engines, Wankel engine, working principle of Wankel engine. Features of rotary engines. Variable compression ratio engines, theoretical analysis, methods of obtaining variable compression ratio. Surface ignition engines, free piston engines, EGR, homogeneous charge combustion engines

### UNIT – III

**Combustion in Spark – Ignition Engines:**
Introduction – Stages of combustion in SI Engine - Flame front propagation– Factors influencing flame speed - Rate of pressure rise – Analysis of cylinder pressure data – Heat release analysis - Cyclic variations in combustion, partial burning and misfire – Abnormal combustion and knocking – Effects of detonation - Effect of engine variables on detonation – SI Engine combustion chamber design principles – Types of combustion chambers
**Combustion in Compression – Ignition Engines:**
Introduction – Stages of combustion in CI Engine – Ignition delay – Factors effecting ignition delay – Knocking in CI Engine – Factors affecting knocking - Types of Diesel Combustion systems – Direct injection systems - Indirect injection systems, comparison of combustion Systems - Combustion in direct injection multi spray – Analysis of cylinder pressure data - Heat release analysis.

### UNIT –IV

**Performance of IC Engines and Alternate fuels**
Introduction - Parameters of performance – Engine performance characteristics – variables affecting performance characteristics - Pressure- Volume measurement and combustion Analysis performance test – heat balance test problems

**Alternate Fuels:** Necessity of Alternative fuels – Biodiesels-Transesterification process – Use of Alcohols – Gaseous fuels -CNG – LPG – Hydrogen and Biogas.

**UNIT – V**

**Pollutant Formation and Control:**
Nature and extent of problem-Pollution Norms- Types of pollutants-Nitrogen Oxides – Carbon Monoxide – Unburned Hydrocarbons – Particulate Emissions – Measurement of Emissions – Oxides of Nitrogen, carbon monoxide, Unburned Hydrocarbons and smoke – Exhaust gas treatment – Catalytic converters – Thermal reactors – Particulate traps.

**REFERENCES**


1. John. B.Heywood, "Internal Combustion Engine Fundamentals" Mc Graw -Hill
2. Obert E.F, Harper and Row "Internal Combustion Engine and Air Pollution"
3. V.Ganesan, "Internal Combustion Engines" Tata Mc Graw-Hill.
4. Maleeve V.L, "Internal Combustion Engines" Mc Graw -Hill Book Company
5. Mathur & Sharma, "Internal Combustion Engines" Dhanpat Rai Publishers.
6. Colin R.Ferguson, Allan T.Kirkpatrick, "Internal Combustion Engines", John-Wiley &Sons.
7. Obert, E. F., Internal Combustion Engines and Air Pollution, Harper and Row Publishers, New York,1973.
8. Yadav, R., I. C. Engines and Air Pollution, Central Publishing House, 2002.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.

## MTME1051 - ADVANCED FLUID MECHANICS

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs. |

---

**UNIT-I**

**BASIC CONCEPTS :** Continuum hypothesis –Eulerian and Lagrangian descriptions. Derivation of general differential equations –continuity momentum and energy of incompressible flow-Navier Stokes equation for Viscous Fluids (Rectangular Coordinate Systems)-Euler□s equations for ideal fluids-Bernoulli□s equations (one dimensional) – applications.

**LAMINAR FLOW VISCOUS INCOMPRESSIBLE FLUIDS:** Flow similarity –Reynolds number, flow between parallel flat plates, coquette -flow, plane Poiseuille flow, Hagen – Poiseuille flow.

**UNIT-II**

**LAMINAR BOUNDARY LAYER:** Boundary layer concept, Prandtl's approximations, Blassius solution for a flat plate without pressure gradient –momentum integral equation – Von-Kerman integral relation –Pohlhausen method of obtaining approximate solutions. Displacement thickness, momentum thickness and energy thickness. Boundary layer separation and control. Kerman integral equation.

**UNIT-III**

**INTRODUCTION TO TURBULENCE:** Origin of turbulence, nature of turbulent flow – Reynolds equations and Reynolds stresses, velocity profile.

**COMPRESSIBLE FLUID FLOW BASICS:** Mach number, Flow pattern in compressible flow, classification of compressible flow, isentropic flow, stagnation properties.

**UNIT-IV**

**GAS DYNAMICS:** Compressible flow through duct and nozzles –area velocity relations. Flow through convergent and convergent divergent nozzles. Real nozzles flow at design conditions. Introduction to normal compression shock –normal shock relations. Introduction to Fanno and Raleigh equations.

**UNIT-V**

**FLOW IN DUCTS WITH FRICTION:** Fanno line, adiabatic constant area -Flow of perfect gas, chocking due to friction in constant area flow -Introduction to constant area flow with heat transfer (Raleigh line).

**REFERENCES:**


1. "Foundations of Fluid Mechanics", Yuan S.W- Prentice Hall –Eastern economy edition 1983.
2. "Fundamentals of Compressible Flow", -Yahya S.M- Wiley Eastern
3. " Gas Dynamics", Zucrwo M.J. and Hoffman J.D.Vol-I & Vol -II, John Wiley and Sons Inc. 1977.
4. "A Brief Introduction to Fluid Mechanics" Young, Munsen and kiisyi, 2ndEdition, John Wiley 2000.
5. "Fluid Mechanics Frank.M.White 5thEdn –McGraw Hill 2005.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNA DT, A.P.

## MTME1052 - INDUSTRIAL AND AUTOMOBILE POLLUTION

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs. |

---

**UNIT - I**

**INTRODUCTION TO POLLUTION:** Types of pollutants, Greenhouse effect, Ozone depletion, Pollution of air, water and soil, Effect of pollution on living systems, Minimum national standards.

**AIR POLLUTION**: Sources and classification of pollutants, Effect of air pollution, Pollution from industries, Chemical reactions in a contaminated atmosphere, urban air pollution, Acid rain, Photo chemical smog, Meteorological aspects of air pollution.

