DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO. ACAD/NP/M.E./Syllabi/189/2013

It is hereby informed to all concerned that, on recommendations of the Faculty of Engineering and Technology, the Hon'ble Vice-Chancellor has accepted the following **"Revised Syllabi with Cumulative Grade Point Average [CGPA]"** under the Faculty of Engineering & Technology on behalf of the **Academic Council Under Section-14(7) of the Maharashtra Universities Act, 1994** as appended herewith :-

Sr. No.	Revised Syllabi
[1]	Revised Syllabus of M.E. [Computer Networking Engg.],
[2]	Revised Syllabus of M.E. [Structural Engineering],
[3]	Revised Syllabus of M.E. [Water Resources Engineering],
[4]	Revised Syllabus of M.E. [Environmental Engineering],
[5]	Revised Syllabus of M.E. [Software Engineering],
[6]	Revised Syllabus of M.E. [Computer Science],
[7]	Revised Syllabus of M.E. [Control System Engineering],
[8]	Revised Syllabus of M.E. [Heat Power],
[9]	Revised Syllabus of M.E. [Manufacturing Engineering],
[10]	Revised Syllabus of M.E. [Electronics],
[11]	Revised Syllabus of M.E. [Electronics & Telecommunication],
[12]	Revised Syllabus of M.E. [Embedded System],
[13]	Revised Syllabus of M.E. [Communication Engineering],
[14]	Revised Syllabus of M.E. [Digital Communication],
[15]	Revised Syllabus of M.E. [Biotechnology],
[16]	Revised Syllabus of M.E. [CAD/CAM],
[17]	Revised Syllabus of M.E. [Thermal],
[18]	Revised Syllabus of M.E. [Design Engineering],

This is effective from the Academic Year 2013-2014 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO. ACAD/ NP/ M.E./
SYLLABI / 2013/14092-100
V.C.14[7] A-08.
Date:- 15-06-2013.

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Director,
Board of College and
University Development.

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Copy forwarded with compliments to :-

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

2] The Director, University Network & Information Centre, UNIC, with **a request to upload the above all syllabi on University Website [www.bamu.net].**

Copy to :-

1] The Controller of Examinations,
2] The Superintendent, [Engineering Unit],
3] The Programmer [Computer Unit-1] Examinations,
4] The Programmer [Computer Unit-2] Examinations,
5] The Superintendent, [Eligibility Unit] ,
6] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,
Dr. Babasaheb Ambedkar Marathwada University,
7] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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S/160613/-*

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Revised Syllabus of

M.E.

THERMAL ENGINEERING

[Effective from the Academic Year 2013-14 & onwards]

DR. BABASAHEB AMBEDKAR MARATHAWADA UNIVERSITY, AURANGABAD

Proposed Teaching /Examination Scheme for 2013-14 for **M.E.(Thermal Engg.)**

Semester I

Course code	Name of the Subject	Teaching scheme Hrs per week				Examination scheme- Marks					Credit
		L	T	P	Total hrs	Theory	Avg. of 2 Class Test	Term Work	Viva voce	Total	
MTE 601	Advanced Thermodynamics	3	1		4	80	20			100	4
MTE 602	Advanced Heat Transfer	3	1		4	80	20			100	4
MTE 603	Research Methodology	3	1		4	80	20			100	4
MTE 604	Modern Energy Sources	3	1		4	80	20			100	4
MTE 641	Elective- I	3	1		4	80	20			100	4
MTE 621	Laboratory Practice – I			4	4			50		50	2
MTE 622	Seminar – I			2	2				50	50	1
MTE 623	Thermal Lab-I			2	2				50	50	1
	Total	**15**	**5**	**8**	**28**	**400**	**100**	**50**	**100**	**650**	24

Semester II

Course code	Name of the Subject	Teaching scheme Hrs per week				Examination scheme- Marks					Credit
		L	T	P	Total hrs	Theory	Avg. of 2 Class Test	Term Work	Viva voce	Total	
MTE 651	Advanced Refrigeration & Air Conditioning	3	1		4	80	20			100	4
MTE 652	Solar Thermal Systems and Green Building	3	1		4	80	20			100	4
MTE 653	I.C. Engines Theory and Performance	3	1		4	80	20			100	4
MTE 654	Advanced Fluid Mechanics	3	1		4	80	20			100	4
MTE 691	Elective- II	3	1		4	80	20			100	4
MTE 671	Laboratory Practice – II			4	4			50		50	2
MTE 672	Seminar – II			2	2				50	50	1
MTE 673	Thermal Lab-II			2	2				50	50	1
	Total	**15**	**5**	**8**	**28**	**400**	**100**	**50**	**100**	**650**	24

