**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY**

**CIRCULAR NO. ACAD / NP /M.E./M.Tech./97/2012**

It is hereby notified for the information of all concerned that, the Academic Council at its meeting held on 06-07-2012 **has accepted the following New Syllabi** under the Faculty of Engineering & Technology **as appended herewith** :-

| Sr. No. | Syllabi. |
|---|---|
| [1] | M.E. Mechanical, |
| [2] | M.E. Mechanical [Design Engineering], |
| [3] | M.E. [Thermal], |
| [4] | M.E. [Biotechnology], |
| [5] | M. Tech. [Computer Science and Technology], |
| [6] | M.Tech. [Food Processing Tech.]. |

This is effective from the academic year 2012-2013 and onwards.

All concerned are requested to note the contents of this circular for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.ACAD/ NP/ M.TECH./
2012/20668-72

A.C.S.S. I.No.84

Date:- 03-08-2012.

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*Director,*
*Board of College and*
*University Development.*

**Copy forwarded with compliments to :-**

1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.

**Copy to :-**

1] The Controller of Examinations,
2] The Superintendent, [ Engineering Unit ],
3] The Superintendent, [ Eligibility Unit ],
4] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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# Dr BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

## New Structure and Syllabus of

# M.E. [THERMAL]

**EFECTIVE FROM - 2012-13 & ONWARDS**

# DR. BABASAHEB AMBEDKAR MARATHAWADA UNIVERSITY, AURANGABAD

## Teaching /Examination Scheme for 2012-13 for M.E.(Thermal Engg.)

### Semester I

| Course Code | Name of the Subject | Teaching scheme Hours per Week | | | Examination Scheme -Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | Total Hrs | Theory | Term Work | Viva Voice | Total |
| ME-T 101 | Advanced Thermodynamics | 3 | 1 | 4 | 100 | | 25 | 125 |
| ME-T 102 | Advanced Heat Transfer | 3 | 1 | 4 | 100 | | 25 | 125 |
| ME-T 103 | Research Methodology | 3 | 1 | 4 | 100 | | | 100 |
| ME-T 104 | Modern Energy Sources | 3 | 1 | 4 | 100 | 25 | | 125 |
| ME-T 105 | Elective-I | 3 | 1 | 4 | 100 | | | 100 |
| ME-T 106 | Lab-I | - | 2 | 2 | | | 50 | 50 |
| ME-T 107 | Seminar-i | - | 2 | 2 | | | 25 | 25 |
| | **Total** | **15** | **9** | **24** | **500** | **25** | **125** | **650** |

### Semester II

| Course Code | Name of the Subject | Teaching scheme Hours per Week | | | Examination Scheme-Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | Total Hrs | Theory | Term Work | Viva Voice | Total |
| ME-T 201 | Advanced Refrigeration and Air Conditioning | 3 | 1 | 4 | 100 | | 25 | 125 |
| ME-T 202 | Solar Thermal Systems | 3 | 1 | 4 | 100 | | | 100 |
| ME-T 203 | IC Engine Theory and Performances | 3 | 1 | 4 | 100 | 25 | | 125 |
| ME-T 204 | Advance Fluid Mechanics | 3 | 1 | 4 | 100 | | 25 | 125 |
| ME-T 205 | Elective-II | 3 | 1 | 4 | 100 | | | 100 |
| ME-T 206 | Lab-II | - | 2 | 2 | | | 25 | 25 |
| ME-T 207 | Seminar-II | - | 2 | 2 | | | 50 | 50 |
| | Total | 15 | 9 | 24 | 500 | 25 | 125 | 650 |

Semester III

| Course Code | Name of the Subject | Progress with Discussion and Presentation Hours per Semester | | | Examination Scheme -Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | Total Hrs | Theory | Term Work | Viva Voice | Total |
| ME-T 301 | Dissertation Part- I | - | 48 | 48 | - | 50 | 50 | 100 |
| | **Total** | **-** | **48** | **48** | - | 50 | **50** | **100** |

Semester IV

| Course Code | Name of the Subject | Progress with Discussion and Presentation Hours per Semester | | | Examination Scheme -Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | Total Hrs | Theory | Term Work | Viva Voice | Total |
| ME-T 401 | Dissertation Part- II | - | 48 | 48 | - | 50 | 150 | 200 |
| | **Total** | **-** | **48** | **48** | - | 50 | **150** | **200** |
| **Grand Total** | | | | | | | | **1600** |

**L-Lectures**

**T-Tutorials**

**Elective-I**

1. Computational Fluid Dynamics
2. Cryogenics Engineering
3. Tribology

**Elective-II**

1. Energy Management in Thermal System
2. Design of Thermal System
3. Simulated Design of Solar Energy Engineering System

## ME-I 101 ADVANCED THERMODYNAMICS

**Teaching Scheme:**

**Theory :**3 Hrs Per week

**Tutorial:**1 Hrs Per week

**Examination Scheme:**

**Theory:**100 Marks, (3 Hrs.)

**Viva Voce:** 25

**Unit.I Introduction And Overview:** Introductory Concepts and Preliminaries; Properties of Pure Substances; Energy and the First Law of Thermodynamics. Energy Transfer by Heat, Work, and Mass; Second Law of thermodynamics, Entropy: A Measure of Disorder, Exergy – A Measure of Work Potential.