**WATER POLLUTION AND CONTROL:** Origin of waste water, Types of water pollutants and their effects, Water pollution laws and standards, Waste water sampling and analysis, Treatment of waste water.

**UNIT - II**

**POLLUTION FORMATION AND CONTROL IN SI ENGINES**

**Emission Formation-**Mechanism of HC and CO formation in four stroke and two stroke SI engines, $NO_x$ formation in SI engines, Emissions as a function of Equivalence ratio, Effects of design and operating variables on SI engine emissions.

**Control-**Thermal Exhaust After treatment, Catalytic Exhaust After treatment, Types of Catalytic convertor, Gasoline Direct Injection Stratified Charge (DISC) engines, On-Board Diagnostic (OBD) systems.

**UNIT - III**

**POLLUTION FORMATION AND CONTROL IN CI ENGINES**

**Emission Formation-**HC and $NO_x$ formation in CI engines, Smoke and particulate emissions in CI engines, Emissions as a function of Equivalence ratio, Effects of design and operating variables on CI engine emissions.

**Control-**Exhaust Gas Recirculation, Diesel oxidation catalysts, Diesel de-$NO_x$ catalysts, Selective catalytic Reduction (SCR), Diesel Particulate filters (DPF).

**UNIT - IV**

**EMISSION TEST PROCEDURES**

Test cycles-Test cycles for Light and Medium and Heavy duty vehicles, Test procedure for Evaporative Emissions, Emission Norms (Bharat stage and EURO emission Norms) for Light and Heavy duty vehicles.

**EMISSION TEST MEASURMENTS**

Emission Measurement-NDIR Analyzers, Chemiluminescence Analyzer, Oxygen Analyzer, Smoke Measurement, Constant volume sampling, Particulate Emission Measurement.

LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNA DT, A.P.

**UNIT - V**

**NOISE POLLUTION**

Physical Acoustics, Levels and spectra, Character of Noise, Sound propagation, Sound measurement and Analysis.

**NOISE POLLUTION CONTROL**

Noise Control Methods-Acoustic Materials, Acoustical Enclosures, Active Noise control in silencers and Mufflers, Reverberation control, Vibration control.

**REFERENCE BOOKS:**


1. C.S.Rao "Environmental pollution control engineering" Wiley Eastern Limited, India, 2006.
2. B.P.Pundir, Engine Emissions, First Edition, Narosa Publishing House, 2010.
3. Lewis H.Bell and Douglas H.Bell, Industrial Noise control, Second edition, Marcel Dekker, INC, 1994.
4. Crouse William, Automotive Emission control, First edition, Mc Graw-Hill, 1980.
5. George springer and Donald J Patterson, Pollutant formation and measurement, First edition, Plenum press, 1972.
6. Noel de Nevers, Air Pollution and Control Engineering, McGraw Hill, 2010.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.

## MTME1053 - FUELS AND COMBUSTION

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs. |

---

**UNIT – I**

**FUELS:**

Detailed classification – Conventional and Unconventional Solid, Liquid, gaseous fuels and nuclear fuels – Origin of Coal – Analysis of coal. Coal – Carbonisation, 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. 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 behaviour of HC's.

**UNIT – III**

**THERMODYNAMICS OF COMBUSTION**:

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

**UNIT – IV**

**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 – V**

**ENVIRONMENTAL CONSIDERATIONS**:

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

**REFERENCES:**


1. Rao Y. V. C., An Introduction to Thermodynamics, University Press, 2009
2. Sharma, S. P., Fuels and Combustion, Tata McGraw Hill, New Delhi, 2001
3. Shaha A.K, Combustion Engineering and Fuel Technology /./ Oxford and IBH.
4. Benson, R. S. and Whitehouse, M. D., Internal Combustion Engines, Vol. I, Pergamon Press, 2002.
5. Stephen R. Turns, An Introduction to Combustion, McGraw Hill International Edition.
6. Gary L. Berman & Kenneth W. Ragland Combustion Engineering McGraw Hill International Edition.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM - 521 230., KRISHNA DT, A.P.

## MTME1061 - ADVANCED POWER PLANT ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT - I**

**INTRODUCTION**-Sources of Energy, Types of power plants, Direct energy conversion system, Recent developments in power generation, Combustion of coal, liquid and gaseous fuels, Volumetric analysis, Gravimetric analysis.
**ECONOMICS OF POWER GENERATION:** Factors affecting the economics, Load factor, Utilization factor, Performance and operating characteristics of Power plants-Economic load sharing, Depreciation-Energy rates-Specific economic energy problems.

**UNIT - II**

**STEAM POWER PLANTS**: Introduction-General layout of Steam Power Plant, Power Plant Cycles, Fuel Handling, Combustion Equipment, Ash handling, Dust Collectors- ESP, bag houses.
**GAS POWER GENERATION**: Operating Principle; Classification – Open Cycle, Closed Cycle, Analysis of GT plant, Fuels for Gas Turbine Power Plants, Advantages and Limitations.

**UNIT - III**

**COMBINED CYCLE POWER GENERATION USING GAS TURBINES** : Types-Working-Cogeneration, Combined Cycle with Gas Production from coal (IGCC Power Plants), combined cycles using PFBC-system, advantages of combined cycles, Performance of Combined cycle, Future of Combined Cycle
**WASTE HEAT RECOVERY SYSTEMS:**- Introduction, Sources of Waste Heat and Their Grading, Thermodynamic Cycles for Waste Heat Recovery, Recovery forms and Methods, Other uses of Waste Heat

**UNIT - IV**

**PRINCIPLES OF NUCLEAR ENERGY**: Introduction-Atomic structure – Chemical and Nuclear equations – Energy from Nuclear reactions – Nuclear Fission and Fusion – Energy from fission and fuel burn up.
**NUCLEAR POWER PLANTS**: Nuclear Reactors-Classification-Types of Reactors, Site selection, Methods of Enriching Uranium- Applications of Nuclear Power Plants.
Nuclear Power Plant Safety: Bi-Products of Nuclear Power Generation-Nuclear Waste Disposal-Future of Nuclear power.

