Solapur University, Solapur

Choice Based Credit System Syllabus (w.e.f. June 2015-16)

M.E. Mechanical (Thermal Engineering)

(Part-I)

Sr.No.	Name of the Subject	Teaching Scheme		Examination Scheme			Total Marks
		L	T/P	T/W	TP	Oral	
1	Advanced Fluid Mechanics & CFD	3	2	25	100	-	125
2	Measurement in Thermal Systems	3	1	25	100	-	125
3	Advanced Heat & Mass Transfer	3	2	25	100	-	125
4	Design of Experiments & Research Methodology	3	1	25	100	-	125
5	Elective-I	3	1	25	100	-	125
6	Seminar-I	-	2	25	-	-	25
	Total	**15**	**9**	**150**	**500**	**-**	**650**

Elective-I:

1. Advanced Thermodynamics
2. Turbomachines
3. Combustion
4. Steam & Gas Turbines

(Part-II)

Sr.No.	Name of the Subject	Teaching Scheme		Examination Scheme			Total Marks
		L	T/P	T/W	TP	Oral	
1	Design of Thermal Systems	3	1	25	100	-	125
2	Computational Techniques in Thermal Engineering	3	2	25	100	-	125
3	Theory & Design of I.C.Engines	3	2	25	100	-	125
4	Design of Refrigeration & Air Conditioning System	3	2	25	100	-	125
5	Elective-II	3	1	25	100	-	125
6	Seminar-II	-	2	25	-	-	25
	Total	**15**	**10**	**150**	**500**	**-**	**650**

Elective-II:

1. Power Plant Engineering
2. Energy Analysis & Management
3. Rocket Technology
4. Cryogenics & Vacuum Technology

(Part-III)

Sr.No.	**Name of the Subject**	**Teaching Scheme**		**Examination Scheme**			**Total Marks**
		L	T/P	T/W	TP	Oral	
1	In-Plant Training	-	-	50	-	-	50
2	Seminar-III	-	1	-	-	50	50
3	Project Phase-I	-	4	50	-	-	50
	Total	**-**	**5**	**100**	**-**	**50**	**150**

(Part-IV)

Sr.No.	**Name of the Subject**	**Teaching Scheme**		**Examination Scheme**			**Total Marks**
		L	T/P	T/W	TP	Oral	
1	Project Phase-II	-	5	200	-	100	300
	Total	**-**	**5**	**200**	**-**	**100**	**300**

Note:-

1. L=Lecture, T/P = Tutorial/Practical, T/W = Term Work, TP=Theory Paper.
2. In-plant training report for the training for at least two weeks undertake in the vacation after part-II is to be submitted in part-III.
3. In-plant Training should be in the industries related to thermal engineering.
4. The Contact Hours for the calculation of load of teacher.

   Seminar- 1 Hr/Week/Student &

   Project- 2 Hr/Week/Student

M. E. MECHANICAL (Thermal Engineering) Part -I

1. ADVANCE FLUID MECHANICS & CFD

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 2 Period (120 min.) per week	Term Work: 25 marks

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1. **Fluid Motions with friction**: Hagen Poiseulli equation, Navier-Stokes equations **(2Hrs)**

2. **Boundary Layer Theory**: Reynolds principle of similarity, laminar and turbulent boundary layer. flow along a flat plate. Exact and integral methods of solutions flowin a straight conduit, flow separation and control, hydrodynamic theory of lubrication. **(8Hrs)**

3. **Turbulence:** Origin, nature of turbulent flow, energy distribution in turbulent flows. Derivation of stress tensor of apparent turbulent friction flow from Navier-Stokes equation ,prandd's mixing length theory, Von Karman velocity distribution, turbulent flow through pipes. Boundary layer at zero pressure gradient on a smooth flat plate..Measurement of turbulent flow over aerofoils & choice of suitable sections based on performance. **(10Hrs)**

4. **Compressible Fluid Flow:** Fundamental equations of Gas-dynamics propagation of shock waves, oblique shock waves (elementary treatment). **(4Hrs)**

5. **Philosophy of computational fluid mechanics:**
   Introduction, impact of CFD, application areas. **(2Hrs)**

6. **Governing equations of fluid dynamics:**
   Introduction, Models of the flow, substantial derivative of moving fluid element, Divergence of the velocity, Continuity equation, momentum equation, energy equation, physical boundary conditions. **(5Hrs)**

7. **Mathematical Behaviour of PDE, the impact of CFD**
   Suitable forms of Governing equations, Hyperbolic, parabolic, Elliptic equations, Well- posed problems. **(3Hrs)**

8. **Some Simple CFD Techniques :**
   1. Introduction, Lax-wendroff Technique, Mac Cormackls Techniques, Relaxation Technique, Numerical dissipation and dispersion, Alternating direction-implicit technique, pressure correction formula, boundary condition for pressure correction method, introduction to different plots of computer graphics.