Semester III

Course code	Name of the Subject	Teaching scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MTE 731	Dissertation Phase I	--	12	12	--	50	50	100	12
	Total	--	**12**	**12**	--	**50**	**50**	**100**	**12**

Semester IV

Course code	Name of the Subject	Teaching scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MTE 781	Dissertation Phase II	--	20	20	--	100	200	300	20
	Total	--	**20**	**20**	--	**100**	**200**	**300**	**20**
	Grand Total							**1700**	**80**

Elective – I
MTE 641-A Computational Fluid Dynamics
MTE 641-B Cryogenics Engineering
MTE 641-C Tribology

Elective – II
MTE 691-A Energy Management in Thermal Systems
MTE 691-B Design of Thermal Systems
MTE 691-C Simulated Design of Solar Engineering System

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per week CH: Contact hours

Total Credits = SEM I + SEM II + SEM III + SEM IV
= 24 + 24 + 12 + 20
= 80

Semester I

MTE 601 ADVANCED THERMODYNAMICS

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs.)
Class Test: 20 Marks (1 hr)

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. (5 hrs.)

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; (5 hrs.)

Unit. III The Destruction Of Exergy: Lost Available Work, Mechanisms of Entropy Generation or Exergy Destruction, Entropy Generation Minimization. (5 hrs.)

Unit. IV Multi Phase Systems: General considerations, Dalton & Amagat Model, Mixture of gases and vapors. Changes in Molar Properties upon Mixing, Gibbs Entropy Equation and Gibbs -Duhem Equation. (5 hrs.)

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. (5 hrs.)

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) (5 hrs.)

Recommended Books:

1. Advanced Engineering Thermodynamics, Adrian Bejan, Wiley-Interscience Publication, Second Edition, ISBN 0-471-14880-6.
2. Fundamentals of Engineering Thermodynamics, Michael Moran & Howard Shapiro, Wiley & Sons, Sixth Edition, ISBN 978-0-471-78735-8

3. Fundamentals of Classical Thermodynamics, Richard Sonntag, Claus Borgnakke, John Wiley & Sons, Seventh Edition, ISBN: 978-0-470-04192-5.
4. Thermodynamics: An Engineering Approach, Yunus A. Cengel & Michael A. Boles, Sixth Edition, ISBN-13 9780073305370.

MTE 602 ADVANCED HEAT TRANSFER

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

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. (3 hrs.)

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. (5 hrs.)

Unit. III Convective 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. (5 hrs.)

Unit. IV Radiation heat transfer: Basic laws of radiations, Emissive power, Stefan–Boltzmann's Law, Lambert's Law, Wien's Law and Kirchhoff's laws, Emissivity, Radiation intensity. (2 hrs.)

Unit. V Radiative exchange between black isothermal surfaces: Diffuse grey surface, 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. (5 hrs.)

Unit. VI Boiling and condensation heat transfer with phase change: Boiling and Condensation, Flow boiling, Correlations. (5 hrs.)

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. (5 hrs.)

Books Recommended: (Note: Heat transfer data book will be permitted in Exam hall)

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 Oostiuson, 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

MTE 603 RESEARCH METHODOLOGY

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

Unit. I Research Concept: Concept, meaning, objectives, motivation; Types of research, approaches (descriptive research, conceptual, theoretical, applied and experimental research) (2 hrs.)

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. (3 hrs.)

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. (4 hrs.)

Unit. IV Experimental Modeling: Definition of experimental design, examples, single factor experiments, guidelines for designing experiments. (2 hrs.)

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. (4 hrs.)

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. (3 hrs.)

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. (5 hrs.)

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. (3 hrs.)

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. (4 hrs.)

Books Recommended:

1. Research Methodology, C R Kothari, Wiley Eastern publishers, New Delhi, 10th edition, 2006.
2. Research in Education, John W Besr & James V Kahn, Prentice Hall of India, New Delhi.
3. Theories of Engineering Experiments, Schank Fr, Tata McGraw Hill Publishing Ltd., New Delhi.
4. Experimental design by Cochran & Cocks, John Wielly & sons, New Delhi, 2005.
5. Design of Experiments, Douglas Montgomary, 1995.
6. Formulation of Hypothesis, Willkinson K, P L Bhandarkar, Himalaya Publishing House, Mumbai, 2005.

