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

Syllabus of

M. E. (Heat Power)

[Effective from Academic Year 2013 - 2014]

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Proposed Syllabus Structure of M.E. (Heat Power) w.e.f. Academic Year 2013-14

Semester I

Course code	Name of the Subject	Teaching scheme Hrs per week				Examination Scheme- Marks					Duration of Theory Exam	Credit
		L	T	P	Total hrs	Theory	Class Test	Term Work	Viva voce	Total		
MHP 601	Computational Mathematics	3	1		4	80	20			100	3 Hrs	4
MHP 602	Advanced Thermodynamics	3	1		4	80	20			100	3 Hrs	4
MHP 603	Advanced Fluid Mechanics	3	1		4	80	20			100	3 Hrs	4
MHP 604	Refrigeration & Cryogenics	3	1		4	80	20			100	3 Hrs	4
MHP 641	Elective- I	3	1		4	80	20			100	3 Hrs	4
MHP 621	Lab – I	-	-	04	04	-	-	50	-	50		2
MHP 622	Lab-II	-	-	02	02	-	-	-	50	50		1
MHP 623	Seminar – I	-	-	02	02	-	-	-	50	50		1
	Total	**15**	**05**	**08**	**28**	**400**	**100**	**50**	**100**	**650**		**24**

Semester II

Course code	Name of the Subject	Teaching scheme Hrs per week				Examination Scheme- Marks					Duration of Theory Exam	Credit
		L	T	P	Total hrs	Theory	Class Test	Term Work	Viva voce	Total		
MHP 651	Experimental Methods	3	1		4	80	20			100	3 Hrs	4
MHP 652	Advanced I.C. Engines	3	1		4	80	20			100	3 Hrs	4
MHP 653	Advanced Heat & Mass Transfer	3	1		4	80	20			100	3 Hrs	4
MHP 654	Turbo Machinery	3	1		4	80	20			100	3 Hrs	4
MHP 691	Elective- II	3	1		4	80	20			100	3 Hrs	4
MHP 671	Lab-III	-	-	04	04	-	-	50	-	50		2
MHP 672	Lab-IV	-	-	02	02	-	-	-	50	50		1
MHP 673	Seminar – II	-	-	02	02	-	-	-	50	50		1
	Total	**15**	**05**	**08**	**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	
MHP 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	
MHP 781	Dissertation Phase II	--	20	20	--	100	200	300	20
	Total	--	**20**	**20**	--	**100**	**200**	**300**	**20**
	Grand Total							**1700**	**80**

Elective – I (MHP 641A-D)
Fuels & Combustion
Renewable Energy Systems
Non-conventional Power Plant
Computational Fluid Dynamics

Elective – II (MHP 691A-D)
Energy Management of Thermal Systems
Alternative Fuels for Transportation
Advanced Gas Dynamics and Jet Propulsion
Energy Systems Modeling & Analysis

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

(MHP 601) COMPUTATIONAL MATHEMATICS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction to numerical methods applied to engineering problems**: Examples, solving sets of equation – Matrix notation – Determination and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs. **Numerical integration:** Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration.	10
2	**Optimization:** One dimensional unconstrained optimization, multidimensional unconstrained optimization – direct methods and gradient search methods, constrained optimization. **Boundary value problems and characteristic value problems:** Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayieigh - Ritz method – Characteristic value problems.	10
3	**Numerical solutions of partial differential equations:** Laplace's equations – Representation as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non-rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method. **Parabolic partial differential equations:** Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.	10
4	**Hyperbolic partial differential equations:** Solving wave equation by finite differences-stability of numerical method – method of characteristics wave equation in two space dimension-computer programs. **Curve fitting and approximation of functions:** Least square approximation fitting of non-linear curves by least squares – regression analysis – multiple linear regression, non linear regression – computer programs.	10

Recommended Books:

1. Steven C. Chapra, Raymond P. Canale "Numerical Methods for Engineers" Tata Ma-Graw Hill Pub.
2. Curtis F. Gerald, Partick. O. Wheatly, "Applied numerical analysis" Addison-wesley,1989.
3. Douglas J. Faires, Riched Burden, "Numerical methods" Brooks/cole publishing company, 1998 Second edition.

Reference Books:

1. Ward Cheney & David Kincaid "Numerical mathematics and computing" Brooks/cole publishing company 1999 fourth edition.
2. Riley K.F.M.P.Hobson & Bence S. J., "Mathematical methods for physics and engineering" Cambridge university press, 1999.

(MHP 602) ADVANCED THERMODYNAMICS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	State postulate for simple system and equation of state. Ideal gas equation of state. Compressibility factor. Deviation from ideal gas behavior. Other equations of state. Law of corresponding states.	05
2	Phase change processes of pure substances. Property diagrams for phase change processes. Use of property tables and charts.	05
3	Review of laws of thermodynamics. Second law analysis of thermal systems. Entropy. Principle of increase of entropy. Entropy change of pure substances. T-ds relations. Entropy generation. Thermo-electricity. Onsager equation.	05
4	Introduction to exergy. The decrease of exergy principle . Exergy analysis of thermal systems.	05
5	Thermodynamic property relations. Helmholtz and Gibb's function. Maxwell's relations. The Clapeyron equation. General relations for du, dh, ds, and C_v and C_p. The Joule-Thomson Coefficient. The Δh, Δu, Δs of real gases.	05
6	Chemical thermodynamics and equilibrium. Chemical reaction. Fuels and combustion. Enthalpy of formation and enthalpy of combustion. First law analysis of reacting systems. Adiabatic flame temperature. Conditions for chemical equilibrium. Phase equilibrium. Gibb's phase rule. Third law of thermodynamics. Nerst heat theorem and heat death of universe.	05
7	Composition of a gas mixture- Mass and mole fractions. P-v-T behaviour of gas mixtures. Dalton's law of partial pressure. Amagat's law. Kay's rule. Properties of gas mixtures.	05
8	Fundamentals of statistical thermodynamics. Lagrangian multipliers. Partition function. Equipartition of energy. Bose- Einstein statistics. Fermi-Dirac statistics.	05