2. Numerical solution for quasi one dimensional nozzle flows: subsonic –supersonic, isentropic flow and its CFD solution, stock capturing **(6Hrs)**

Term Work:

1. Four to five assignment on Chapter 1 to 4
2. Four to five assignment on Chapter 5 to 8

References Books:

1. “Computational Fluid Dynamics, The basics with application”, John D. Anderson,
2. “Transport phenomenon, 2nd edition”, John Wiley and Sons.
3. “Boundary Layer Theory”, Schlichting.
4. “Fluids Mechanics”, W. Kanzman
5. “Fluids Mechanics”, Mohanty A.K.
6. “Numerical heat transfer,” Suhas V.Pathankar,Taylor& Francis.
7. “Fundamentals of Compressible Flow,” S.M Yahya, Newage international publisher.
8. “Computational Methods for Fluid Dynamics,”J.H.Fergiger and M.Peric, Springer.
9. “Computational Fluid Flow and Heat Transfer,” K.Muralidhar& T. Sundararajn,Navosa Publishing House.
10. “Introduction to Computational Fluid Dynamics,” Anil W.Date,Cambridge.Univercity Press.
11. “Introduction to Computational Fluid Dynamics,” PradipNiyogi, S.K Chakrabartty, M.K.Laha, Pearson Education.

M. E. MECHANICAL (Thermal Engineering) Part -I

2. MEASUREMENT IN THERMAL SYSTEMS

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

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1. Error Analysis in Experimental Investigations-Curve Fitting of Experimental Data. **(5 Hrs)**

2. Methods of Measuring Temperature-Thermocouple. Error Estimation. Convective and Radiation Affects. **(6 Hrs)**

3. Measurement of Unsteady Temperature-Optical Methods Shadow graph, Schilieren and Interferometer, Spectroscopic Temperature Determination. **(8 Hrs)**

4. Measurement of Pressure, Vacuum, Level etc. **(5 Hrs)**

5. Heat Flux: Sponsors. Transient Experimental Techniques for Surface Flux Rates. **(6 Hrs)**

6. Measurement- Thermal Radiation. Volume Flow Rate, Velocity- Hot Wire and Hot Film Anemometer, Acoustic Methods. **(6 Hrs)**

7. Measurement of Turbulence, Pojlatants-Gas Chromatography. **(4 Hrs)**

Term Work:

Eight to ten Practical/Tutorial based on above syllabus.

Reference Books:

1.E.G.R. Eckert and R.G. Goldstein, Measurement Techniques in Heat Transfer.
2.J.E.O. Doebelin; Measurement Systems: Application and Design.
3.T.P. Holeman, Experimental Methods for Engineers.
4.H.D. Young, Statistical Treatment of Experimental Data.

M. E. MECHANICAL (Thermal Engineering) Part -I

3. ADVANCED HEAT & MASS TRANSFER

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 2 Period (120 min.) per week	Term Work: 25 marks

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1. Conduction

Differential equation of heat conduction in Cartesian, cylindrical and spherical coordinates for isotropic and anisotropic materials. Heat generation problems, thermal conductivity of solids, liquids and gases and its variation with temperature. Experimental methods to determine thermal conductivity, Critical thickness of insulation, Extended surfaces, The straight fin of uniform cross section, The annular fin of uniform thickness, Two dimensional steady stale heat conduction problems. Unsteady state heat conduction in an infinite slab, Lumped heat capacity system. Use of charts for solving unsteady state heat conduction problems, Graphical analysis. Numerical methods of analysis, Gauss- Seidel iteration. Transient numerical methods. The Schmidt plot. **(11 Hrs)**

2. Convection

Principles of Fluid Flow: The differential equation of continuity. The differential equation of motion in fluid flow - Navier Stokes equation. Laminar flow in a circular pipe. Turbulent flow in a pipe. The velocity boundary layer. Laminar flow over a flat plate. The integral method. Turbulent flow over a flat plate.

Forced Convection: Differential equation of heat convection in Cartesian coordinates. Cylindrical coordinates Laminar flow heat transfer in circular pipe. Turbulent flow heat transfer in a pipe. The Thermal heat transfer in laminar flow over a flat plate. The integral method. Reynolds analogy.Colburn analogy. Empirical relations for forced convection **(8 Hrs)**

3. Radiation

Law of radiation, radiation properties. Shape factor. Heat exchange between non-black bodies. Radiation shields. Gas radiation. Radiation network for absorbing and transmitting medium. Solar radiation, Effect of radiation on temperature measurement. Radiation heat transfer coefficient. Radiation from flames **(7 Hrs)**

4. Condensation and Boiling:

Film and drop condensation. Film condensation on vertical plate and horizontal tube. Condensation number. Film condensation inside horizontal tube. Drop condensation promoters. Boiling heat transfer. Simplified relation for boiling heat transfer with water.