**UNIT - V**

**POWER PLANT INSTRUMENTATION**: Classification-Pressure measuring Instruments types-mechanical, electrical. Temperature measurement, Types- expansion thermometers, pressure thermometers, thermocouple, RTD, radiation and optical pyrometers. Flue gas analysis-Orsat apparatus.

**POLLUTION:** Air pollution, Water pollution -Methods to control pollution. Acid rain & Acid fog.

**REFERENCES**


1. M.M. EI. Wakil Power Plant Engineering — McGraw Hill, 1985.
2. Arora, S. C. and Domkundwar, S., Power Plant Engineering, Dhanpat Rai & Sons, 2012.
3. P.K. Nag Power Plant Engineering –-TMH
4. Sharma, P.C., Power Plant Engineering, S. K. Kataria & Sons, 2010.
5. Glasstone, S. and Sesonske, A., Nuclear Reactor Engineering: Reactor Design Basics, Vol. I & II, CBS Publishers & Distributors Pvt. Ltd, 2004.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering

## MTME1062 - TURBO MACHINERY

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT- I**

**INTRODUCTION**: Types of Turbo machines, Applications of Turbo machines, Performance Characteristics, Methods of Analysis

**DIMENSIONAL ANALYSIS**: Dimensions and Dimensional Homogeneity, Buckingham Pi Theorem, Other Non-dimensional Parameters for Turbo machines, Similarity Laws

**ENERGY TRANSFER IN TURBO MACHINES**: Review of Fluid Mechanics related to Turbo machinery, Energy in Flowing Fluids, Euler Equations, Equations for Axial Flow Machines, Equations for Mixed and Radial Flow Machines. Degree of Reaction, Applications of Turbo Machines.

**UNIT-II**

**CENTRIFUGAL PUMPS**: Classification and Basic Construction, Basic Working Principles, Performance Characteristics, Cavitation, Performance Modifications, Preliminary Design Procedure, Pump Performance Tests.

**FLOW PUMPS AND FANS**: Introduction, Flow over Isolated Airfoils, Axial Flow Cascade, Preliminary Design Procedure, and Propellers –Applications of Pumps, fans and Blowers

**UNIT- III**

**CENTRIFUGAL FANS BLOWERS AND COMPRESSORS**: Classification- Performance Parameters and Characteristics Change of Performance, Polytropic Efficiency and Preliminary Design of Centrifugal Compressors.

**AXIAL FLOW COMPRESSORS**: Introduction. Basic Theory, Preliminary Design of Compressor Stage, Determination of Stage Efficiency, Axial Flow Compressor Performance, Surge and Stall in Compressor and the Remedies –Various Compressor Applications.

**UNIT- IV**

**GAS TURBINES**:

Introduction, Thermodynamics of Axial Flow Turbine, Degree of Reaction, Preliminary Design Procedure for Turbine Stage, Determination of Turbine Stage Efficiency, Axial Flow Turbine Performance, Compressor, Turbine Matching, Radial Inflow Gas Turbine, Thermodynamic Processes in Radial Inflow Gas Turbine , Applications of Gas Turbines.

**UNIT- V**

**WIND TURBINES**:

Introduction, Types of Wind Turbines, Wind Turbines Characteristics, Actuator Theory, and Design Analysis of wind Turbines, Variable Speed Performance of Wind Turbines, and Wind Turbine Applications.

**REFERENCE BOOKS:**


1. William W Perg, Fundamentals of Turbo machinery: John Wiley & Sons, Inc.
2. Nicholas Cumpsty, Compressor Aerodynamics, 2004, Kreiger Publications, USA
3. D. G. Shepherd, Principles of Turbo Machinery, The Macmillan Company
4. Cohen, H., Rogers, G F C and Saravanmotto, H I H, Gas Turbine Theory, John Wiley, 5th Edition 2001.H.I.H Longman Group Ltd.
5. Dixon, Fluid Mechanics, Thermodynamics of Turbo machinery, Pergamon Press.
6. Ahmed F. El-Sayed; Aircraft Propulsion and Gas Turbine Engines; CRC press, 2008.

## MTME1063 - FINITE ELEMENT METHOD FOR THERMAL ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT - I**

**BASIC CONCEPTS**: Introduction to Finite Element Method - historical back ground-engineering applications of FEM- general description- basic element shapes-finite element modeling-numbering scheme-element connectivity-coordinates-interpolation functions-properties-Pascal triangle-Pascal pyramid-material properties considered in FEM-types of analysis.

**UNIT - II**

**ONE DIMENSIONAL FLUID FLOW ANALYSIS**: Steady flow of viscous incompressible fluids through circular pipes-relationship between pipe resistance, pressure and volume rate of flow-simple hydraulic pipe network problems.
**STEADY STATE HEAT TRANSFER ANALYSIS**: One dimensional steady state heat conduction- Governing equation- boundary conditions-one dimensional element-B matrix-conductivity matrix-heat rate vector-composite wall problems.

**UNIT - III**

One Dimensional Heat Transfer in Thin Fins, Governing equation- Element conductivity matrix-Convection matrix-Heat rate vector-Global matrices-boundary conditions-temperature distribution in thin fins-cylindrical pin fin, heat loss from fins, Introduction to one dimensional transient heat conduction, element matrices for one dimensional unsteady state heat conduction-element capacitance matrix-element conductance matrix-transient temperature distribution

**UNIT - IV**

**TWO DIMENSIONAL STEADY STATE HEAT CONDUCTION**: Governing equation-boundary conditions-Triangular element-Jacobian matrix- B matrix- element conductivity matrix- heat rate vector- problems
**NUMERICAL INTEGRATION**: Gauss Quadrature formula-sampling points and weights-Gauss Quadrature for one dimension and two dimensions-sampling points for a 2X2, 3X3 and 2X3 Gauss Quadrature rule-problems.