**Unit.II The Two Laws Combined:** Review on some consequences of first Law, Limitations of first Law. Thermodynamic Temperature Scale. Clausius-Clapeyron Equation, Stefan' s Law, Helmholtz and Gibbs Functions. Availability in Steady Flow. Irreversibility and Effectiveness, Combined First and Second Laws, Isothermal and Adiabatic Compressibility; Joule-Kelvin Coefficient, Maxwell Equation, Vander Wall's Gas Equation;

**Unit.III The Destruction Of Exergy:** Lost Available Work, Mechanisms of Entropy Generation or Exergy Destruction, Entropy Generation Minimization.

**Unit.IV Multi Phase Systems:** General considerations, Dalton & Amagat Model, Mixture of gases and vapors. Changes in Molal Properties upon Mixing, Gibbs Entropy Equation and Gibbs -Duhem Equation

**Unit.V Chemically Reactive Systems:** Thermodynamics of reactive Systems and Criterion of Equilibrium. Phase rule. Combustion Process. Enthalpy of formation: First Law Analysis of Reacting Systems; Second Law analysis of Reacting Systems. Equilibrium Constant and its temperature Dependence.

**Unit.VI Thermodynamic Optimization:** Exergy analysis of Vapor and Gas Power Cycles, Guideline for improving Thermodynamic Effectiveness; Exergy analysis of Simple Power Plant (Steam Plant)

**Term Work:** It shall consist of at least four assignments based on above syllabus.

**Recommended Books:**

Advanced Engineering Thermodynamics, Adrian Bejan, Wiley-Interscience Publication, Second Edition, ISBN 0-471-14880-6.

Fundamentals of Engineering Thermodynamics, Michael Moran & Howard Shapiro, Wiley & Sons, Sixth Edition, ISBN 978-0-471-78735-8

Fundamentals of Classical Thermodynamics, Richard Sonntag, Claus Borgnakke, John Wiley & Sons, Seventh Edition, ISBN: 978-0-470-04192-5.

Thermodynamics: An Engineering Approach, Yunus A. Cengel & Michael A. Boles, Sixth

Edition, ISBN-13 9780073305370.

## ME-T 102 ADVANCED HEAT TRANSFER

**Teaching Scheme:**

**Theory** : 3 Hrs Per week

**Tutorial:** 1 Hrs Per week

**Examination Scheme:**

**Theory:** 100 Marks, (3 Hrs.)

**Viva Voce:** 25

**Unit.I Conduction heat transfer**

General heat conduction equation in Cartesian, cylindrical and spherical co-ordinates – Composite geometries – Variable thermal conductivity – Uniform heat generation- Extended surfaces - Two and three dimensional heat conduction –Numerical and analytical methods.

**Unit.II Transient Heat Conduction:** General Lumped capacitance analysis, spatial effects, plane wall with convection. Transient heat flow in semi infinite solid-const, Multidimensional systems. use of Heisler chart. heat conduction with moving boundary – heat conduction in melting and solidification. moving heat source.

**Unit.III Convection heat transferConvective heat transfer** – Boundary layers – Continuity, momentum and energy equations - Boundary layers equations – Dimensional analysis - Exact and approximate solutions to forced convection in laminar and turbulent, internal and external flow – Reynolds and Colburn analogies – forced convection correlations – Solution to free convection problems - Heat transfer at high velocity and incompressible fluid - Liquid metal heat transfer.

**Unit.IV Radiation heat transfer Radiation heat transfer** – Basic laws of radiations – Emissive power – Stefan – Boltzmann, Lambert's, Wien's and Kirchhoff's laws – Emissivity – Radiation intensity -

**Unit.V Radiative exchange between black isothermal surfaces**. diffuse grey surfaces - Reflecting surfaces – Radiation shape factor - Shape factor algebra – Radiation shields – Combined convective and radiation – Electrical net work analogy solution – Radiosity – Solar radiation – Radiation from gases and vapours.