Heat transfer by natural convection: Natural conventional flow patterns, natural convection from vertical flat plate. Correlations for cylinders and plates. Correlation for enclosed spaces **(6Hrs)**

5. Heat Exchangers

Types, fouling factors. LMTD and NTU-effectiveness method. Heat exchanger design considerations.Design of double pipe, shell and tube heat exchanger.Use of baffles- type. Heat pipe heat exchanger **(6Hrs)**

6. Mass Transfer

Fick's law of diffusion. Diffusion of gases. Diffusion in solids and liquids. Mass transfer coefficient. Similarity in heat, mass and momentum transfer. Transport equations. Mass transfer across interface.Schimidt, Lewis, Sherwood numbers. **(2Hrs)**

Term Work:

1. Determination of Thermal conductivity of liquids and gases.
2. Determination of Thermal conductivity of insulating materials, glass wool, PUFF etc.
3. Determination of heat transfer in boiling and condensation.
4. Determination of correlations between Nusselt, Prandtl and Reynold's numbers in Forced convection heat transfer.
5. Determination of effectiveness in Parallel and Counter flow heat exchanger.
6. Plotting of Schmidt plot: by a computer program
7. Two assignment involving computer programmes based on above syllabus.
8. One problem on Thermal analysis using FEM software packages.

References Books:

1. "Heat Transfer", J. P. Holman
2. "Analysis of Heat and Mass Transfer", Eckert and Drabe
3. "A Text Book on Heat Transfer", S.P. Sukhatme.
4. "Heat Transfer", Chapman
5. "Engineering Heat Transfer",Simonson
6." Heat Transfer and Application",B.K.Dutta.

M. E. MECHANICAL (Thermal Engineering) Part -I

4. DESIGN OF EXPERIMENTS & RESEARCHMETHODOLOGY

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

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1. Research concept: concept, meaning. objectives,motivation, types of research approaches. research (Descriptive research, conceptual, theoretical. Applied experimental) **(4 Hrs)**

2. Formulation of research task: literature review: importance and methods, sour quantification of cause effect relations, discussions, field study, labours experiments. critical analysis of already generated facts. hypothetical proposal future development and testing.selection of research task. Prioritization research. **(4 Hrs)**

3. Mathematical modeling and simulation: concept of modeling, classification mathematical models, modeling with ordinary differential equations. Differential equations, partial differential equations, graphs. Simulation: concept type (quantitative. experimental. computer. fuzzy theory. statistical) process formulation of model based on simulation. **(6Hrs)**

4. Experimental Modeling:

a) Definition of experimental design, examples, single factor experiment blocking and nuisance factors, guidelines for designing experiments.

b) General model of process; input factors/variables,.o/p parameters variables, controllable /uncontrollable variables, dependent/independent variables. Compounding variables, extraneous variables. Experiment validity.

c) Process optimization and designed experiments: methods for study response surface, I order design. Determining optimum combination of factors, method of steepest ascent. Taguchi approach parameter design. **(8Hrs)**

5. Analysis of results: (parametric and non-parametric. descriptive and infinite.data): types of data, collection of data (normal distribution, calculation correlation coefficient) processing, analysis, error analysis, meaning, different methods analysis of variance, significance of variance, analysis of co variance multiple regression, testing linearity/ non linearity of model, testing adequate model, testing model/ hypothesis. **(6Hrs)**

6. Report writing: Types of report, layout of research report, interpretation of new style manuals, layout and format, style of writing, typing, references, paging, tables, figures, conclusions, appendices. **(6Hrs)**

7.Landscape of creativity: Convergent v/s divergent thinking, creativity, creativity v/s intelligence. creativity abilities, creativity and madness, determination of creativity, increasing creativity, creative achievement, techniques of creativity, collective creativity.

(6Hrs)

Term Work:

At least ten assignments based on above syllabus.

Reference Books:

1. “Research Methodology”, C.R. Kothari, Wiley Eastern.
2. “Formulation of Hypothesis”, Willkinson K.P, L Bhandarkar, Hymalaya Publication, Bombay.
3. “Research in Education”, John W Best and V. Kahn, PHI Publication.
4. “Research Methodology- A step by step guide for beginners”, RanjitKumar,Pearson Education
5. “Management Research Methodology-Integration of principles, methods and Techniques”, K.N. Krishnaswami and others, Pearson Education.
6. “Optimization theory and application ”,S.S.Rao.WilyEasern ,New Delhi.
7. “Experimental Design”,Cochran and cocks,john Willy and Sons.
8. “Introduction to SQC,John Willy and Sons.