**UNIT - V**

**MESH GENERATION & FEM SOFTWARE**: Convergence requirements- mesh generation using Tesselation method, Quadtree method and Octree method- Mesh refinement-h, p, x and r refinements- band width- pre processor- solution- post processor-Use of software.

LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM - 521 230, KRISHNA DT, A.P.

**REFERENCES**


1. Reddy, J. N. and Gartling D. K., The Finite Element Method in Heat Transfer and Fluid Dynamics, 3rd Edition, CRC Press, 2010.
2. Rao, S. S., The Finite Element Method in Engineering, 5th Edition, Elsevier 2011.
3. Tirupathi R. Chandrupatla, Ashok D Belegundu, Introduction to Finite Elements in Engineering Prentice- Hall India.
4. Robert Cook. Concepts and Applications of Finite Element Analysis, John Wiley & Sons.
5. Nithiarasu, P., Seetharamu, K. N. and Lewis, R. W., The Finite Element Method for Heat Transfer Analysis, John Wiley and Sons, 2004.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM - 521 230, KRISHNA DT. A.P.

## MTME151 - ADVANCED THERMAL ENGINEERING LAB

| | | | | | |
|---|---|---|---|---|---|
| Lab/Practical | : | 3 Periods / Week | Internal Marks | : | 25 |
| Tutorial | : | 0 Period / Week | External Marks | : | 50 |
| Credits | : | 2 | External Examination | : | 3 hrs |

---

### List of Experiments

At least 10 Experiments are required to be conducted.

1. Performance test on single cylinder 4-Stroke diesel Engine by using rope brake dynamometer.
2. Performance Test on Variable Compression Ratio on single cylinder 4-Stroke petrol Engine By using Eddy Current Dynamometer
3. Performance test on PC based diesel engine test rig.
4. Emission analysis of single cylinder 4-Stroke diesel Engine by using rope brake dynamometer.
5. Performance test on VCR System.
6. Performance test on Multi stage Air Compressor unit.
7. Performance test on Air conditioning unit.
8. Performance analysis of heat pipe.
9. Determination of thermal conductivity of composite material.
10. Critical Heat Flux Apparatus
11. Shell and Tube Heat Exchanger.
12. Counter Flow Heat Exchanger.
13. Combustion analysis of computer aided CI engine test rig.
14. Preparation of Heat Balance sheet on Twin cylinder 4 stroke diesel engine with electrical rheostat.

**REFERENCES**

Lab Manuals

LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNA DT, A.P.

# II SEMESTER

## MTME201 - MEASUREMENTS IN THERMAL ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT-I**

**TEMPERATURE MEASUREMENT**: Introduction, Pressure thermometers, Thermocouples- Measurement of Thermal EMF- RTD, Thermisters,- Total radiation Pyrometry –Errors resulting from conduction and Radiation-Measurement of Temperature in rapidly moving gas-Measurement of Heat Flux.

**UNIT-II**

**PRESSURE MEASUREMENT TECHNIQUES**: Introduction, Barometers, Manometers, Dial type pressure gauge, Pressure Transducers, Pitot, Static, and Pitot-Static Tube and Its characteristics, Flow direction measurement probes and Low Pressure Measurement Gauges

**UNIT-III**

**VELOCITY MEASUREMENT**: Introduction, Velocity & Mach number from pressure measurements, Laser droplet anemometer- LDA Principle, Doppler shift equation, Reference beam system, Fringe system. Measurement of velocity by Hot-Wire Anemometer, Measurement of velocity using vortex shedding Technique, Fluid Jet Anemometer, Mass & volume flow measurement

**UNIT-IV**

**ANALOG METHODS**: Introduction, Hale-Shaw Apparatus, Electrolytic Tank, Hydraulic Analogy, Hydraulic Jumps -Simple Harmonic Relations-circular and cyclic Frequency

**UNIT-V**

**DIGITAL TECHNIQUES IN MECHANICAL MEASUREMENTS:** Fundamental Digital Circuit Elements, Binary Codes , Simple Digital Circuitry-Digital computer as a measurements system tool-Data Processors, Microcomputers-Analog to Digital and Digital to Analog Conversion

**REFERENCE BOOKS:**


1. E. Rathakrishnan, Instrumentation, Measurements and Experiments in Fluids, CRC press, 2007.
2. Thomas G. Beckwith and Lewis Buck, Mechanical Measurements, Narosa Publishing House, 2009.
3. Holman, J. P., Experimental Methods for Engineers, Tata McGraw Hill Book Company, New Delhi, 2010.
4. Jack Philip Holman, Walter J.Gajda, Experimental methods for Engineers, 4th Edition: McGraw-Hill, 1984.
5. Ernest, O. D., Measurement Systems - Applications and Design, Tata McGraw Hill Book Company, New Delhi, 2011.
6. Beckwith, Nelson Lewis Buck, Mechanical Measurements, Thomas GE 5th Edition: Wesley Pub. Co., 1961.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521230., KRISHNA DT, A.P.

## MTME202 - REFRIGERATION AND CRYOGENICS

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT-I**

**REFRIGERATION:** Introduction-Necessity and applications, unit of refrigeration, Heat Engine, Refrigerator and Heat Pump-C.O.P and Types of Refrigeration.

**AIRCRAFT REFRIGERATION SYSTEM**: Necessity of Aircraft Refrigeration – Advantages of Air cycle for Aircraft Refrigeration – Classification of Aircraft Refrigeration Systems –Simple air craft Bootstrap– Regenerative air refrigeration systems

**REFRIGERANTS:** A survey of Refrigerants-Nomenclature, Desirable properties-Classification of Refrigerants – Alternate refrigerants – Ozone depletion potential and Global Warming Potential.

**UNIT-II**

**VAPOUR COMPRESSION REFRIGERATION**: Performance of Vapour Compression System-Subcooling and Superheating-Actual VCR cycle

**MULTISTAGE VAPOUR COMPRESSION SYSTEMS**: Introduction-Multi stage or Compound Compression-Multi Evaporator system-Cascade Systems.