Reference Books:

1. Cengel Y. A.,Boles M. A., Thermodynamics- An Engineering Approach, 7e, Tata McGraw Hill
2. Holman J.P., Thermodynamics, 4th edition, McGraw Hill
3. Dittman R.H., Zemansky M.W., Heat and Thermodynamics, 7e, Tata McGraw Hill
4. Gupta M.C., Stastistical thermodynamics, New Age
5. Turns S.R., Thermodynamics- Concepts and Applications, Cambridge University Press
6. Wark, Advanced Thermodynamics, McGraw Hill
7. Jones & Dugan, Advanced Thermodynamics, Prentice Hall Int.
8. Ness H.C., Smith J. M., Abbott M., Introduction to Chemical Engineering Thermodynamics, 7e, Tata McGraw-Hill
9. Kalyan Annamalai, Ishwar K Puri, Advanced Thermodynamics Engineering, CRC Press London
10. Moran M.A., Shapiro H.N., Fundamentals of Engineering Thermodynamics, 6e, Wiley India

(MHP 603) ADVANCED FLUID MECHANICS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Governing Equations:** Mass conservation in differential and integral forms, Flow kinematics, Momentum equation, substantial derivative, differential and integral form, stress tensor, stress- strain relations, and Ideal Fluid flow concepts.	06
2	**Navier-Stokes Equation:** Special forms, Euler equations, Bernoulli equation and its applications, stream function, vorticity. Exact solutions, fully developed flow in channel, pipe, flow between concentric rotating cylinders, Couette flow, Stokes First problem (unsteady flow),Creeping flow past a sphere, cylinder.	08
3	**Boundary Layer:** Boundary layer assumptions, equations, flow over a flat plate, similarity (Blasius) solution, Von –Karmon Integration Equation Falkner-Skan equation, momentum integral method, external flows, drag, lift, flow separation.	06
4	**Turbulent flow**: Introduction to hydrodynamic stability, characteristics of turbulence, governing equations, turbulent boundary layer, algebraic models (Prandtl's mixing length), velocity profile over a flat plate and in pipes.	06
5	**Turbulent Shear Flow:** Equations for free shear layers, mixing layer, plane and axisymmetric jet, wake, Turbulent energy equation, two equation model(k-epsilon), Large Eddy Simulation, Various Turbulent Models.	06
6	**Compressible Flow:** One-dimensional Flow, speed of sound, variable cross-section flow, converging diverging nozzle, effect of friction and heat transfer, normal shock relations, Introduction to oblique shocks, 2-dimensional flows(subsonic and supersonic) past slender bodies, compressible boundary layers.	08

Reference Books:

1. K. Muralidhar, Gautam Biswas,"Advanced Engineering Fluid Mechanics", Alpha Science International, Limited.
2. Frank M. White," Fluid Mechanics", Tata McGraw-Hill.
3. H. Schlichting , K Gersten ,"Boundary Layer Theory", Springer Technology & Engineering.
4. Yunus A Cengel, John M Cimbala, " Fluid Mechanics", Tata McGraw- Hill.

(MHP 604) REFRIGERATION AND CRYOGENICS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Vapour Compression Refrigeration System:** Simple systems, Multi-evaporator system; Multi expansion system; Cascade systems; Study of P-h; T-s; h-s and T-h charts for various refrigerants, Concept of Heat Pump	03
2	**Refrigerant:** Designation, selection, desirable properties, refrigerant blends, secondary refrigerants, refrigerant recycling, reclaim and charging, alternative refrigerants, Refrigerant-lubricant mixture behavior, ODP, GWP concepts	05
3	**Vapour Absorption Refrigeration:** Standard cycle and actual cycle, thermodynamic analysis, Li-Br-water, NH3-water systems, Three fluid absorption systems, half effect, single effect, single-double effect, double effect, and triple effect system	05
4	**Non-Convention Refrigeration System:** (Principle and thermodynamic analysis only): Thermoelectric refrigeration, thermo-acoustic refrigeration, adsorption refrigeration, steam jet refrigeration, vortex tube refrigeration, and magnetic refrigeration.	05
5	**Compressor Rating And Selection:** Hermetic, reciprocating, screw, Scroll and centrifugal Compressors based on applications.	05
6	**Evaporators:** types, thermal design, effect of lubricants accumulation, draining of Lubricants, selection and capacity control	05
7	**Condenser:** types, thermal design, purging, selection and capacity control	02
8	**Introduction To Cryogenics:** Importance of cryogenics, development history of cryogenics, application areas of cryogenics', material properties at cryogenic temperatures, super conductivity applications, cryogenics in space industries. cryogenics in aviation and aerospace industry, cryobiology.	05
9	**Liquefaction Systems:** Carnot Liquefaction system, F.O.M. and Yield of Liquefaction system, Inversion Curve – Joule Thomson Effect. Linde system, Linde-Hampson System, Precooled Linde Hampson System, Claudes system, Dual pressure System, Kapitza system, Heylandt system, Philips machine.	05