M. E. MECHANICAL (Thermal Engineering) Part -I

5. ADVANCED THERMODYNAMICS (Elective-I)

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

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1. Thermodynamic Relations

Maxwell relations, thermodynamic relations involving enthalpy, internal energy and entropy. Thermodynamic relations involving specific heat. Developing tables of thermodynamic properties from experimental data (**4 Hrs)**

2. Entropy

Principle of increase of entropy, thermal death of universe, fluctuation hypothesis, entropy and disorder, entropy production. Limitations of second law of thermodynamics. Third law of thermodynamics and its corollaries. (**8 Hrs)**

3. Real Gases

Deviation from ideal gas behavior, equations of state for real gases. Reduced coordinates, generalized equation of state. Law of corresponding states, generalized compressibility charts, enthalpy, deviation and entropy deviation charts and their applications. P-V-T surfaces of real substances. Fugacity and activity (**8 Hrs)**

4. Mixtures of Ideal Gases

Gravimetric analysis and volumetric analysis, Amagat's model, Dalton's model, Gas constant and molecular weight of the mixtures, Energy changes and entropy changes of the mixtures, Reversible and irreversible mixing of the ideal gases. Elementary analysis of mixture of real gases. (**6 Hrs)**

5. Energy, Entropy and Exergy

Exergy calculations. Exergetic efficiency and exergy charts. Exergy balance and analysis of exergy losses

Relative Systems: Combustion with excess, deficient and stoichiometric air. Heats of reaction, heating values of fuel. Enthalpy of formation. Adiabatic flame temperature. Gibb's function of formation, entropy changes during ideal gas reactions. Dissociation, condition for chemical equilibrium, equilibrium constant. (**8 Hrs)**

6. Kinetic Theory of Gases

Postulates, concept of elastic collisions and mean free path. Derivation of ideal gas laws from kinetic theory; Distribution of molecular velocities. Maxwellion speeds and temperature. Law of equipartition of energy. Survival equation. Transport phenomenon.

Statistical Thermodynamics: Quantum considerations, degeneracy, microstates, microstates and thermodynamic probability. The equilibrium distribution, microscopic interpretation of heat and work. Partition function and its use. **(6 Hrs)**

Term Work:

Eight to Ten Practicals / Tutorials based on above syllabus.

References Books:

1. “Fundamentals of Classical Thermodynamics”, V. Wylen& E. Sonntag.
2. “Thermodynamics”, J. P. Holman.
3. “Exergy”, S. Zagit& R. Petela, Moscow Publication.
4. “Heat and Thermodynamics”, M. W. Zemansky.
5. “Thermodynamics far Engineers”, M. L. Mathur& S. C. Gupta.
6. “Fundamentals of Engineering Thermodynamics”, Howell &Buckins.
7. “Engineering Thermodynamics”, Lee-Sears

M. E. MECHANICAL (Thermal Engineering) Part -I

5. TURBOMACHINES (Elective-I)

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

1. Dimensional analysis and principle of similitude, Energy transfer between fluid and rotor, Potential flow through cascades of blades. 3-dimensional viscous and compressibility effects**.** **(15 Hrs)**

2.Principles of design and performance of different types of turbomachines. **(15 Hrs)**

3.Equilibrium running diagrams, Principles of Mechanical design of different components of turbomachines and its auxiliary equipment, Regulation of turbomachines. **(10 Hrs)**

Term Work:

Eight to Ten Assignments based on above syllabus.

References Books:

1.D.G. Shephard, Principles of Turbo machinery, McMillan Co., New York.
2.S.M. Yahya, Turbomachines, lIT, New Delhi.
3.H. Cohen and Rogers, Gas Turbines Theory, Longman Green Co., Ltd

M. E. MECHANICAL (Thermal Engineering) Part -I

5. COMBUSTION (Elective-I)

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

1.Fuels and their properties, Review of basic thermodynamics and gaseous mixtures, combustion thermodynamics, stoichiometry**.** **(7Hrs)**

2.The First and Second Laws of Thermodynamics applied to combustion, composition of products in equilibrium, fundamentals of combustion kinetics. **(6Hrs)**

3. Theory of thermal ignition, self ignition temperature, ignition delay. **(3 Hrs)**

4.Flame phenomena, deflagration and detonation, laminar flame propagation, flammability limits, flame quenching and minimum ignition energy . **(7 Hrs)**

5.Laminar burning velocity measurements, turbulent flame propagation, flame stabilization, diffusion flames. **(7 Hrs)**

6.Gaseous jet flames, burning of condensed phase, vaporization and combustion of liquid fuel droplet. **(5 Hrs)**

7.Spray combustion, combustion of solid fuels, Rocket motor systems. **(5Hrs)**

Term Work:

Eight to Ten Assignments based on above syllabus.