**Unit.VI Boiling and condensation Heat transfer with phase change** – Boiling and Condensation – Flow boiling – Correlations.

**Unit.VII Mass Transfer** – Concentration, velocities, Mass fluxes Fick's law – Species – Conservation equation – Steady state molecular diffusion, Equimolar counter diffusion, diffusion through a stagnant gas film

**Term Work:** It shall consist of at least four assignments based on above syllabus.

**Books Recommended:**

1.Arpaci. V.S., Conduction Heat Transfer, Addison Wesley, 1966.

2.E.R.G. Eckert and R.M. Drake, Analysis of Heat Transfer, McGraw Hill, 1972.

3.E.M. Sparrow, R.D. Cess, Radiative Heat Transfer, McGraw Hill. 1972.

4.Holman. J.P, Heat Transfer, McGraw Hill.

5.R.C. Sachdeva, Fundamental of Engineering. Heat and Mass Transfer,

New Age International, 2003.

6.Bird R.B and J.R. Howell. Transport Phenomena. Wiley International. 1960.

7.Patrico Gostiuson. Convective heat and Mass Transfer. McGraw Hill

8.Frank P Incropera and David P Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, 6thEdition 1998

Note: Heat transfer data book will be permitted in Exam hall

## ME-T 103 RESEARCH METHODOLOGY

**Teaching Scheme:**

**Theory** : 3 Hrs Per week

**Tutorial:** 1 Hrs Per week

**Examination Scheme:**

**Theory:** 100 Marks, (3 Hrs.)

**Unit.I Research Concept:** Concept, meaning, objectives, motivation; Types of research, approaches (descriptive research, conceptual, theoretical, applied and experimental research)

**Unit.II Formulation of Research Task:** Literature Review: importance & methods, sources, field study, laboratory experiments, critical analysis of already generated facts, hypothetical proposal for future development and testing, selection of research task, prioritization of research, introduction to hypothesis testing.

**Unit.III Mathematical Modeling and Simulation:** Concept of modeling, classification of mathematical models, modeling with ordinary differential equations, differential equations, partial differential equations, graphs. Simulation concept, types (quantitative, experimental, computer, statistical), process of formulation of model based on simulation.

**Unit.IV Experimental Modeling:** Definition of-experimental design, examples, single factor experiments, guidelines for designing experiments.

**Unit.V General model of process:** Input factors/variables, Output parameters/variables, controllable/ uncontrollable variables, dependent/independent variables, compounding variables, extraneous variables and experimental validity.

**Unit.VI Process optimization and designed experiments:** methods for study of response surface, First order design. Determining optimum combination of factors, determination of steepest ascent, Taguchi approach to parameter design.

**Unit.VII Analysis of Results** (Parametric and Non parametric, Descriptive and Inferential Data): types of data, Methods and techniques of data collection, sampling and sample design, Non parametric test, error analysis, analysis of variance, significance of variance, analysis of co-variance, multiple regression. Introduction to Analytical hierarchical process, Factor analysis, Cluster analysis, Fuzzy logic, testing linearity/ non linearity of model, testing adequacy of model.

**Unit.VIII Report Writing:** types of report, layout of research report, interpretation of results, layout and format, style of writing, typing, references, pagination, tables, figures, conclusions, appendices.

**Unit. IX Landscape of Creativity:** Convergent Vs. divergent thinking. creativity, creativity Vs intelligence, creativity abilities, determination of Creativity, increasing creativity, creative achievement, techniques of creativity, collective creativity.

**Books Recommended:**

Research Methodology. C R Kothari. Wiley Eastern publishers. New Delhi, 10th edition, 2006.

Research in Education. John W Besr & James V Kahn, Prentice Hall of India, New Delhi.

Theories of Engineering Experiments, Schank Fr, Tata McGraw Hill Publishing Ltd., New Delhi.

Experimental design by Cochran & Cocks, John Wielly & sons, New Delhi, 2005.

Design of Experiments, Douglas Montgomary, 1995.

Formulation of Hypothesis, Willkinson K, P L Bhandarkar, Himalaya Publishing House, Mumbai, 2005.

## ME-T 104 MODERN ENERGY SOURCES

**Teaching Scheme:**

**Theory:** 3 Hrs Per week

**Tutorial:** 1 Hrs Per week

**Examination Scheme:**

**Theory:** 100 Marks,(3 Hrs.)

**Term Work:** 25

**Unit.I Solar Energy:** Flat plate and concentrating collectors- design, analysis and performance, applications. Thermal Power, Photovoltaic power; Economic Analysis

**Unit.II Wind Energy:** Atmospheric circulation, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, application, design aspects

**Unit.III Tidal and Ocean Energy:** Applications, Design aspects, Power generation methods, various cycles and analysis.