Reference Books:

1. R.J. Dossat, Principles of refrigeration, Pearson Education Asia
2. C.P. Arora, Refrigeration and Air-Conditioning
3. Stoecker and Jones, Refrigeration and Air-conditioning
4. Jordan and Priester, Refrigeration and Air-conditioning
5. A.R. Trott, Refrigeration and Air-conditioning, Butterworths.
6. J.L. Threlkeld, Thermal Environmental Engineering, Prentice Hall
7. W.F. Stoecker, Industrial Refrigeration Handbook, McGraw-Hill
8. John A. Corinchock, Technician's guide to Refrigeration systems, McGraw-Hill.
9. P.C. Koelet, Industrial Refrigeration: Principles, design and applications, McMillan

10. ASHRAE Handbook (i) Fundamentals (ii) Refrigeration
11. ISHRAE handbooks
12. ARI Standards
13. Refrigeration Handbook, Wang, Mc Graw Hill, Int.
14. Mamata Mukhopadhyay, Fundamentals of Cryogenic Engineering, PHI Learning, Private limited.
15. R. Baron, Cryogenic Systems, Oxford University Press.
16. A Bose and P. Sengupta, Cryogenics applications and progress, , McGraw-Hill

ELECTIVE-I
(MHP 641-A) FUELS AND COMBUSTION

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Types and Characteristics of Fuel** Determination of Properties of Fuels, Fuels Analysis, Proximate and Ultimate Analysis, Moisture Determination, Calorific Value, Gross and Net Calorific Values, Calorimetry, DuLong's Formula for CV Estimation, Flue Gas Analysis, Orsat Apparatus, Fuel and Ash Storage, and Handling.	06
2	**Solid Fuels** Types, Coal Family, Properties, Calorific Values, ROM, DMMF, DAG AND Bone Dry Basis, Ranking, Bulk and Apparent Density, Storage, Washability, Coking Properties and Caking Index of Coals, Renewable Solid Fuels, Biomass, Wood Waste, Agro Fuels, Manufactured Solid Fuels, Uses of Solid fuels.	06
3	**Liquid Fuels** Types, Sources, Petroleum Fractions, Classification, Refining, Properties of Liquid Fuels, Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number, etc., Alcohols, Tar Sand Oil, Liquefaction of Solid Fuels, Uses of Liquid Fuels.	06
4	**Gaseous Fuels** Types, Composition and Properties, Estimation of Calorific Value, Gas Calorimeter, Rich and Lean Gas, Wobbe Index, Natural Gas, Dry & Wet Natural Gas, Stripped Natural Gas, Foul & Sweet Natural Gas, LPG, CNG, Methane, Producer Gas, Gasifiers, Water Gas, Semi-water Gas, Town Gas, Biogas, Manufacture and uses of Gaseous Fuels, Coal Gasification, Gasification Efficiency, Non-Thermal Route, Digesters, Reactions, Viability, Economics.	06
5	**Combustion: Thermochemistry** Stoichiometry, Absolute Enthalpy and Enthalpy of Formation, Enthalpy of Combustion and Heating Value, Laws of Thermochemistry, Theoretical Air-Fuel ratio, Excess Air, Combustion Processes, Explosive Combustion, Mechanism of Combustion, Ignition and Ignition Energy, Spontaneous Combustion, Solid, Liquid and Gaseous Fuels Combustion, Adiabatic Flame Temperature, Chemical and Equilibrium Products of Combustion,	08
6	**Combustion: Flame and Detonation** Flame- Concept of Flame, Definition, Classification and Properties of Premixed Flames, Properties of Diffusion Flames, Flame Propagation, Measurement of Burning Velocity, Flame Stabilization, Quenching, Flame Temperature Measurement Techniques, Ionization. Detonation- Detonation Wave and their Characteristics, Deflagration to Detonation Transition, Derivation of Rankine- Hugoniot equation, Chapman Jouguet States and their Properties, Detonation Velocity.	08

Reference Books:

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Logman, Latest Edition
2. S. P. Sharma and Chander Mohan, Fuels & Combustion, Tata Mcgraw Hill,1984
3. Kanury Murty, Introduction to Combustion Phenomenon, Mc Graw Hill
4. Saha, Combustion Engineering and Fuels Technology, Oxford & IBM.
5. Turns, S. R., An Introduction to Combustion, McGraw-Hill: New York, 1996.

ELECTIVE-I

(MHP 641-B) RENEWABLE ENERGY SYSTEMS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	Introduction: World's Production and reserves of commercial energy sources, India's production and reserves, Energy alternatives, Different forms of non-conventional energy source, Limitation of conventional and non-conventional sources of energy.	05
2	Solar Energy: Production and transfer of solar energy, Availability and limitations of solar energy, Solar radiation geometry, Estimation and measurement of solar energy. Solar thermal collectors, General description and characteristics, Photovoltaic application: Types and characteristics of Photovoltaic cells, Solar cell arrays, balance of system, Thermal Application: Water heating, Drying, Cooking, Desalination, Solar refrigeration, solar ponds (Basic concepts).	05
3	Biomass Energy Sources: Different species, Conversion of biomass into fuels, Energy through fermentation, Pyrolysis, gasification and combustion, Aerobic and anaerobic bio-conversion, Thermo-chemical and Bio-chemical routes to biomass Utilization. Properties of biomass, Biogas plants, Types of plants, Design and operation, Properties and characteristics of biogas.	05
4	Wind Energy: Betz theory for wind energy conversion, Estimation of wind energy Potential, Characteristics of wind turbines (HAWT and VAWT), Aerofoil blade structure, Water pumping and power generation using wind turbines. Wave energy: Wave energy conversion machine & recent advances.	05
5	Mini and micro hydro power generation: Basic concepts, Types of turbines, Hydrological analysis.	05
6	Geothermal Energy Conversion: Forms of geothermal energy sources, geothermal electric power plants.	05
7	Tidal Energy: Single basin and double basin tidal systems (Basic concepts), Scope and economics, Introduction to integrated energy systems.	05
8	Energy storage: Sensible heat storage, Liquid media storage, Solid media storage, Dual media storage, Phase change energy storage, Storage capacity, Other storage methods, Solar dehumidification, Design, performance and applications, Combined solar heating and cooling systems, Performance and cost calculations.	05