References Books:

1.Glassman I., Combustion 2nd Edition, Academic Press, 1987
2.Kuo K.K. Principles of Combustion, John wiley & Sons, New York 1986
3.Stephen R.Turns, An Introduction to combustion, concepts and applications, 2e, McGraw Hill, 2000
4.Gary L Borman and Kenneth W Ragland, Combustion Engineering, McGraw Hill,1998
5.R.M.Fristrom, Flame structure and processes, McGraw Hill, New York, 1995
6.Mukunda H.S., Understanding Combustion, Macmillan India Limited, Madras 1992
7.S.P Sharma and Chandermohan, Fuels and Combustion, Tata McGraw Hill

M. E. MECHANICAL (Thermal Engineering) Part -I

5. STEAM & GAS TURBINES (Elective-I)

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

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1. Steam Turbines: power plant cycles, Cycle analysis and design, losses in steam turbine. **(7 Hrs)**

2. Design of a stage, Design of multistage axial flow turbines, Vortex flow and lower pressure stage design**.** **(8 Hrs)**

3. Performance at varying loads governing, Calculation of design point efficiency using cascade data. **(8 Hrs)**

4. Gas Turbines - Performances of practical gas turbine cycles. **(7 Hrs)**

5. Design point performance of simple and series flow cycles, factors affecting performance. **(10 Hrs)**

Term Work:

Eight to Ten Assignments based on above syllabus.

References Books:

1.W.J. Kearton, Steam Turbine Theory and Practice.
2.Lee, Theory and design of Steam and Gas Turbine, Me Graw Hill.
3.Cohen and Roger, Gas Turbine Theory; Longmans London.
4.Jennings and Rogers, Gas turbine analysis and Practice, Me Graw Hill. /NITK-

M. E. MECHANICAL (Thermal Engineering) Part -I

6. SEMINAR-I

Teaching Scheme:
Tutorial/Practical: 2 Hr./Week/Student Term Work:25 Marks

Seminar I shall be delivered on one of the advanced topics chosen in consultation with the guide after compiling the information from the latest literature and also internet. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both side printed, preferably in IEEE format) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the guide along with other details if any.

M. E. MECHANICAL (Thermal Engineering) Part -II

1. DESIGN OF THERMAL SYSTEMS

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

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1. Engineering Design: Introduction, Decisions in an engineering Undertaking, Activities.
Designing a Workable System: Workable and optimum systems. Steps involved in arriving at a workable system **(5 Hrs)**

2. Economics of Engineering Decision: Variable factor involved.
Mathematical Modeling: Equation fitting, Modeling a thermal equipment – counter-flow heat exchanger, evaporators and condensers **(8 Hrs)**

3. System Simulation
Uses of simulation, Method of simulation **(6 Hrs)**

4. Optimization: Level of optimization, Mathematical representation of optimization, Optimization procedures.
Mathematical Modeling of Thermodynamic Properties: Need, Form of the equation, Criteria for fidelity of representation. Linear and nonlinear regression analysis. Thermodynamic properties. Internal energy and enthalpy. Clapeyron equation, Pressure-temperature relationship at saturated conditions. Maxwell relations, p-v-t equations, Building a full set of data **(8 Hrs)**

5 Steady-State Simulation of Large Systems
Newton-Raphson technique. Accelerating the solutions of linear equations. Quasi-Newton method. Influence coefficients **.** **(8 Hrs)**

6 Introduction to Dynamic Behavior of Thermal Systems **(5 Hrs)**

Term Work:

1. Any two assignments on above syllabus.
2. Development of Computer Programs for simulation of thermal system.

Reference Books:

1. “Design of Thermal System”, W.F. Stoecker, McGraw Hill International Edition.
2. “Cryogenic Regenerative Heat Exchanger”, Robert A. Ackermann, Plenum Press, New York.
3. “Thermal Design and Optimization”, Adrian bejan, George Tsatsaronis, Michel Moral, John Wiley and sons.
4. “Design and Optimization of Thermal Systems”, Yogesh Jaluria, Mc Graw Hill Co.

M. E. MECHANICAL (Thermal Engineering) Part -II

2. COMPUTATIONAL TECHNIQUES IN THERMAL ENGINEERING

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 2 Period (120 min.) per week	Term Work: 25 marks

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1. Solution Of Linear Simultaneous Equations: Gauss elimination, Gauss-Jordan, Matrix inversion, Gauss-Seidal, Eigen value problem.
Non-Linear Equations: Iterative method, Half interval search techniques, Regula-Falsi method, Newton-Raphson method, Methods for simultaneous non-linear equations Algebraic and Transcendental equations, Lin-Bairstows method **(8 Hrs)**