MTE 604 MODERN ENERGY SOURCES

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

Unit. I Solar Energy: Flat plate and concentrating collectors- design, analysis and performance, applications. Thermal Power, Photovoltaic power; Economic Analysis. (7 hrs.)

Unit. II Wind Energy: Atmospheric circulation, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, application, design aspects. (8 hrs.)

Unit. III Tidal and Ocean Energy: Applications, Design aspects, Power generation methods, various cycles and analysis. (5 hrs.)

Unit. IV Geothermal Energy And Magneto Hydrodynamics: Study of various components, Performance and methods of energy conversion. (5 hrs.)

Unit. V Nuclear Energy: Fusion and fission, study of various components, Design aspects, Performance and methods of power generation. (5 hrs.)

Books Recommended:

1. Solar Energy: Principles of thermal collection and Storage by Suhas P. Sukhatme ,Second Edition, Tata McGraw-Hill, 2006
2. Power Plant Technology by El- Wakil, McGraw Hill publication.
3. Principles of Solar Thermal Engineering by F.Kreith & J .F.Kreider, McGraw Hill Publications 1978.
4. Solar Engineeering of thermal Processes by J .A.Duffie and W.A.Beckman, John Wiley & Sons publication 1999.
5. Applied Solar Energy by A.B.Meinal & F.P.Meinal, Addison Wesley 1976 publication.
6. Solar Energy : Fundamentals and Applications (1st Revised Edition), Tata McGraw-Hill, 2000.
7. Thomas H. Kuehn, James W. Ramsey and Threkled, J.L., Thermal Environmental Engineering, 3rd Edition, Pearson Pub., 1998, ISBN-13: 978-0139172205.

MTE 641-A COMPUTATIONAL FLUID DYNAMICS (ELECTIVE-I)

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

Unit. I Review of Governing Equations: Governing Equations of Fluid flow and heat transfer, review of numerical methods. (3 hrs.)

Unit. II Discretization: Introduction to finite differences, difference equations, explicit and implicit approaches: definition and contrasts, errors and analysis of stability. (6 hrs.)

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. (6 hrs.)

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. (10 hrs.)

Unit. V Initial And Boundary Value Problems: Free falling of a spherical body, two dimensional motions of a body through a fluid radial flow. (5 hrs.)

Books Recommended:

1. Computational Fluid Flow and Heat Transfer, Muralidhar, K. and Sundararajan, T., Narosa Pub., 2004.
2. Computational Fluid Dynamics: The Basics with Applications, Anderson, J. D., Jr. McGraw Hill, 2002.
3. Computational Fluid Dynamics: An Introduction for Engineers, Abbot, M. B. and Basco, D. R., John Wiley & Sons, 2006.
4. Computational Fluid Dynamics: Principles and Applications, Blazek, J., Elsevier Science, 2001.

MTE 641-B CRYOGENIC ENGINEERING (ELECTIVE-I)

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hr per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs.)
Class Test: 20 Marks (1 hr)

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. (7 hrs.)

Unit. II Gas Separation and Purification - Principles - Plate Calculations - Air, Hydrogen and Helium separation systems. (8 hrs.)

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. (7 hrs.)

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. (8 hrs.)

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.

5. Thomas H. Kuehn, James W. Ramsey and Threkled, J.L., Thermal Environmental Engineering, 3rd Edition, Pearson Pub., 1998.

MTE 641-C TRIBOLOGY (ELECTIVE-I)

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 100 Marks,(3 hrs)
Class Test: 20 Marks (1 hr)

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. (7 hrs.)

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. (8 hrs.)

Unit. III Solid tribological coatings and materials – surface treatments –surface modification processes. (5 hrs.)

Unit. IV Tribological properties of metallic and ceramic coatings. (3 hrs.)

Unit. V Surface topography measurements - Electron microscope, friction and wear measurements. Use of transducers and instruments in Tribology- film thickness measurement using modern techniques – Development of test rigs for Tribology research. (7 hrs.)

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.

MTE 621 LABORATORY PRACTICE-I

Teaching Scheme:
Practical: 4 hrs per week
Credit: 2

Examination Scheme:
Term Work: 50 Marks

Laboratory Practice shall constitute laboratory experiments, design, Simulation, Programming Assignments, Industrial Visits with reports and its outcome, etc. Any one experiment from the courses viz., Steam Turbine, Case study on Modern Energy Sources.