Reference Books:

1. H.P. Garg & J. Prakash, Solar Energy - Fundamentals and Application, Tata McGraw-Hill Publications.
2. J.A. Duffie and W.A. Beckman: Solar Energy Thermal Processes, J. Wiley, 1994
3. A.A.M. Saigh (Ed): Solar Energy Engineering, Academic Press, 1977
4. F. Kreith and J.F. Kreider: Principles of Solar Engineering, McGraw Hill, 1978

5. G.N. Tiwari: Solar Energy-Fundamentals, Design, Modelling and Applications, Narosa Publishers, 2002
6. H.P. Garg, S.C. Mullick and A.K. Bhargava: Solar Thermal Energy Storage, 1985
7. K.M. Mittal: Non-conventional Energy Systems-Principles, Progress and Prospects, Wheeler Publications, 1997
8. G.D. Rai: Non-conventional Energy Sources, Khanna Publishers, 2003
9. D.Y. Goswami, F. Kreith and J.F. Kreider, "Principle of Solar Engineering", Taylor and Francis, 2000.
10. Sukhatme S.P., "Solar Energy", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
11. Bansal and othes, "Non-Conventional Energy Sources".
12. J.F. Kreider, F. Kreith, "Solar Energy Handbook", McGraw Hill, 1981
13. S.P. Sukhatme, Solar Energy - Principles of Thermal Collection & Storage, Tata McGraw-Hill Publications.

ELECTIVE-I

(MHP 641-C) NON-CONVENTIONAL POWER PLANT

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction** Status of energy scenario. Renewable and non-renewable energy sources. Availability, limitations, application of solar energy. Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO2 reduction potential of renewable energy.	06
2	**Solar Thermal Power Plants** (Concentrators, solar chimney etc.), solar thermal conversion devices, Economics and social considerations, Design considerations of component selection. Solar photovoltaic power plants, photovoltaic technology, Design of a photovoltaic system, economics and costing, Application as a distributed power supply strategy.	06
3	**Wind Energy** Wind energy potential measurement, wind electric generator component design, economics and demand side management, energy wheeling, and energy banking concepts.	06
4	**Biogas** Properties of biogas (calorific value and composition etc.), biogas plant technology and status. Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. engine operation and economic aspects.	08
5	**Geothermal Energy** Hot springs and steam ejection site selection, power plants, and economics.	03
6	**Ocean Energy** Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.	06
7	Environmental impacts, Economic and social considerations, financing mechanisms, carbon credits, clean development mechanisms.	05

Recommended Books:

1. Non-Conventional Energy Sources by G.D. Ra
2. Renewable Energy Technologies by Ramesh & Kumar /Narosa

Reference Books:

1. Renewable energy resources by Tiwari and Ghosal, Narosa.
2. Non-Conventional Energy by Ashok V Desai, Wiley Eastern.
3. Non-Conventional Energy Systems by K Mittal, Wheeler
4. Solar Energy by Sukhame

ELECTIVE-I

(MHP 641-D) COMPUTATIONAL FLUID DYNAMICS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction and Governing Equations of CFD** Historical background, impact of CFD, derivation, discussion of physical meanings and presentation of forms particularly suitable to CFD.	03
2	**Basic Aspects of Discretization** Introduction to FDM, FEM and FVM, detailed treatment of FDM, explicit and implicit methods, errors and stability analysis. **Grids with Appropriate Transformations** Adaptive grids and unstructured meshes, uniform and non-uniform grids, Numerical errors.	08
3	**Few CFD Techniques** The Lax-Wendroff Technique, MacCormack's Technique, Space marching, Relaxation Technique, Numerical dissipation and dispersion, artificial viscosity, The ADI Technique, Pressure correction Technique: Application to incompressible viscous flow, the SIMPLE algorithm, Computation of Boundary layer flow, Finite deference approach.	08
4	**Numerical Solution of Governing equations:** Numerical solution of elliptical equations, Linear system of algebraic equations, Iterative solution of system of linear equation, Model Equations, Wave equations, Numerical solution of parabolic equations, Stability analysis, Solutions of convection, Diffusion equation, Conservative and non-conservative schemes, Navier-Stokes equations, Basics of grid generation, Numerical solution of hyperbolic equations.	08
5	**Convection Heat Transfer** Steady One-Dimensional and Two-Dimensional Convection, Diffusion, Unsteady one-dimensional convection, Diffusion, Unsteady two-dimensional convection, Diffusion.	05
6	**Incompressible Couette Flow:** Solution by implicit method and the pressure correction method, Governing Equations, Stream Function, Vorticity method, Determination of pressure for viscous flow. **Numerical Solution of 2D Supersonic Flow:** Prandtl-Meyer Expansion Wave. **Supersonic Flow over a Flat Plate:** Numerical Solution by solving complete Navier Stokes equation.	08

Reference Books:

1. J. D. Anderson, Computational Fluid Dynamics-The Basics with Applications, Mcgraw Hill.
2. Fletcher C.A.J., Computational Techniques for Fluid Dynamics, Volumes I and II, Springer, Second Edition 2000

3. C. Hirsch, Numerical Computation of Internal and External Flows, Volumes I and II, John Wiley & Sons, 2001
4. Muralidhar K. and Sundararajan T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi1995.
5. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, T & F.