2 .Numerical Integration:
Area and Volume Integration: Trapezoidal rule, Simson's rules, Gaussian Quadrature, Newton-Cotes Quadrature formulae.
Numerical Solutions Of Ordinary Differential Equations: Taylor's method, Eular's method, Modified Eular's method Runge-Kutta method,Methods for simultaneous and higher order equations. **(8 Hrs)**

3 .Curve Fitting
Principal of least squares, fitting a straight line, fitting a parabola, fitting an exponential curve, fitting a curve of the form $y = a\ x^b$ **(4 Hrs)**

4 .Finite Difference and Solution of Partial Differential Equations
Forward difference, backward difference, Central difference expression for first and second derivative terms. **(6 Hrs)**

5. Applications of Finite Difference Technique
In conduction and convection heat transfer (ID & 2D Problems) **(8 Hrs)**

6. Introduction to Finite Element Method
Solutions of boundary value problems, Integral formulations for numerical solutions, One dimensional linear element, Application of FEM in ID and 2D conduction and convection heat transfer problems. **(5 Hrs)**

Term Work :

Numerical problems and computer programs based on above syllabus.

Reference Books:

1. “Numerical Methods”, S.P. Garg.
2. “Numerical Method”, P.Kandasamy, Thilagavathy, K. Gunavathy, S.Chand & Co. Ltd. N.D.
3. “Computer Simulation of Flow and Heat Transfer”, P.S. Ghoshdastidar, Tata McGraw Hill Delhi.
4. “Introductory Methods of Numerical Analysis”, S. S. Satry, Prentice Hall India.
5. “Applied Finite Element Analysis”, Larry. J. Segerlind, John Wiley & Sons,New York.

M. E. MECHANICAL (Thermal Engineering) Part -II

3. THEORY & DESIGN OF I.C.ENGINES

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 2 Period (120 min.) per week	Term Work: 25 marks

1.Constructional features of different engines. **(5 Hrs)**

2. Combustion phenomena in SI engine, Combustion knock, Combustion chamber designs for SI engine. **(8 Hrs)**

3.Combustion phenomenon in the CI engine, Combustion chamber design for the CI engine, Delay period, and diesel knock, IC engine design principles. **(8 Hrs)**

4.Design of engine components, Piston, connecting rod, crankcase, crankshaft, manifolds, valves. **(10 Hrs)**

5. Design of cooling system, lubricating oil system and radiator fans, computer aided design of engine components, Engine balancing, recent advances. **(9 Hrs)**

Term Works:

Six to Eight practical / Assignments based on above syllabus.

References Books:

1. “I.C. Engines”, Obert.
2. “A Course in I. C. Engines”, Mathur and Sharma, Dhanpatrai Publications.
3. “I. C Engine Fundamentals”, J. B. Heywood, McGraw Hill.
4. “Diesel and High Compression Gas Engine Fundamentals”, Edgar J. Kates.
Taraporewala and Sons.
5. “Computer Simulation of Spark Ignition Engine Processes”, V. Ganesan, Uni. Press.
6. “Auto Design”, R.B. Gupta.
7. “High Speed Combustion Engines”, P. M. Heldt, IBH Publications.
8. “I.C. Engines”, V. L. Ma1eev, McGraw Hill.
9. “I.C. Engines”, Lester C. Lichty. McGraw Hill.
10. “The I.C Engine”, C. Fayette Taylor and Edward S. Taylor, International Textbook Co.
11. “I. C. Engines”, Ricardo.
12. “Machine Design”, R. K. Jain, Khanna Pub1ishers.
13.Kolchin A and Demidov V, Design of Automotive Engines, Mir Publishers, Moscow, 1984
14.Charles Fayette Taylor, Internal combustion Engines in theory and practice. Vols I and. II The MIT Press Massachusetts Institute of Technology, USA, 1996
15.John Fenton, Engine Design, University Press Cambridge, Great Britain, 1986
16.Colin Ri Ferguson, Internal Combustion Engine, Applied Thermosciences, John wiley and sons.

M. E. MECHANICAL (Thermal Engineering) Part -II

4. DESIGN OF REFRIGERATION & AIR CONDITIONING SYSTEM

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 2 Period (120 min.) per week	Term Work: 25 marks

1.Principles of vapour compression refrigeration system, cascade cycles, working fluids **(4 Hrs)**

2.Compressors : reciprocating, rotary, scroll compressors, screw and centrifugal compressors. Heat exchangers, condensers, evaporators, dynamics of capillary and valve expansion devices **(5 Hrs)**

3.Design criteria for pipelines, absorption and adsorption refrigeration cycles, choice of working fluids, Thermoelectric refrigeration and Hybrid cycles. **(7 Hrs)**

4.Psychrometry. Air-conditioning calculations. Comfort scales. Solar radiation. Estimation of solar radiation from the solar angles. **(5 Hrs)**

5.Cooling load and heating load calculations. Solar space heating and cooling. Passive cooling systems. Dehumidification and humidification equipment. **(7 Hrs)**

6.Design of cooling towers, spray washers, air washers, cooling and dehumidifying coils. Design of air duct system. Room air distribution. Various types of air conditioning systems. **(6 Hrs)**

7.Various types of system controls. Mass transfer by molecular diffusion and convection. Calculation of mass transfer coefficients. Interface mass transfer. Application of air conditioning. **(6 Hrs)**

Term Works:

Six to Eight Practicals / Assignments based on above syllabus.