**UNIT-III**

**VAPOUR ABSORPTION REFRIGERATION SYSTEM:** Description and working of simple and actual Aqua-Ammonia system-Maximum COP-Li-Br Water system-Three fluid absorption system-Applications.

**NON-CONVENTIONAL REFRIGERATION METHODS:** Principle and operation of (i) Thermoelectric refrigeration (ii) Vortex tube or Hilsch tube (iii) Adiabatic demagnetization.

**UNIT-IV**

**INTRODUCTION TO AIR CONDITIONING:** Psychometric properties and processes, Construction of psychometric chart -Requirements of Comfort Air conditioning – Thermodynamics of human body, Summer, Winter and Year round air conditioning systems-Cooling load estimation.

**DESIGN OF AIR CONDITIONING SYSTEMS:** All fresh air, Re-circulated air with and without bypass- factor -ADP, RSHF, GSHF& ESHF for different systems

**UNIT-V**

**CRYOGENICS :** Introduction , Joules Thomson effect, production of dry ice, liquefaction of Hydrogen, Liquefaction of helium, Linde system, Claude system & its analysis, application of cryogenics.

LBRCE EXAMINATION SECTION

HEAD Dept. of Mechanical Engineering LAKIREDDY BALI REDDY COLLEGE OF ENGG. MYLAVARAM-521 230., KRISHNA DT, A.P.

**REFERENCES**


1. Arora, C. P., Refrigeration and Air-conditioning, 3rd Edition, Tata McGraw-Hill, 2008
2. Stoecker, W. F. and Jones, J. W., Refrigeration and Air-Conditioning, TMH Edition, 2001
3. Manohar Prasad, "Refrigeration and Air Conditioning"-, New Age International, 2003.
4. Roy J. Dossat, Principles of Refrigeration, 4th Edition, Prentice Hall of India (P) Ltd, 2004.
5. Wilbert F. Stoecker, "Refrigeration and air conditioning"- Jerold W. Jones, MGH, 1986.
6. Randal Barron "Cryogenics systems", McGraw Hill.
7. Klaus, D. T. and Thomas, F. M., Cryogenic Process Engineering, Plenum Press, 2001.
8. Arora & Domkundwar " Refrigeration and Air Conditioning", Dhanpat Rai &co, seventh edition ,2005.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNA DT, A.P.

## MTME203 - COMPUTATIONAL FLUID DYNAMICS

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT-I:**

**Philosophy of CFD, Areas of Application, Numerical methods**: FDM, FEM, FVM. Governing equations of Fluid Dynamics- Derivation, Boundary conditions. Classification of Partial Differential equations, behavior and impact on CFD, Derivation of Finite Difference equations, Accuracy of Finite Difference solutions.

**UNIT-II**

**Solution methods of FD equations**: Elliptic, Parabolic, Hyperbolic and Burgers equations, Explicit and Implicit schemes, Sources of Errors, simple numerical problems.

**UNIT-III**

**Solution procedures for Incompressible Viscous flows:** Artificial compressibility method, Pressure correction methods, Vortex methods. Formulation and Solution procedures for Compressible Inviscid flows – Potential equation: Artificial viscosity, Artificial compressibility and Artificial Flux methods.

**UNIT-IV**

**Formulation and Solution procedures for Compressible Inviscid flows:** Euler equations: Central schemes, First order upwind scheme, Second order upwind scheme with low resolution, Boundary conditions for Euler equations, Pre conditioning process for compressible and incompressible flows.

**UNIT-V**

**CFD modelling for Combustion**: Enthalpy of formation, stoichiometry, equivalence ratio, adiabatic flame temperature, equilibrium and dissociation, governing equations of combusting flows, modeling of a laminar diffusion flame, SCRC model for turbulent combustion.

**REFERENCES**


1. Anderson J.D.(Jr), Computational fluid dynamics-Basics with applications, McGraw-Hill, 1995.
2. Muralidhar and Sundararajan, Computational fluid flow and heat transfer – Narosa Publishers
3. S.V.Patankar, Numerical heat transfer and fluid flow – Hemisphere Publishers,1980.
4. Anderson D.A., Tannehill, J.C and Pletcher R.H, Computational fluid mechanics and heat transfer, McGraw-Hill, 2002.
5. Versteeg.H.K, Malalasekhara.W, An introduction to computational fluid dynamics, Finite volume method, Pearson Education, 2010.
6. R.W.Lewis, K.Morgan, H.R.Thomas, K.N.Seetharamu, The Finite element method in Heat Transfer Analysis, John Wiley,1996.
7. T. J.Chung – Computational fluid dynamics, Cambridge University Press,2003.
8. Tapan K. Sengupta – Fundamentals of Computational Fluid Dynamics, Universities Press.

9. Niyogi , Chakravarty, Laha – Introduction to computational fluid mechanics, Pearson publications.
10. Ferziger, Peric, Computational methods for fluid dynamics – Springer.
11. Tu, Yeou,Liu, Computational fluid dynamics, A practical approach, Elsevier.
12. Frank Chorlton, Text book of Fluid dynamics, CBS Publishers.

LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM - 521 230, KRISHNA DT. A.P.

## MTME204 - DESIGN OF THERMAL SYSTEMS

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT-I**

**CLASSIFICATION OF HEAT EXCHANGERS: INTRODUCTION**- Recuperation & Regeneration-Tubular heat exchangers-Double pipe, Shell and Tube heat exchangers, Plate heat Exchangers-Plate fin and Tubular fin heat exchangers.