**Unit.IV Geothermal Energy And Magneto Hydrodynamics:** Study of various components, Performance and methods of energy conversion.

**Unit.V Nuclear Energy:** Fusion and fission, study of various components, Design aspects, Performance and methods of power generation.

**Term Work:** It shall consist of at least four assignments based on above syllabus.

**Books Recommended:**

Solar Energy: Principles of thermal collection and Storage by Suhas P. Sukhatme ,Second Edition, Tata McGraw-Hill, 2006

Power Plant Technology by El- Wakil, McGraw Hill publication.

Principles of Solar Thermal Engineering by F.Kreith & J .F.Kreider, McGraw Hill Publications 1978.

Solar Engineering of thermal Processes by J .A.Duffie and W.A.Beckman, John Wiley & Sons publication 1999.

Applied Solar Energy by A.B.Meinal & F.P.Meinal, Addison Wesley 1976 publication.

Solar Energy : Fundamentals and Applications (1st Revised Edition), Tata McGraw-Hill, 2000.

## ELECTIVE-I

## ME-T 105 COMPUTATIONAL FLUID DYNAMICS

**Teaching Scheme:**

**Theory :**3 Hrs Per week

**Tutorial:**1 Hrs Per week

**Examination Scheme:**

**Theory:**100 Marks,(3 Hrs.)

**Unit.I Review of Governing Equations:** Governing Equations of Fluid flow and heat transfer, review of numerical methods.

**Unit.II Discretization:** Introduction to finite differences, difference equations, explicit and implicit approaches: definition and contrasts, errors and analysis of stability.

**Unit.III Classification of Partial Differential Equations:** Explicit and Implicit methods, solution of select model equations; Laplace heat and wave equation, laminar boundary layer solution.

**Unit.IV CFD Techniques:** The lax -wendroff technique, Mac Cormack's technique, Relaxation technique and its use with low speed inviscid flows, aspects of numerical dissipation and dispersion; artificial viscosity, Alternating Direction Implicit (ADI) technique, pressure correction technique with application to incompressible viscous flow.

**Unit.V Initial And Boundary Value Problems:** Free falling of a spherical body, two dimensional motions of a body through a fluid radial flow.

**Books Recommended:**

Computational Fluid Flow and Heat Transfer, Muralidhar, K. and Sundararajan, T., Narosa Pub., 2004.

Computational Fluid Dynamics: The Basics with Applications, Anderson, J. D., Jr. McGraw Hill, 2002.

Computational Fluid Dynamics: An Introduction for Engineers, Abbot, M. B. and Basco, D. R., John Wiley & Sons, 2006.

Computational Fluid Dynamics: Principles and Applications, Blazek, J., Elsevier Science, 2001.

## ME-T 105 ELECTIVE-I

## CRYOGENIC ENGINEERING

**Teaching Scheme:**

**Theory :**3 Hrs Per week

**Tutorial:**1 Hrs Per week

**Examination Scheme:**

**Theory:**100 Marks,(3 Hrs.)

**Unit.I Gas Liquefaction Systems** - Thermodynamically Ideal System, Joule - Thomson Effect, Adiabatic Expansion - Liquefaction Systems for Air, Neon, Hydrogen and Helium - Effect of component efficiencies on System Performance

**Unit.II Gas Separation and Purification** - Principles - Plate Calculations - Air, Hydrogen and Helium separation systems.

**Unit.III Cryogenic systems** - Ideal and practical systems - Cryogenic Fluid Storage and Transfer systems - Storage vessels , Insulation - Two Phase Flow in Cryogenic Transfer Systems - Cool Down Process

**Unit.IV Cryogenic Fluid Vacuum Technology** - Low Temperature Properties of Materials –

Properties of Cryogenic Fluids - Pump Down Time - Applications of Cryogenic Systems - Super Conductive Devices , Rockets and Space Simulation, Cryogenics in Biological and Medicine - Cryo pumping

**Books Recommended:**

1.Randall Baron, Cryogenic System, Mc Graw Hill

2.K.D. Timmerhaus & T.M. Flynn, Cryogenic Process Engineering, Plenum Press

3.Russel B Scott, Cryogenic Engineering, Van Nostrand

4.R W Yance and WM Duke, Applied Cryogenic Engineering, John Willey.