(MHP 621) LAB-I

Teaching Scheme:
Practical: 04 Hrs/Week
Credits: 02

Examination Scheme:
Term Work: 50 Marks

- **Numerical solution based on each of the following mentioned programming for heat power application.**

1. Linear Algebraic Equations
2. Curve fitting – Least square regression
3. Interpolation
4. Ordinary differential equations
5. Parabolic / Hyperbolic Partial Differential Equations

(MHP 622) LAB-II

Teaching Scheme:
Practical: 02 Hrs/Week
Credits: 01

Examination Scheme:
Viva voce: 50 Marks

- **Development of code using any programming language (C, C++, VB, etc.) for wide application of heat power/thermal engineering.**

For Example:

1. To find air fuel ratio, mixture formation, air required to complete combustion with given input of C, H, N, O, and S of species.
2. To find adiabatic flame temperature with given input of fuels (diesel, petrol, hydrogen, CNG and LPG).
3. To find emission formation after combustion with given input of fuels (diesel, petrol, hydrogen, CNG and LPG).

Note: Above mentioned are only examples, simulation can be conducted with wide application of heat power/thermal engineering.

Practical Examination should be based on Viva-Voce on the above exercise.

(MHP 623) SEMINAR-I

Teaching Scheme:
Practical: 02Hrs/Week
Credits: 01

Examination Scheme:
Viva voce: 50 Marks

Seminar – I shall be based on the literature survey on any topic, which will lead to dissertation in that area. It will be submitted as a report of about 30 pages.
The candidate will have to deliver a seminar presentation before the examiners, one of them will be guide and the other will be examiner appointed by the university.

(MHP 651) EXPERIMENTAL METHODS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	Terminology used in experimental methods. The generalized measurement system. Basic concepts in dynamic measurements. Experiment planning.	04
2	Design of experiments. Strategy of experimentation. Applications of experimental design. Basic principles of experimental design-randomization, replication and blocking. Guidelines for designing an experiment. Statistical design of experiments.	04
3	Analysis of experimental data. Experimental errors. Uncertainty analysis. Statistical analysis of experimental data. Probability distributions. Gaussian error distribution. Comparison of data with normal distribution. The chi-square test of goodness of fit. Method of least squares. The correlation coefficient. Multivariable regression. Standard deviation of the mean. Student's t-distribution. Graphical analysis and curve fitting. Choice of graph formats. General considerations in data analysis.	06
4	Pressure Measurement- Static and dynamic pressure in fluids. Pressure measuring transducers. High pressure measurement. Low pressure measurements.	04
5	Flow Measurement- Positive displacement methods. Flow obstruction methods. The sonic nozzle. Flow measurement by drag effects. Hot-wire and hot-film anemometers. Magnetic flow-meters. Flow visualization methods. The Shadowgraph. The Schlieren. The interferometer. The Laser Doppler Anemometer (LDA). Smoke Methods. Pressure probes. Impact pressure in Supersonic Flow.	08
6	Measurement of Temperature and Heat Flux- Temperature Scales. Ideal gas thermometer. Temperature measurement by mechanical effects. Temperature measurement by electrical effects. Temperature measurement by radiation. Effect of heat transfer on temperature measurement. Transient response of thermal systems. Thermocouple compensation. Temperature measurements in high speed flow. Thermal conductivity measurements. Convection heat transfer measurements. Heat flux meters. Error Estimates in Temperature Measurement, temperature Measurements in Cryogenics, Transient Experimental Techniques for Surface Heat Flux Rates.	10
7	The general data acquisition system. Signal conditioning. Data transmission. A/D and D/A conversion. Data storage and display.	04

Reference Books:

1. Holman J.P., Experimental Methods for Engineers, Tata McGraw-Hill
2. Beckwith T.G., Mechanical Measurements - Beckwith TG., Lienhard J.H., Marangoni R.D., Pearson Education
3. Doebelin E.O., Manik D.N., Measurement systems-Application and Design, Tata McGraw-Hill
4. Wheeler A.J., Ganji A.R., Introduction to Engineering Experimentation, Prentice Hall
5. Montgomery D.C., Design and Analysis of Experiments, Wiley

(MHP 652) ADVANCED I.C. ENGINES

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Spark Ignition Engines** Mixture requirements, Fuel Induction systems, Stages of combustion, Normal and abnormal combustion, factors affecting knock, Combustion chambers, Engine design, Basic concepts of simulation technique.	06
2	**Compression ignition engines** Stages of combustion in C.I. Engine, Direct and indirect Injection systems, Combustion chambers, Fuel spray behavior, spray structure, spray characteristics, air motion, engine design, Basic concepts of simulation technique.	06
3	**Fuels for SI and CI Engine** Qualities of SI & CI engine fuels, rating of SI & CI engine fuels, fuel additives for SI & CI engines, Fuel supply systems for SI and CI engines to use gaseous fuels like hydrogen, CNG, biogas and, other possible fuels.	06
4	**Super-charging and Turbo-charging** Purpose of supercharging, effects of supercharging on SI & CI engines performance and its limitations, different types of turbo-charges, methods of turbo charging & its limitations.	06
5	**Engine Emissions & Control:** Air pollution due to IC engines, Emissions-HC, CO, NOx, particulates, GHGs (CO_2, CH_4 and N_2O), emission norms, emission control methods-exhaust gas recirculation, three way catalytic convertor, particulate trap, modern methods.	08
6	**Recent Trends** Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Data Acquisition System –pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines.	08