**BASIC DESIGN METHODS OF HEAT EXCHANGERS**: Basic equations in Design, Overall heat transfer coefficient-LMTD method for heat exchanger analysis-Parallel flow, Counter flow, Multi pass,

**CROSS FLOW HEAT EXCHANGER DESIGN CALCULATIONS** – Effectiveness method (NTU))-Keys and London charts-Compact Heat exchangers – Heat Transfer optimization

**UNIT-II**

**DESIGN OF CONDENSERS:** Types of Condensers-Air cooled condenser –Water cooled condensers-Evaporative condensers-Heat Transfer in condensers-De-superheating-Condensing heat transfer coefficient-Condensation outside horizontal tubes-Condensation inside horizontal tubes-Water side coefficient-Fouling factor-Air side coefficient-Augmentation of condensing heat transfer coefficient-Influence of air inside condensers

**UNIT-III**

**DESIGN OF EVAPORATORS:** Types of Evaporators-Heat transfer in Evaporators-Pool boiling – Heat transfer coefficient for Nucleate pool boiling-Flow or forced convection boiling-Forced convection boiling correlations-Horizontal Vs. Vertical tube-Effect of oil in refrigerant on heat transfer-Extended surface evaporators-Cooling and dehumidifying coils-Augmentation of boiling heat transfer-Pressure drop in evaporators

**UNIT-IV**

**DESIGN OF COOLING TOWERS AND SPRAY PONDS:** Classification-performance of cooling towers – analysis of counter flow cooling towers- enthalpy-temperature diagram of air and water- cooling ponds- types of cooling ponds –cross flow cooling towers- procedure for calculation of outlet conditions.

**UNIT- V**

**COOLING OF ELECTRONIC EQUIPMENTS:** Introduction-The chip carrier-Printed circuit boards-Cooling load of Electronic equipment.

**CONDUCTION COOLING:** Conduction in chip carriers-conduction in printed circuit boards-heat frames.

**AIR COOLING**: Natural convection and radiation- Forced convection- Fan selection-cooling personal computers and Heat Pipes.

**REFERENCE BOOKS:**


1. Necati Ozisik, Heat Transfer –Tata Mc Graw Hill, 1985
2. C.P.Arora, Refrigeration & Air-Conditioning, Tata Mc Graw Hill, 2001
3. J.D. Gurney, Maclaren Cooling Towers – (London)
4. A.P. Frass and M.N. Ozisik, Heat Exchanger Design- John Wiley & Sons,New York
5. Arora & Domkundwar.,Heat and mass transfer, Dhanapat Rai and Company
6. Stoecker, Refrigeration & Air-Conditioning, Mc Graw Hill publishers
7. Dossat, Refrigeration & Air Conditioning, Prentice Hall of India.

## MTME2051 - ENERGY CONSERVATION AND MANAGEMENT

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT - I**

General energy problem, Energy uses patterns and scope of conversion.

**ENERGY MANAGEMENT PRINCIPLE:** Need, Organizing and managing an energy management program.

**ENERGY AUDITING:** Elements and concepts, Type of energy audits instruments used in energy auditing.

**UNIT – II**

**ECONOMIC ANALYSIS:** Cash flows, Time value of money, Formulae relating present and future cash flows- single amount, uniform series.

**FINANCIAL APPRAISAL METHODS:** Pay back periods, net present value, benefit cost ratio, internal rate of return and Life cycle cost / benefits.

**UNIT – III**

**THERMODYNAMICS OF ENERGY CONSERVATION:** Energy conservation in Boilers and furnace, Energy conservation in stream and condensate system.

**COGENERATION:** Concepts, type of cogeneration system, performance evaluation of a cogeneration system.

**UNIT –I V**

**WASTE HEAT RECOVERY:** Potential, benefit, waste heat recovery equipments. Space Heating, Ventilation Air Conditioning (HVAC) and water heating of building, Transfer of heat, space heating methods, Ventilation and air conditioning, Heat pumps, Insulation, Cooling load, Electric water heating systems, Electric energy conversation methods.

**UNIT – V**

**ENERGY CONSERVATION IN ELECTRIC UTILITY AND INDUSTRY:** Energy cost and two -part tariff, Energy conservation in utility by improving load factor, Load curve analysis, Energy efficient motors, Energy conservation in illuminating system, Importance of power factor in energy conservation - Power factor improvement methods, Energy conservation in industries.

**REFERENCE BOOKS:**


1. Wayne C. Turner, **Energy management handbook -**, CRC Press Publications, 2004.
2. S.C. Tripathy, **Electrical Energy Utilization and Conservation -** Tata McGraw-Hill, 1991.
3. D.A. Reay, **Industrial Energy Conversation -**, Pergamon Press
4. **Industrial energy conservation Manuals**: MIT Press.

## MTME2052 - GAS DYNAMICS

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT- I**

**BASICS OF COMPRESSIBLE FLOW:** Introduction, Properties of fluids, Thermodynamic Properties, Thermodynamics of fluid flow, Laws of thermodynamics, Perfect gas, Compressibility, Basic Equations of compressible flow- Energy equation, Isentropic flow relations, Stagnation Properties, Speed of sound, Mach Number, Mach angle, Mach cone, Mach wave, Shock wave, Wave propagation

**UNIT-II**

**STEADY ONE-DIMENSIONAL FLOW:** Introduction, Fundamental Equations, Discharge from a reservoir, Critical values, Stream tube area-velocity relation, Types of nozzles, Applications of nozzles, Area Mach number relation, Isentropic flow through nozzles, Diffusers, Dynamics head measurement in compressible flow, Compressibility correction to dynamics pressure, Pressure coefficient

**UNIT-III**

**NORMAL SHOCK WAVES:** Introduction, Types of waves, Normal shock-equations of motion, the normal shock relations for perfect gas, Change of stagnation or total pressure across the shock, Hugoniot equation

**UNIT-IV**

**OBLIQUE SHOCK AND EXPANSION WAVES:** Introduction, Oblique shock- relations, Relation between β-θ-M, Shock Polar, Supersonic Flow over a Wedge, Weak Oblique Shocks, Detached Shocks, Expansion waves, Flow with shocks and expansion waves at the exit of a convergent- divergent nozzle

**UNIT-V**

**FLOW WITH FRICTION AND HEAT TRANSFER:** Introduction, Flow in constant Area Duct with friction, Adiabatic Constant area flow of a perfect gas, Fanno line Flow, Flow with heating and cooling in ducts, Rayleigh line relation.