Steam Turbine Module/Test Rig (1 kW capacity) (50 Marks)

Steam turbine working principle, requirement, measure the steam turbine efficiency, steam quality, flow rate and condenser effectiveness

or

Case Study (25 Marks)

Thermal performance of domestic solar water heater installed for furnace water heater etc

Industrial visits with reports and its outcome

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

Term Work: Term Work will be based on the work carried out by student with respect to any one topic mentioned above.

MTE 622 SEMINAR-I

Teaching Scheme:
Practical: 2 hrs per week
Credit: 1

Examination Scheme:
Viva voce: 50 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.

MTE 623 THERMAL LAB-I

Teaching Scheme:
Practical: 2 hrs per week
Credit: 1

Examination Scheme:
Viva voce: 50 Marks

Laboratory Practice shall constitute laboratory experiments on any one from the courses viz., Modern Energy Sources: Solar Water Heater, Solar Photovoltaic, Computational Fluid Dynamics (CFD-FLUENT).

Modern Energy Sources (25 Marks)

Utilization of Solar systems (residential/office buildings): Solar Water Heater, Solar Photovoltaic Grid connected Power Systems and street light applications etc

or

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.

Viva Voce: Viva Voce will be based on the work carried out by student with respect to any one topic mentioned above.

Semester II

MTE 651 ADVANCED REFRIGERATION AND AIR CONDITIONING

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

Unit.I Actual vapor compression system – Multi-pressure vapour compression system – Environment friendly refrigerants – cascade system. (7 hrs.)

Unit.II Absorption refrigeration system – Three fluid absorption system – comparison of absorption with compression system - Analysis of multistage systems. (8 hrs.)

Unit.III Advanced psychometric calculations - Cooling load calculations – Determination of U factor short method calculation. (5 hrs.)

Unit.IV Low temperature refrigeration - Joule Thompson coefficient – liquefaction of air – hydrogen –helium - Applications of cryogenics. (5 hrs.)

Unit.V Room air distribution – Friction losses in ducts - Duct design, Air filters clean rooms – Air Curtain. (5 hrs.)

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.

5. Thomas H. Kuehn, James W. Ramsey and Threkled, J.L., Thermal Environmental Engineering, 3rd Edition, 1998, Pearson Pub., ISBN-13: 978-0139172205.

MTE 652 SOLAR THERMAL SYSTEMS AND GREEN BUILDING

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

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. (5 hrs.)

Unit.II SOLAR THERMAL SYSTEMS Active Systems - Water Heating Systems - Active and Passive - Passive Heating and Cooling of Buildings - Solar Distillation - Solar Drying. (5 hrs.)

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. (5 hrs.)

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. (5 hrs.)

Unit.V WIND ENERGY CONVERSION SYSTEM (WECS) Basics-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. (5 hrs.)

Unit.VI GREEN BUILDING Background of Green/Solar building, both solar passive and active heating and cooling of buildings, various solar house concepts, Solar heating and cooling using Earth-air heat exchanger. Solar water heater applications in both residential and industrial sectors. 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. (5 hrs.)

MTE 654 ADVANCED FLUID MECHANICS

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

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. (7 hrs.)

Unit.II Laminar Flow of Viscous Incompressible Fluids: Introduction to compressible viscous flows, governing equations, Fanno and Rayleigh lines, normal and oblique shocks. 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. (8 hrs.)

Unit.III Exact Solution of Navier – Stokes Equation: Ideal and non-ideal flows, General equations of fluid motion, Navier-Stokes equations and their exact solutions, Hele Shaw flow stagnation point flow, creeping flow over sphere and circular cylinder. (8 hrs.)

Unit.IV Boundary- Basics, boundary layer theory, solutions to flow over external surfaces, flow through internal surfaces, integral methods, steady laminar and turbulent incompressible flows. (7 hrs.)

Books Recommended:

1. F.M.White, Viscous Fluid Flow, Second Edition, McGraw-Hill, Inc. New York
2. Muralidhar & Biswas, Advanced Fluid Mechanics, Second Edition, ISBN: 978-81-7319-627-0, 2005.
3. H. Schlichting, Boundary layer theory, McGraw-Hill, New York, 1968.
4. S.W.Yuan, Foundations of fluid mechanics, Prentice Hall, 1987.
5. P.Bradshaw, Turbulence, Springer-Verlag Pub., ISBN: 9780387077055, 1976.

MTE 653 I.C. ENGINE THEORY AND PERFORMANCE

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

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. (7 hrs.)

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. (8 hrs.)

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. (7 hrs.)

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, (8 hrs.)

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.