Reference Books:

1. E.F. Obert, "Internal Combustion Engines and Air Pollution", Intext Educational Publishers, 1973.
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. L.C. Litchy, "Combustion Engines Processes", McGraw Hill, 1967.
5. V. Ganesan, Int. Combustion Engines, II Edition, TMH, 2002.
6. V. Ganesan, Computer simulation of spark ignition process: University process, Hyderabad 1993.
7. V. Ganesan, Computer simulation of compression ignition engine. Orient Long man 2000.

(MHP 653) ADVANCED HEAT & MASS TRANSFER

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	Review of heat transfer fundamentals. Review of steady state (one-dimensional) and transient conduction, convection, and radiation heat transfer.	04
2	Extended surfaces. Steady state analysis and optimization of fin design. Conduction shape factor. Two dimensional steady heat conduction. Transient heat conduction (one-dimensional and two-dimensional).	04
3	Numerical and graphical methods in heat transfer. Introduction to CFD in conduction heat transfer (steady one-dimensional and unsteady one-dimensional).	04
4	Flow across tube banks. Heat transfer enhancement in internal flows. Natural convection from-finned surfaces and from inside enclosures. Micro scale heat transfer. Non-Fourier heat conduction. Combined natural and forced convection. Heat transfer with phase change. Flow boiling. Film condensation over plates, tubes, spheres and inside tubes. Non-condensable gases in condensers. Drop-wise condensation. Heat pipes.	08
5	Multimode heat transfer.	02
6	Effectiveness-NTU method of designing heat exchangers. Compact heat exchangers. Introduction to simulation and optimization of heat exchangers.	06
7	Electronic equipment cooling. Cooling load of electronic equipment. Conduction cooling in chip carriers and PCBs. Heat frames. Air cooling. Cooling of PCs. Liquid cooling. Immersion cooling. Ablative, transpiration and high speed cooling.	06
8	Analogy between heat and mass transfer. Fick's law of diffusion. Diffusion in gases, liquids and solids. Convective mass transfer. Simultaneous heat and mass transfer.	06

Reference Books:

1. Incropera, F.P., De Witt, D.P., Bergman T.L., Lavine, A.S., Fundamentals of Heat and Mass Transfer, 6e, John Wiley and Sons
2. Lienhard, J.H IV and V, A Heat Transfer Textbook, free download from Internet
3. Yunus Cengel, Heat Transfer: A Practical Approach, 4e, Tata McGraw Hill
4. Ozisik, M.N., Heat Transfer-A Basic Approach, McGraw-Hill
5. Michael Modest, Radiative Heat Transfer, McGraw-Hill
6. Holman J.P., Heat transfer, Tata McGraw- Hill
7. Patankar S.V., Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation
8. Oleg Zikanov, Essentials of Computational Fluid Dynamics, Wiley
9. Welty J.R., Wicks C.E., Wilson R.E., Fundamental of Momentum, Heat and Mass Transfer, John Wiley and Sons

10. Suryanarayana N.V., Engineering Heat Transfer, Penram International Publishing (India) Pvt. Ltd.
11. Kern D.C., Process Heat Transfer, McGraw Hill
12. Bejan A., Convective Heat Transfer, John Wiley and Sons.
13. Sukhatme, S. P., Textbook of Heat Transfer, Orient Blackswan-University Press.

(MHP 654) TURBO MACHINERY

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction To Turbo Machines** Principles of operation, Energy transfer in turbo machines, classification of turbo machines, Losses and efficiencies – performance Characteristics	04
2	**Flow Through Nozzle And Diffuser** flow over immersed bodies – flat plate, sphere and air foil – pressure distribution over a symmetrical and inclined air foil – blade technology, blade cascades and nomenclature – lift and drag coefficients – elementary, concept of three dimensional flows – free and forced vortex	06
3	**Steam Turbines** Types – impulse turbine – compounding of impulse turbines – Velocity triangles – reaction turbines – Velocity diagrams – degree of reaction – governing of turbines – Gas turbine classification – Cycle analysis – simple cycle – improvements –Effect of operating variables on thermal efficiency – application of gas turbine	06
4	**Axial Flow Fans** Construction and operation – types of stages – performance of fans – applications - Centrifugal fans – construction and operation – types – fan stage, parameters – drum type and partial flow fans – losses.	06
5	**Hydraulic Turbines** Pelton wheel, analysis of force and power generation in a Pelton wheel, governing of Pelton wheel. Francis turbine, velocity triangles and analysis of force, power and efficiency, net head across Francis turbine, draft tubes. Kaplan turbines. Characteristics of reaction turbines. Comparison of specific speeds of hydraulic turbines	08
6	**Pumps** Classification of pumps, centrifugal pump, pumping system and net head developed by pump, manometric efficiency, losses in centrifugal pumps, head discharge and discharge characteristics of a centrifugal pump. axial flow pump. Matching of pump and system characteristics, pumps in series and parallel. Cavitations.	10

Reference Books:

1. Turbines Compressors and Fans – S.M.Yahya – Tata McGraw-Hill Company 2002
2. Principles of Turbo machines by – D.G.Shephard Macmillan company 1984
3. Gas Turbine Theory – Cohen Rogers, Saravana Muttoo, Long man publishing 2004
4. Steam Turbine - Theory and Practice – William J. Kerten, CBS Publishing 1988
5. Fundamentals of Turbomachinery by William W. Peng, John Wiley & Sons, 2007, ISBN 978-0-470-12422-2

ELECTIVE-II

(MHP 691-A) ENERGY MANAGEMENT OF THERMAL SYSTEMS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Energy Management:** Energy Scenario - Basics of Energy and its various forms - Energy Management and -Audit Material and Energy Balance -Energy Action Planning-Financial Management –Project Management -Energy Monitoring and Targeting - Global Environmental Concerns	08
2	**Energy Efficiency in Thermal Utilities:** Fuels and Combustion-Boilers-Steam System-Furnaces - Insulation and Refractory -FBC Boilers -Cogeneration -Waste heat recovery-Case study	08
3	**Energy Efficiency in Electrical Utilities:** Electrical Systems-Electric Motors-Compressed Air System-HVAC and Refrigeration System-Fans and Blowers-Pumps and Pumping System-Cooling Tower-Lighting System-Diesel Generating System-Energy Efficient Technologies in Electrical Systems	08
4	**Energy Performance Assessment for Equipment and Utility systems:** Boilers-Furnaces-Cogeneration, Turbines (Gas, Steam)- Heat Exchangers-Electric Motors and Variable Speed Drives-Fans and Blowers-Water Pumps-Compressors--Case study	08
5	**Waste Heat Recovery:** HVAC Systems-Lighting Systems-Performing Financial Analysis-Applications of Non- Conventional and Renewable Energy Sources-Waste Minimization and Resource Conservation	08

Reference Books:

1. Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiencies, 2005
2. Electrical Energy Utilization and Conservation - S.C. Tripathy, Tata McGraw-Hill, 1991.
3. Energy management handbook - Wayne C. Turner, CRC Press Publications, 2004.

ELECTIVE-II

(MHP 691-B) ALTERNATIVE FUELS FOR TRANSPORTATION

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction** Need for alternate fuel, availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources. Like Electric vehicle, hybrid, fuel cell and solar cars.	08
2	**Alcohols** Properties as engine fuel, alcohols and gasoline blends, performance in SI engine, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, DME, DEE properties performance analysis, performance in SI & CI Engines.	08
3	**CNG, LPG, Hydrogen and Biogas** Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG, LPG and Biogas using in SI & CI engines, Hydrogen; storage and handling, performance and safety aspects.	08
4	**Vegetable Oils** Various vegetable oils for engines, transesterification, biodiesel and its properties, performance, emission and combustion characteristics of engine.	08
5	**Electric, Hybrid, Fuel Cell and Solar** Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar powered vehicles.	08

Reference Books:

1. M.K. Gajendra Babu, K.A. Subramanian, Alternative Transportation Fuels: Utilisation in Combustion Engines, CRC Press, 2013.
2. Richard L. Bechfold, Alternative Fuels Guide Book - SAE International Warrendale 1997.
3. B. P. Pundir, Engine Emissions, Alpha Science International Limited, 2007
4. B. P. Pundir, IC Engines Combustion and Emissions, Alpha Science International Limited, 2010.
5. Nagpal, Power Plant Engineering, Khanna Publishers - 1991.

ELECTIVE-II

(MHP 691-C) ADVANCED GAS DYNAMICS AND JET PROPULSION

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction to gas dynamics**: control volume and system approaches acoustic waves and sonic velocity - Mach number - classification of fluid flow based on mach number- mach cone-compressibility factor - General features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.	05
2	**Isentropic flow of an ideal gas:** basic equation - stagnation enthalpy, temperature, pressure and density-stagnation, acoustic speed - critical speed of sound-dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area -stream thrust and impulse function. Steady one dimensional isentropic flow with area change-effect of area change on flow parameters- chocking- convergent nozzle -performance of a nozzle under decreasing back pressure -De lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.	07
3	**Simple frictional flow**: adiabatic flow with friction in a constant area duct-governing equations - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct-governing equations -limiting conditions. Steady one dimensional flow with heat transfer in constant area ducts- governing equations - Rayleigh line entropy change caused by heat transfer -conditions of maximum enthalpy and entropy	07
4	**Effect of heat transfer on flow parameters**: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations - Rankine Hugoniat equations - Prandtl's velocity relationship -converging diverging nozzle flow with shock thickness - shock strength.	07
5	**Propulsion:** Types of jet engines - energy flow through jet engines, thrust, thrust power and propulsive efficiency turbojet components-diffuser, compressor, combustion chamber, turbines, exhaust systems. Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines. Rocket propulsion - rocket engines, Basic theory of equations - thrust equation - effective jet velocity - specific impulse - rocket engine performance - solid and liquid propellant rockets - comparison of various propulsion systems	14

Reference Books:

1. Anderson, J.D., Modern Compressible flow, McGraw Hill, 3rd Edition, 2003.
2. S.M. Yahya, Fundamentals of Compressible Flow, New Age International New Delhi, 1996.
3. Elements of gas dynamics - Liepman & Roshko
4. N.J. Zucrow, Aircraft and Missile Propulsion, vol.1 & II, John Wiley, 1975.
5. Gas dynamics - M.J. Zucrow & Joe D.Holfman
6. V. Ganesan, Gas Turbines, Tata McGraw Hill Publishing Co., New Delhi, 1999
7. Mechanics and Dynamics of Propulsion –Philip Hill and Carl Peterson.- Addison Wesley