References Books:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw Hill
2. Manohar Prasad, Refrigeration and Air conditioning, Wiley Eastern Limited, New Delhi.
3. Heat transfer, Refrigeration, Thermodynamics/Air conditioning Data Hand Book.
4. Jones,“Air Conditioning”.
5. Stockers ,“Refrigeration and Air Conditioning”

M. E. MECHANICAL (Thermal Engineering) Part -II

5. POWER PLANT ENGINEERING (Elective-II)

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

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1. Resources and Development of Power India:
Source of energy, energy consumption as a measure of prosperity. Availability of commercial or conventional energy sources in India**.** **(3 Hrs)**

2. Hydro-Electric Power Plant:
Introduction, site selection, elements of hydroelectric power plant, classification of hydro-electric power plants, types of hydraulic machines, selection of turbines, hydro plant auxiliaries, hydro plant controls, electrical and nonelectrical equipments in hydro-plant, hydro power development in India. **(4 Hrs)**

3. Thermal Power Plant:
Introduction, classification , layout of modern steam power plant, site selection, fuel handling equipments, combustion equipment, spreader stoker, conveyor stoker, underfeed stoker, pulverised fuel firing, pulverised fuel handling ,pulverising mills, coal burners, gas & oil burners, ash handling equipments ,dust collection.
Steam Generators:-Components, design criteria, boiler types, high pressure boiler, water boiler, boiler accessories. **(5 Hrs)**

4.Diesel Engine Power Plant:
Introduction,Adv. & Dis.Adv. , Applications,site selection,essential components of diesel power plant,operation of diesel power plant,types of diesel engine used for diesel power plant,layout of a diesel engine power plant. **(4 Hrs)**

5. Nuclear Power Plant:
Nuclear reactors classification, essential components of a nuclear reactor, power of a nuclear reactor, main components of nuclear power plant, description of various types of reactors, selection of materials for reactor components, advantages & disadvantages of Nuclear power plant. Application of nuclear power plants. Safety measures for nuclear power plants, nuclear power plants in India**.** **(4 Hrs)**

5.Variable Loads on Power Plant:
Industrial production and power generation comparison, Ideal and Load curves, Effect of variable loads on power plant design and operation, method of meeting the load. **(4 Hrs)**

7. Power Plant Economics:

Economics in plant selection, factors affecting economics of generation & distribution of power, economics of hydro-electrics, combined hydro & steam power plants, performance & operating characteristics of power plants, economic load shearing, tariff for electrical energy. **(4 Hrs)**

8. Peak Load Plant:

Introduction, requirement, various types of peak load plants. **(2 Hrs)**

9. Combined Operation of Different Power Plant:

Advantages of combined operations of plants, load division between power sations. Hydraulic plant in combined with steam plant, hydro-electric and gas turbine combination, co-ordination of different types of plants. **(3 Hrs)**

10. Instrumentation & Controls:

Classification of instruments ,Pressure, temp., Liquid level, Flow. PIL Speed, Humidity instruments, Gas Analyzers. **(2 Hrs)**

11.Major Electrical Equipments in Power Plants:

Generator, Transformers, Cooling of Generators & Transformers, Switch Gears, Protection systems, Control room, Transmission of electrical power. **(3 Hrs)**

12.Pollution and Its Control:

Air and Water pollution by thermal power plants & its control, Pollution due to Nuclear power plant its control, Standardization for environmental protection. **(2 Hrs)**

Term Works:

Six to Eight Assignments based on above syllabus.

References Books:

1.“ Power plant Engineering”,F.T.Morse,D.Van Nostrand Co.
2.“ Power plant Engineering”,R.K.Rajput,Laxmi publication,New Delhi.
3.“ Power plant Engineering”,Arora S.Domkundwar,Dhanpatrai and sons,Delhi,
4. “Non Conventional Energy Sources”,G.D.Rai,khanna publication,Delhi.