## ME-T 105 ELECTIVE-I

## TRIBOLOGY

**Teaching Scheme:**

**Theory :**3 Hrs Per week

**Tutorial:**1 Hrs Per week

**Examination Scheme:**

**Theory:**100 Marks,(3 Hrs.)

**Unit.I Introduction** - Tribology in design. Tribology in industry. Lubricants- Properties- physical and chemical. Types of additives, extreme pressure lubricants. Lubrication-introduction, basic modes of lubrication

**Unit.II Friction** - friction measurement, theory of friction. Wear: Types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theory of wear. Gas Lubrication. Lubrication in metal working: Rolling, Forging, Drawing and extrusion.

**Unit.III Solid tribological coatings and materials** – surface treatments –surface modification processes.

**Unit.IV Tribological properties of metallic and ceramic coatings**.

**Unit.V Surface topography measurements** - Electron microscope and friction and wear measurements. Use of transducers and instruments in Tribology- film thickness measurement using modern techniques – Development of test rigs for Tribology research.

**Books Recommended:**

1. Kenneth C Ludema, Friction, Wear, Lubrication: A text book in Tribology, CRC press, 1996.

2. G. W. Stachowiak, A. W. Batchelor and Gwidon Stachowiak, Engineering Tribology, Butterworth-heinemann, 2006.

3. S. K. Basu, S.N.Sengupta & B.B.Ahuja, Fundamentals of Tribology, Prentice –Hall of India Pvt Ltd , New Delhi, 2005.

4. J.A. Williams, Engineering Tribology, Oxford Univ. Press, 1994.

## ME-I 201 ADVANCED REFRIGERATION AND AIR CONDITIONING

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| **Theory :**3 Hrs Per week | **Theory:**100 Marks,(3 Hrs.) |
| **Tutorial:**1 Hrs Per week | **Viva Voce:** 25 |

**Unit.I Actual vapor compression** system – Multi-pressure vapour compression system – Environment friendly refrigerants – cascade system.

**Unit.II Absorption refrigeration system** – Three fluid absorption system – comparison of absorption with compression system - Analysis of multistage systems

**Unit.III Advanced psychometric calculations** - Cooling load calculations – Determination of U factor short method calculation

**Unit.IV Low temperature refrigeration** - Joule Thompson coefficient – liquefaction of air – hydrogen –helium - Applications of cryogenics.

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

**Term Work:** It shall consist of at least four assignments based on above syllabus.

**Books Recommended:**

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

2. Stoeker, W.P. and Jones, J.W., Refrigeration and Air Conditioning, 2nd ed., Tata McGraw Hill, 1982.

3. Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 1996.

4. Gosney, W.B., Principles of Refrigeration, Cambridge Uni. Press, 1982.

## ME-T 202 SOLAR THERMAL SYSTEMS

**Teaching Scheme:**

**Theory:** 3 Hrs Per week

**Tutorial:** 1 Hrs Per week

**Examination Scheme:**

**Theory:** 100 Marks, (3 Hrs.)

**Unit.I SOLAR RADIATION** Availability- Measurement and Estimation - Introduction to Solar Collectors (Liquid Flat - Plate Collector, Air Heater and Concentrating Collectors) and Thermal Storage (PCM)- Steady State Transient Analysis - Solar Pond - Solar Refrigeration.

**Unit.II SOLAR THERMAL SYSTEMS** Active Systems - Water Heating Systems - Active and Passive - Passive Heating and Cooling of Buildings - Solar Distillation - Solar Drying.

**Unit.III STAND-ALONE AND GRID CONNECTED PHOTOVOLTAIC SYSTEMS** Solar cell: p-n Junction - Metal - Schottky Junction, Electrolyte - Semiconductor Junction, Types of Solar Cells - Characteristics of Solar Cells – Components and requirements for Photovoltaic Systems: Stand-alone and Grid Connected PV systems, Application of Photovoltaic Systems and Importance of Electric Vehicle.

**Unit.IV WIND** Its Structure - Statistics - Measurements and Data Presentation - Wind Turbine Aerodynamics - Momentum Theories - Basics Aerodynamics - Airfoils and their Characteristics - HAWT - Blade Element Theory- Prandtl's Lifting Line Theory (wake analysis) - VAWT Aerodynamics -Wind Turbine Loads - Aerodynamic Loads in Steady Operation- Wind Turbulence- Yawed Operation and Tower Shadow.

**Unit.V WIND ENERGY CONVERSION SYSTEM (WECS)** Siting - Rotor Selection - Annual Energy Output - Horizontal Axis Wind Turbine (HAWT) Vertical Axis Wind Turbine - Rotor Design Considerations- Number of Blades –Blade Profile -2/3 Blades and Teetering - Coning - Upwind/Downwind - Power Regulation- Yaw System- Tower- Synchronous and Asynchronous Generators and Loads – Integration of Wind Energy Converters to Electrical Networks - Inverters - Testing of WECS - WECS Control System - Requirements and Strategies - Miscellaneous Topics - Noise etc -Other Applications.