ELECTIVE-II

(MHP 691-D) ENERGY SYSTEMS MODELING & ANALYSIS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credits: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	Overview of various technologies and Conventional methods of Energy Conversion - Power Cycles - Designing a Workable System - Workable and Optimum Systems	06
2	Modeling: Basic features of Modeling, Types of Models, General Procedure of Mathematical Modeling, Curve fitting - Exact fit, Best fit	06
3	Modeling of Thermal Equipment – Counter flow Heat Exchanger, Evaporators and Condensers, Heat Exchanger Effectiveness, Effectiveness of Counter flow Heat Exchanger, NTU, Pressure drop and Pumping power	08
4	System Simulation: Sequential Simulation, Simultaneous Simulation-Successive Substitution and Newton- Raphson Method. Examples of Energy Systems Simulation	08
5	Optimization: Mathematical representation of Optimization problems, Optimization Procedures-Calculus Methods, Search Methods, Dynamic Programming, Geometric Programming, Linear Programming. Case Studies of Optimization in Energy Systems	08
6	Pinch Technology- Basic Concepts-Design of Recovery system using Pinch Technology	04

Reference Books:

1. Y. Jaluria, Design and Optimization of Thermal Systems, McGraw-Hill
2. W.F.Stoecker, Design of Thermal Systems, Mc-Graw Hill
3. I J Nagrath & M Gopal , Systems : Modeling and Analysis,Tata McGraw-Hill
3. R F Boehm, Design Analysis of Thermal Systems, John Wiley & Sons
4. B K Hodge, Analysis and Design of Energy Systems, Prentice-Hall Inc.
5. A Bejan, G.Tsatsaronius and M.Moran, Thermal Design and Optimization, John Wiley & Sons
6. D J Wide,Globally Optimal Design, Wiley Interscience
7. S S Rao, Optimisation Theory and Applications, Wiley Eastern
8. P Meier, Energy Systems Analysis for Developing Countries, Springer Verlag

(MHP 671) LAB-III

Teaching Scheme:
Practical: 04Hrs/Week
Credits: 02

Examination Scheme:
Term Work: 50 Marks

- **Experiment /Case study list (Any Five)**
  1. Computer aided energy analysis of steady flow cyclic system
  2. Energy audit of a Cogeneration system
  3. Performance analysis of Diesel Gen- Set.
  4. Performance assessment of Compressed Air System
  5. Design of Vapor Absorption **OR** Vapor Compression System.
  6. Design of waste heat recovery system.
  7. Case study for engine selection
  8. Duct design for any one application from: Hospital, Hotel, Auditorium, Computer lab, Operation Theater, etc.
  9. Exergy analysis of a steam power plant.
  10. Fluidized bed combustion

(MHP 672) LAB-IV

Teaching Scheme:
Practical: 02Hrs/Week
Credits: 01

Examination Scheme:
Viva voce: 50 Marks

- **Simulation study using mathematical simulation software such as Fluent /Star CD/ ANSYS/CFX / HyperWork AcuSolve for thermal engineering application.**

For example:

1. Steady state conduction in solid.
2. Steady state convection in solid.
3. Combined conduction and convection.
4. Unsteady state conduction and convection.
5. Steady state conduction in fluids.
6. Steady state convection in Fluids.
7. Two-phase flows.
8. Condensation and boiling heat transfer.
9. Flow over a cylinder/sphere at different Reynolds Number
10. Flow through a converging-diverging nozzle.
11. Incompressible flow through pipes/ducts of variable cross-section Laminar/Turbulent

Above mentioned are only examples, simulation can be conducted with wide application of heat power/thermal engineering.

Practical Examination should be based on Viva-Voce on the above study.

(MHP 673) SEMINAR-II

Teaching Scheme:
Practical: 02Hrs/Week
Credits: 01

Examination Scheme:
Viva voce: 50 Marks

Seminar – II shall be based on the literature survey on any topic, (preferably in continuation with the Seminar – I) which will lead to dissertation in that area. It will be submitted as a report of about 40 pages.
The candidate will have to deliver a seminar presentation before the examiners, one of them will be guide and the other will be examiner appointed by the university.

(MHP 731) DISSERTATION – I

Teaching Scheme:
Contact Hours: 12 Hrs/Week
Credits: 12

Examination Scheme:
Term Work: 50 Marks
Viva voce: 50 Marks

The dissertation shall consist of a report on any research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The dissertation will consist of two parts as dissertation part-I and dissertation II.

Term work:
The dissertation part I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be a senior faculty member from the department.

Viva-voce:
The dissertation part I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be an external examiner.

(MHP 781) DISSERTATION – II

Teaching Scheme:
Contact Hours: 20 Hrs/Week
Credits: 20

Examination Scheme:
Term work: 100 Marks
Viva voce: 200 Marks

The dissertation part - II will be in continuation of dissertation part - I and shall consist of a report on the research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The examinee shall submit the dissertation in triplicate to the head of the institution duly certified by the guide and the concerned head of department and the principal that the work has been satisfactorily completed.

Term work:
The dissertation will be assessed by two internal examiners appointed by the Institute, one of whom will be the guide and other will be a senior faculty member from the department.

Viva voce:
It shall consists of a defense presented by the examinee on his work in the presence of examiners appointed by the university, one of whom will be the guide and other will be an external examiner.