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

MTE 691-A ENERGY MANAGEMENT IN THERMAL SYSTEMS (ELECTIVE II)

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

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. (7 hrs.)

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. (8 hrs.)

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. (6 hrs.)

Unit.IV Electrical Systems: Demand Control, Power factor Correction, Load Scheduling / Shifting, Motor Drives - Motor Efficiency Testing, Energy Efficient Motors, Motor Speed Control. (6 hrs.)

Unit.V Lighting- Lighting Levels, Efficient Options, Fixtures, Daylighting, Timers, Energy Efficient Windows (3 hrs.)

Books Recommended:

1. Reay.D.A , Industrial Energy Conservation, Pergamon Press 1977
2. D.Merick and R. Marshall, Energy Present and Future Options. Vol I & II , John Wiley & Sons, 1981.
3. B. Sorenson, Renewable Energy, Academic Press, 1989.
4. Andy Lewry, Energy Management in the Built Environment-A Review of Best Practice, IHS BRE Press, 2012.
5. Bureau of Energy Efficiency, General aspect of energy management and energy audit, Book I-IV, 2nd Edition, New Delhi, India. 2005. (http://www.beeindia.in/energy_managers_auditors/ema.php?id=4)

MTE 691-B DESIGN OF THERMAL SYSTEMS (ELECTIVE II)

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

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. (4 hrs.)

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. (11 hrs.)

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. (15 hrs.)

Books Recommended:

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

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

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

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

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

MTE 691-C SIMULATED DESIGN OF SOLAR ENERGY ENGINEERING SYSTEM (ELECTIVE II)

Teaching Scheme:
Theory: 3 hrs per week
Tutorial: 1 hrs per week
Credit: 4

Examination Scheme:
Theory: 80 Marks (3 hrs)
Class Test: 20 Marks (1 hr)

Unit.I SOLAR HEAT SYSTEMS: General System, solar collectors, solar DHW systems; liquid based and air based solar space heating systems; solar radiation collection. (5 hrs.)

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. (5 hrs.)

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. (5 hrs.)

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. (5 hrs.)

Unit.V DESIGN OF ACTIVE SYSTEMS BY UTILIZABILITY METHODS: Hourly Utilizability, daily Utilizability; the phi-bar f-chart method. (5 hrs.)

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. (5 hrs.)

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

MTE 671 LABORATORY PRACTICE-II

Teaching Scheme:
Practical: 4 hrs per week
Credit: 2

Examination Scheme:
Term work: 50 Marks

Laboratory practice shall constitute laboratory experiments, design, simulation, programming assignments, etc.

At least two experiments from each of the courses viz., I.C. Engine, Fluid Mechanics, Solar Thermal Systems, Green Building etc

Petrol/Diesel Engine Test Rig: Experimental Study of Petrol/ Diesel Engine Test Rig (optional Morse Test Setup/ emission analyzer etc).

Or

Solar Thermal Systems: Solar thermal application of water heater for furnace water input

Or

Green Building: Skylight a natural light for artificial light energy conservation in Green Building

Term Work: Term work will be based on the work carried out by student with respect to any one topic mentioned above.

MTE 672 SEMINAR-II

Teaching Scheme:
Practical: 2 hrs per week
Credit: 1

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.

MTE 673 THERMAL LAB-II

Teaching Scheme:
Practical: 2 hrs per week
Credit: 1

Examination Scheme:
Viva-voce: 50 Marks

Laboratory practice shall constitute laboratory experiments, design, simulation, programming assignments, etc.

At least two experiments from each of the courses viz., I.C. Engine, Fluid Mechanics, Solar Thermal Systems, Green Building etc

Solar Energy: Hybrid Wind-Photovoltaic power unit, Grid connected Photovoltaic systems

Or

CFD: Computational fluid dynamics software application

Or

Fluid Mechanics: Test Rig for Turbine (Francis/Kaplan turbine etc)

Viva Voce: Viva Voce will be based on the work carried out by student with respect to any one topic mentioned above.

Semester III

MTE 731 DISSERTATION PHASE – I

Teaching Scheme:
Contact Hour: 12 hrs per week
Credit: 12

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 and guided by Departmental committee with guide suggestions and final approval for set of experiments for final project presentation. Students are advised to bring trial runs results if any with literature review and discuss regularly

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.

Semester IV

MTE 781 DISSERTATION PHASE – II

Teaching Scheme:
Contact Hour: 20 hrs per week
Credit: 20

Examination Scheme:
Term Work: 100 Marks
Viva-voce: 200 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.