**REFERENCE BOOKS:**


1. E.Rathakrishnan, Gas Dynamics, Second Edition Prentice Hall of India Pvt. Ltd, New Delhi
2. Ascher H. Shapiro, The dynamics and thermodynamics of compressible fluid flow Vol I by The Ronald press Co. New York, 1953
3. H.W. Lipmann and A. Roshko Elements of Gas Dynamics,
4. Thomson P.A ,McGraw Compressible Fluid Dynamics, -Hill, New York, 1972
5. Anderson, J.D. Jr., "Fundamentals of Aerodynamics", 4th Edition, McGraw-Hill, 2007.

## MTME2053 - CONVECTIVE HEAT & MASS TRANSFER

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT-I**

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

**EQUATIONS OF CONVECTIVE HEAT TRANSFER:** Continuity, Navier-Strokes equation & energy equation for steady state flows – similarity – Equations for turbulent convective heat transfer – Boundary layer equations for laminar, turbulent flows – Boundary layer integral equations.

**UNIT-II**

**EXTERNAL LAMINAR FORCED CONVECTION:** Similarity solution for flow over an isothermal plate – integral equation solutions – Numerical solutions – Viscous dissipation effects on flow over a flat plate.

**EXTERNAL TURBULENT FLOWS:** Analogy solutions for boundary layer flows – Integral equation solutions – Effects of dissipation on flow over a flat plate.

**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-III**

**NATURAL CONVECTION:** Boussin eq 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-IV**

**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-V**

**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.

LBRCE EXAMINATION SECTION

HEAD Dept. of Mechanical Engineering LAKIREDDY BALI REDDY COLLEGE OF ENGG. MYLAVARAM-521230., KRISHNA DT, A.P.

**REFERENCES:**


1. Kays, W. M. and Crawford, M. E., Convective Heat and Mass Transfer, 4th Edition, Tata McGraw Hill,2012.
2. Introduction to Convective Heat Transfer Analysis – Patrick H. Oosthuigen & David Naylor, McGraw-Hill Science/Engineering/Math, 1998
3. Bejan, A., Convection Heat Transfer, 3rd Edition, Wiley India, 2006.
4. Louis, C. Burmeister, Convective Heat Transfer, John Wiley and Sons, New York, 2002.
5. J. P. Holman, Heat transfer – TMH, 2010
6. Necati Ozisik Heat Transfer –,TMH, 1985
7. V.Gupta and I.Srinivasan ,Heat and Mass transfer - - Tata Mc.Graw Hill


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNADT, A.P.

## MTME2061 - JET AND ROCKET PROPULSION

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT-I**

**PRINCIPLES OF JET PROPULSION**
Introduction, Fundamental Principles of jet propulsion, Basic construction.
**AIR-BREATHING ENGINES**
Introduction, Thermodynamics of Aircraft Jet Engines- Turbo jet, Turbo fan, Turbo prop, and Ramjet engines, Typical Engine Performance –Applications of Jet Propulsion.

**UNIT-II**

**AEROTHERMODYNAMICS OF COMBUSTORS AND NOZZLES**
Introduction, Subsonic Inlets, Supersonic Inlets, Gas Turbine Combustors, after burners and Ram jet Combustors, Supersonic Combustion, Exhaust Nozzles- Applications of combustors and nozzles.

**UNIT-III**

**PERFORMANCE OF ROCKET VEHICLES**
Introduction, Static Performance, Vehicle Acceleration, Gravity-Free Drag-Free Space Flight, Forces Acting on a Vehicle in the Atmosphere, Basic relations of Motion, Space Flight, Flight Manoeuvres, Effect of Propulsion System on Vehicle Performance, Flight Vehicles, Military Missiles, Flight Stability, Chemical Rockets -Applications

**UNIT-IV**

**TURBOMACHINERY FOR LIQUID ENGINES**
Propellant Feed systems and engine cycles (gas-pressure feed and turbo pump feed, gas-generator cycle, staged combustion, cycle, expander cycle, typical examples) – Centrifugal pumps – Inducers and axial pumps (inducers, cavitation, axial pumps) – Axial turbines-Applications
**ELECTRICAL ROCKET PROPULSION**
Introduction – Electrostatic propellant accelerator – Bombardment ionization – The plane diode –Electrostatic thruster performance – The arc jet – Pulsed-magneto plasma accelerators -Applications.

**UNIT - V**

**LIQUID PROPELLANTS:** Propellant Properties, Liquid Oxidizers, Liquid Fuels, Liquid Monopropellants, Gelled Propellants, Gaseous Propellants, Safety and Environmental Concerns –Applications.
**SOLID PROPELLANTS:** Classification, Propellant Characteristics, Hazards, Propellant Ingredients, Other Propellant Categories, Liners, Insulators, and Inhibitors, Propellant Processing and Manufacture -Applications

**REFERENCES**


1. Yahya, S. M., Turbines, Compressors and Fans, 4th Edition, Tata McGraw Hill, 2010.
2. Sutton, G. P. and Biblarz, O., Rocket Propulsion Elements, 7th Edition, John Wiley & Sons, Inc., Singapore, 2001.
3. Sarvanamuttoo, H.I.H., Rogers, G. F. C. and Cohen, H., Gas Turbine Theory, 6th Edition, Pearson Prentice Hall, 2008.
4. Martin J.L. Turner, Rocket and Spacecraft Propulsion, Springer publications
5. Ganesan, V., Gas Turbines, 3rd Edition, Tata McGraw Hill, 2010.

## MTME2062 - RENEWABLE ENERGY TECHNOLOGY

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT - I**

**INTRODUCTION:** Energy Scenario – Survey of Energy Resources – Classification – Need for Non-Conventional Energy Resources.