**Unit.VI GREEN BUILDING** Background of Green/Solar building, solar passive and active heating and cooling buildings, various solar house concepts, Solar heating and cooling using Earth-air heat exchanger. Solar water heaters and its applications in residential and industrial sector. Importance of Daylighting in building. Energy efficient building materials, Utility for natural thermal comfort buildings in rural and urban areas. Energy management in residential and office buildings. Emissions from construction sector of building.

**Books Recommended:**

1. A.Duffie and W.A.Beckmann, Solar Engineering of Thermal Processes-John Wiley (1980)
2. F.Kreith and J.F.Kreider, Principles of Solar Engineering, McGraw-Hill (1978)
3. T.N. Veziroglu, Alternative Energy Sources, Vol 5 and 6, McGraw-Hill (1978)

**Websites:**

1. www.solstice.crest.orgl
2. www.res-.ltd-com
3. www.mnes.mic.in
4. www.ireada.org
5. http://sundancepower.com

## ME-T 203 I.C. ENGINE THEORY AND PERFORMANCE

**Teaching Scheme:**

**Theory :**3 Hrs Per week

**Tutorial:**1 Hrs Per week

**Examination Scheme:**

**Theory:**100 Marks,(3 Hrs.)

**Term Work:** 25

**Unit.I Spark Ignition Engines**, mixture requirements – Fuel – Injection systems– Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – Factors affecting knock – Combustion chambers.

**Unit.II Compression ignition engines.** Stages of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers – Fuel spray behaviour – spray structure, spray penetration and evaporation – Air motion – Introduction to Turbo charging and supercharging

**Unit.III Alternative fuels.** Alcohol, Hydrogen, Natural Gas Bio diesel. fuel cell. Other possible fuels and Liquefied Petroleum Gas-Properties, Suitability, Merits and Demerits as fuels, Engine Modifications. Dual fuel operation

**Unit.IV Recent trends**, Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition engines – Plasma Ignition – Zero Emission Vehicles, Engines for special applications – Mining, Defence, Off-highway -Tractor, Bulldozer etc. Submarines, Race car Engine systems, Flexible fuel systems. Surface ignition,

**Term Work:** It shall consist of at least four assignments based on above syllabus.

**Books Recommended:**

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

2. John B Heywood. Internal Combustion Engine Fundamentals, McGraw Hill

3. M.L. Mathur and R.P.Sharma, A course in internal Combustion Engines, Dhanapat Rai Publications, New Delhi.

4. V. Ganesan, Internal Combustion Engines, IInd Edition, TMH, 2002.

5. Duffy Smith, Auto fuel Systems, The Good Heart Willox Company, Inc.

6. Ganesan V., Computer simulation of spark ignition process, University process. Hyderabad 1993.

## ME-T 204 ADVANCED FLUID MECHANICS

**Teaching Scheme:**

**Theory** :3 Hrs Per week

**Tutorial:** 1 Hrs Per week

**Examination Scheme:**

**Theory:** 100 Marks,(3 Hrs.)

**Viva Voce:** 25

**Unit.I Conservation Equations of Fluid Flow:** Conservation of mass, conservation of momentum – stress and strain in fluid flow and their relationship. conservation of energy, work done due to viscous stress.

**Unit.II Laminar Flow of Viscous Incompressible Fluids:** Flow between parallel flat plates, couette flow. plane Poiseuille flow. flow between two co-axial cylinders, flow between two concentric rotating cylinder. unsteady motion of a flat plates.

**Unit.III Exact Solution of Navier** – Stokes Equation: Hele Shaw flow stagnation point flow, creeping flow over sphere and circular cylinder.

**Unit.IV Boundary Layer Theory:** Boundary layer equation, Blasius solution, shear stress and boundary layer thickness, boundary layer on a surface with pressure gradient, momentum integral theorem for boundary layer, boundary layer for axially symmetric flow, speration and its prevention by boundary layer suction.

**Unit.V Turbulence:** Concept of linearized stability of parallel viscous flow, transition to turbulent flow, Reynolds equation for turbulent flow, Reynolds stresses. Prandtl's mixing length theory. velocity profile, turbulent flow in pipes, turbulent boundary layer on flat plate, free turbulence. jets. wakes and mixing layer.

**Term Work:** It shall consist of at least four assignments based on above syllabus.

**Books Recommended:**

Fundamental of Fluid Mechanics: S.W.Yuan

Viscous Fluid Flow: F.M.White

Advanced Fluid Mechanics: Muralidhar & Biswas

## ME-T 205 ELECTIVE II

## ENERGY MANAGEMENT IN THERMAL SYSTEMS

**Teaching Scheme:**

**Theory** :3 Hrs Per week

**Tutorial:**1 Hrs Per week

**Examination Scheme:**

**Theory:**100 Marks,(3 Hrs.)

**Unit.I Importance of Energy Management. Energy Auditing:** Methodology, Analysis of Past Trends (Plant Data), Closing the Energy Balance, Laws of Thermodynamics, Measurements, Portable and on-line instruments.

**Unit.II Co-generation Concept, Options** (Steam/Gas Turbines /Diesel Engine based), Selection Criteria. Control Strategy. Heat Exchanger Networking Concept of Pinch, Target Setting , Problem table Approach. Composite curves. Demand side Management. Financing Conservation.

**Unit.III Energy Conservation in Pumps,** Fans (Flow Control). Compressed Air Systems, Refrigeration and Air Conditioning Systems, Waste Heat Recovery: Recuperators, Heat Wheels, Heat Pipes, Heat Pumps.

**Unit.IV Electrical Systems:** Demand Control, Power factor Correction, Load Scheduling / Shifting, Motor Drives - Motor Efficiency Testing, Energy Efficient Motors, Motor Speed Control.

**Unit.V Lighting-** Lighting Levels, Efficient Options, Fixtures. Daylighting, Timers, Energy Efficient Windows

**Books Recommended:**

1. Kenny. Energy Management in Thermal Systems

2. Reay.D.A . Industrial Energy Conservation, Pergamon Press 1977

3. D.Merick and R. Marshall, Energy Present and Future Options. Vol I & II

## ME-T 205 ELECTIVE II

## DESIGN OF THERMAL SYSTEMS

**Teaching Scheme:**

**Theory:** 3 Hrs Per week

**Examination Scheme:**

**Theory:** 100 Marks,(3 Hrs.)

**Tutorial:** 1 Hrs Per week

**Unit.I Modeling of Thermal Systems:** types of models, mathematical modeling, curve fitting, linear algebraic systems, numerical model for a system, system simulation, methods for numerical simulation;

**Unit.II Acceptable Design of a Thermal System:** initial design, design strategies, design of systems from different application areas, additional considerations for large practical systems; Economic Considerations: calculation of interest, worth of money as a function of time, series of payments, raising capital, taxes, economic factor in design, application to thermal systems;

**Unit.III Problem Formulation for Optimization:** optimization methods, optimization of thermal systems, practical aspects in optimal design, Lagrange multipliers, optimization of constrained and unconstrained problems, applicability to thermal systems; search methods: single-variable problem, multivariable constrained optimization, examples of thermal systems; geometric, linear, and dynamic programming and other methods for optimization, knowledge-based design and additional considerations, professional ethics.

**Books Recommended:**

W.F. Stoecker, Design of Thermal Systems - McGraw-Hill, 1971

References

Y. Jaluria, Design and Optimization of Thermal Systems –CRC Press, 2007.

Bejan, G. Tsatsaronis, M.J. Moran, Thermal Design and Optimization - Wiley, 1996.

R. F. Boehm, Developments in the Design of Thermal Systems - Cambridge University Press, 1997.

N.V. Suryanarayana, Design & Simulation of Thermal Systems - MGH, 2002

## ME-T205 ELECTIVE II

## SIMULATED DESIGN OF SOLAR ENERGY ENGINEERING SYSTEM

**Teaching Scheme:**

**Theory** :3 Hrs Per week

**Tutorial:**1 Hrs Per week

**Examination Scheme:**

**Theory:**100 Marks,(3 Hrs.)

**Unit.I SOLAR HEAT SYSTEMS**: General System, solar collectors. solar DHW systems; liquid based and air based solar space heating systems; solar radiation collection.

**Unit.II PROGRAMMING, SCHEMATIC DESIGN AND ITS DEVELOPMENT**: Programming phase and checklist; schematic design and checklist; Solar collector operational consideration; thermal storage for solar heating systems and its design; design of heat exchangers; selection of pumps, fluids and tubes; design of fans and ducts; solar energy cost equation and its constituents.

**Unit.III SIMULATIONS IN SOLAR PROCESS DESIGN**: Simulation programs; the utility of simulations: information from simulations; TRNSYS, a thermal process simulation program; simulations and experiments. metrological data limitations of simulations.

**Unit.IV DESIGN OF ACTIVE SYSTEMS BY F-CHART**: Review of design methods; the f-chart methods. the f-chart for liquid systems; the f-chart for air systems; service water heating systems: f-chart results; parallel solar energy-heat pump systems.