**SOLAR ENERGY**: The Sun - Sun-Earth Relationship –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**

**WIND ENERGY**: Wind – 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, applications of wind energy.

**GEOTHERMAL ENERGY**: Structure of Earth – Geothermal Regions – Hot springs – Hot Rocks – Hot Aquifers – Analytical Methods to estimate Thermal Potential – Harnessing Techniques – Electricity Generation Systems, applications of geothermal energy.

**UNIT - III**

**ENERGY FROM OCEANS**: Tidal Energy; Tides – Diurnal and Semi – Diurnal Nature – Power from Tides, applications of tidal energy.

**WAVE ENERGY**: Waves – Theoretical Energy Available – Calculation of period and phase velocity of waves – wave power systems – submerged devices, applications of wave energy.

**OCEAN THERMAL ENERGY**: Principles – Heat Exchangers – Pumping requirements – Practical Considerations, applications of ocean thermal energy.

**UNIT - IV**

**BIO – ENERGY**: Biomass Energy Sources – Plant Productivity, Biomass Wastes – Aerobic and Anaerobic bio-conversion processes – Raw Materials and properties of Bio-gas-
Bio-gas plant Technology and Status – The Energetic and Economics of Biomass systems – Biomass gasification, applications of bio-energy energy.

**UNIT - V**

**DIRECT ENERGY CONVERSION SYSTEMS**: Introduction to direct energy conversion systems, Peltier effect, seebeck effect, Thomson effect, Fuel Cells, efficiency of Fuel Cells, and Solar Cells–Thermionic and Thermoelectric Generation – MHD Generator-Open and Closed Systems, applications of direct energy energy conversion systems.

LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNA DT, A.P.

**REFERENCES:**


1. G.D.Rai, Non Conventional Energy Sources, 5th Edition Khanna Publishers, New Delhi, 2011.
2. Bent Sorensen, Renewable Energy ,Physics ,Engineering ,Environmental Impact ,Economics & Planning ,4th Edition ,Elsevier 2011
3. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K.1966.
4. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
5. D.P.Kothari ,K.C.Singal ,Rakesh Ranjan ,Renewable Energy Sources and Emerging Technologies ,Eastern Economy Edition ,2nd Edition 2012
6. Sukhatme, S.P. and Nayak, J.K., Solar Energy - Principles of Thermal Collection and Storage, Tata McGraw Hill, New Delhi, 2008.
   Khan, B.H., Non-Conventional Energy Resources, Tata McGraw Hill, New Delhi, 2006.
7. Duffie, J.A. and Beckman, W.A., Solar Energy-Thermal Processes, John Wiley, 2001.


LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521 230., KRISHNA DT, A.P.

## MTME2063 - OPTIMIZATION METHODS IN ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Lecture | : | 4 Periods / Week | Internal Marks | : | 40 |
| Tutorial | : | 0 Period / Week | External Marks | : | 60 |
| Credits | : | 3 | External Examination | : | 3 hrs |

---

**UNIT- I**

**LINEAR PROGRAMMING:** Introduction to Linear Programming, Two phase Simplex method, Big-M method ,duality, interpretation, applications.

**UNIT- II**

**ASSIGNMENT PROBLEMS:** Hungarian's algorithm, Degeneracy, applications, unbalanced problems, travelling salesman problem.

**CLASSICAL OPTIMIZATION TECHNIQUES:** Single variable optimization with and without constraints, multi-variable optimization without constraints, multi-variable optimization with constraints-method of Lagrange multipliers, Kuhn- Tucker conditions.

**UNIT-III**

**NUMERICAL METHODS FOR OPTIMIZATION:** Nelder Mead's Simplex search method, Gradient of a function, steepest descent method, Newton's method, types of penalty methods for handling constraints.

**UNIT-IV**

**GENETIC ALGORITHM (GA):** Introduction, Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA.

**UNIT-V**

**APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS:** Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

**REFERENCE BOOKS:**


1. Rao S. S., Optimization Theory and Applications, Wiley Eastern Ltd., 3rd Edition, 2010.
2. KalyanmoyDeb,Optimization for Engineering Design, PHI publishers,2nd edition, 2012
3. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 9th edition, 2010.
4. D.E. Goldberg, Genetic algorithms in Research, Optimization and Machine learning-Addison Wesley Publishers
5. J.R.Koza, M.A.keane,J.Yu,F.H.Bennett, Genetic Programming, 2000-Springer
6. Fox, R. L., Optimization Methods for Engineering Design, Addison Wesley, 2001.

## MTME251 - COMPUTATIONAL METHODS LAB

| | | | | | |
|---|---|---|---|---|---|
| Lab/Practical | : | 3 Periods / Week | Internal Marks | : | 25 |
| Tutorial | : | 0 Period / Week | External Marks | : | 50 |
| Credits | : | 2 | External Examination | : | 3 hrs |

---

### LIST OF EXPERIMENTS

1. Simple thermal system modeling and analysis
2. Simulation of temperature contours for a pin fin in natural and forced convective conditions.
3. Fluid Flow and Heat Transfer analysis in a Mixing Elbow
4. Periodic simulation of 2-D heat exchanger using Fluent and correlating the results with theoretical results.
5. Simulation of 3-D heat exchanger
6. Analysis of turbulent flow past a transonic airfoil
7. Analysis of Transient Temperature Distribution in a Slab.
8. Analysis of Temperature Distribution on an Insulated Wall.
9. Analysis of Temperature Distribution along a Straight Fin.
10. Analysis of Temperature Distribution along a Tapered Fin.
11. Analysis of Discharge of Water from a Reservoir.

**REFERENCES**

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

ANSYS, CFX, STARCD, MATLAB, FLUENT etc…

LBRCE EXAMINATION SECTION

HEAD
Dept. of Mechanical Engineering
LAKIREDDY BALI REDDY COLLEGE OF ENGG.
MYLAVARAM-521230, KRISHNA DT, A.P.