**Unit.V DESIGN OF ACTIVE SYSTEMS BY UTILIZABILITY METHODS**: Hourly Utilizability, daily Utilizability; the phi-bar f-chart method.

**Unit.VI DESIGN OF PASSIVE AND HVBRID HEATING SYSTEMS:** Approaches to passive design; the solar-load ratio method; the Utilizability design method: direct gain; Utilizability design method: collector-storage walls; hybrid systems: active collection with passive storage.

**Books Recommended:**


1. Solar Energy Engineering by A.A.M.Sayigh; Academic Press.
2. Solar Engineering of thermal process by Duffie & Beckman: Wiley
3. The Solar Heating Design process by Kreider; MGH
4. Applied Solar Energy by Meinel & Meinel ; Addison
5. Solar Heating and Cooling by Kreider & Kreith; MGH

## ME-T 106 LABORATORY PRACTICE-I

**Teaching Scheme:**

**Tutorial:** 02 Hrs Per week

**Examination Scheme:**

**Viva-Voce**-50 Marks

Laboratory Practice shall constitute laboratory experiments, design, Simulation, Programming Assignments, Industrial Visits with reports and its outcome, Etc.

At least two experiments from the courses viz., Fluid Dynamics.

**Fluid Dynamics (25 Marks)**

Generation of streamlines, velocity potential, equi-pressure lines for some standard geometry such as, circular cylinder, square cylinder, plate, placed in (some) flowing fluid using standard software package such as FLUENT.

Investigate the effect of various fluid properties on streamlines, velocity potential for some geometry used in experiment No. 1 above.

**Case Study (25 Marks)**

Thermal performance of domestic solar water heater installed

Industrial Visits with reports and its outcome

Identify the problems of biogas plant, operating or non operating, in nearby village

Modern Energy Sources

## ME-T 206 LABORATORY PRACTICE-II

**Teaching Scheme:**

**Tutorial:**02 Hrs Per week

**Examination Scheme:**

**Viva Voce:** 25

Laboratory Practice shall constitute laboratory experiments, design, Simulation, Programming Assignments, etc.

At least two experiments from each of the courses viz., I.C. Engine

**Diesel Engine Test Rig (25 Marks)**

Experimental Study of Computerized Diesel Engine Test Rig (performance, emission).

## ME-T 107 SEMINAR-I

**Teaching Scheme:**

**Tutorial:** 2 Hrs per week

**Examination Scheme:**

**Viva Voce:** 25 Marks

The seminar shall consist of study of a particular topic based on 4-6 research papers or case study of industry. The marks shall be awarded as the basis of performance of the individual student during his/her seminar presentation. Each student is also required to submit a report based on above study in the prescribed format. Viva Voce will be based on the work carried out by student with respect to seminar topic.

## ME-T 207 SEMINAR-II

**Teaching Scheme:**

**Tutorial:** 2 Hrs per week

**Examination Scheme:**

**Viva Voce :** 50 Marks

The **SEMINAR-II** shall consist of few particulars amongst the following:

Literature review from sizable number of publications. Design / Development / Synthesis related to a particular area. Implementation of existing theory for applications, pilot experiments etc. Each student is required to prepare a report and deliver a talk based on the work carried out in mini-project under the guidance of a faculty member(s). The work carried out should be preferable related to his/her dissertation topic. Viva voce will be based on contents of the topic.

## ME-T 301 DISSERTATION PART – I

**Teaching Scheme:**

**Tutorial:** 48 Hrs per semester

**Examination Scheme:**

**Term Work:** 50 Marks

**Viva Voce:** 50 Marks

It shall include the problem definition, literature survey. approaches for handling the problem, finalizing the methodology for the dissertation work and design calculations/ experimental design etc. A report of the work shall be submitted at the end of Semester III after approval by the Guide and endorsement of the Head of Department. It will be assessed for term work.

The evaluation committee appointed by the Head of the Department, for appropriateness, sufficiency of contents and offer suggestions if any.

**Note:** The evaluation committee shall consist of the Guide, one senior expert faculty member from other institute appointed by University, and the Head of Department or his/her representative.

## ME-T 401 DISSERTATION PART – II

**Teaching Scheme:**

**Tutorial:** 48 Hrs per semester

**Examination Scheme:**

**Term Work:** 50 Marks

**Viva Voce:** 150 Marks

The candidate shall submit the detailed report as per the synopsis approved by the university, of the dissertation work in the prescribed format after approval by the guide and endorsement by the Head of Department. It will be assessed for term work by the evaluation committee appointed by the University, for completion of the proposed work.

**Note:** The evaluation committee shall consist of the Guide, one senior expert faculty member from other institute appointed by University, and the Head of Department or his/her representative.