M. E. MECHANICAL (Thermal Engineering) Part -II

5. ENERGY ANALYSIS AND MANAGEMENT (Elective-II)

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

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1. Energy Scenario: - Worlds production and reserves of commercial energy sources. India's production and reserves energy alternatives. **(4 Hrs)**

2. Alternative energy sources and technologies : -(a) Solar energy : - Device for thermal collection and storage, thermal applications, liquid flat plate collectors, performance analysis, testing procedures concentrating collectors – varies types, orientations and tracking modes, performance analysis of cylindrical parabolic concentrating collectors, effect of varies parameters on collectors performance.
(b) Other methods for solar energy/ wind energy utilization : - Applications, geothermal resources, geothermal electrical power plant, classification and types, vapour dominated, liquid dominated geothermal power plant, scope for geothermal system in india. **(10 Hrs)**

3. Economical and environmental aspect of alternatives: - Initial and annual costs, definitions of annual solar savings, lifecycle savings, present worth calculations, repayment of loan in equal annual instalments, annual solar savings, cumulative solar savings and lifecycle savings, pay-back period, environmental problem related with utilization of geothermal and wind energy. **(8 Hrs)**

4. Energy auditing : - Introduction, types, preliminary audit, intermediate and compressive audit, procedure of auditing, case study and recommendation. **(5 Hrs)**

5. Energy conservation : - Importance, principles, planning for energy conversion- electrical energy, thermal energy, human and animal muscle energy, waste recovery revelling, cogeneration. **(8 Hrs)**

6. Energy management: - Energy strategic planning, management of supply side- elements, steps, flow. Management of utilization side- elements, transmission, equipment and control systems, principles of energy management. **(5 Hrs)**

Term Work:

Six Assignments based on above syllabus**.**

References:

1. Solar Energy, S.P.Sukhatme,Tata McGraw hill ,Co.Ltd,New Delhi.
2. Hand Book of Industrial Energy Convertion,S.David Hik,Van,Nostrand Rein bold Co. New York.
3. Hand Book of Energy Technology,V.Dantel Hunt,Van.Nostrand Rein hold Co.New York.
4. Energy Technology, Non conventional,Renewable & Conventional, S Rao & Dr.B.B.Parulekar.Khanna publishers,Delhi.
5.Solar Energy,H.P.Garg & J.Prakash,Tata Mcgraw Hill Pub.Co.Ltd.Delhi.

M. E. MECHANICAL (Thermal Engineering) Part -II

5. ROCKET TECHNOLOGY (Elective-II)

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

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1. Reaction Principles, Essential factors of propulsive devices. Momentum theory. **(7 Hrs)**

2. Ramjet engine, Design of propulsion and turbo jet engines. **(10 Hrs)**

3. Performance of rocket vehicles. Design parameters, Solid propellant rocket motors. liquid propellant rockets. **(10 Hrs)**

4. Combustion mechanism, testing of rockets. **(6 Hrs)**

5. Introduction to nuclear and electrical rocket system. .**(7 Hrs)**

Term Works:

Six to Eight assignments based on above syllabus.

References Books:

1.M.J. Zucrow, Principles of Jet Propulsion and Rocket Systems, John Wiley.
2.Mathur and Sharma, Gas Turbines and Jet Propulsion.
3.S.P. Sutton, Rocket Propulsion Elements.
4.M.J. Zucrow, Aircraft and Missile Propulsion, vol.- 11,John Wiley.

M. E. MECHANICAL (Thermal Engineering) Part -II

5. CRYOGENICS & VACUUM TECHNOLOGY (Elective-II)

Teaching Scheme:	Examination Scheme:
Teaching: 3 Periods (60 min.) per week	Uni.Exam:100 marks
Practical: 1 Period (60 min.) per week	Term Work: 25 marks

1.Liquefaction of permanent gases, Methods of Air liquefaction, separation, storage and transport, Applications. **(5 Hrs)**

2.Properties of solids and liquids at Cryogenic temperatures, cryogenic insulations vacuum technology. **(7 Hrs)**

3.Cryo pumping, Cryogenic heat pipes, Cryo engines, Cryogenic instruments. Applications of cryogenic engineering in various fields. **(8 Hrs)**

4.Kinetic Theory of Gases, fluid flow in vacuum lines, transitional and molecular flows; Conductors of pipelines, fitting, pumps down line - Constructional materials for vacuum equipments and their out gassing and their out gassing characteristics - Vacuum production techniques. **(8 Hrs)**

5. Principles of operation of rotary, diffusion, turbo molecular, cryo vacuum production techniques - Principles of operation of rotary, diffusion, turbo molecular, cryo vacuum pumps - Mechanical and thermal design considerations - Selection of vacuum pump . **(6 Hrs)**

6.Measurement of vacuum : Mcleod, thermal seals, valves, flanges and pipelines Applications of vacuum technology for space, food preservation, manufacturing and cryogenic applications. **(6 Hrs)**

Term Works:

Six to Eight assignments based on above syllabus.

References Books:

1.R.B. Scott Cryogenics Engineering - Van Nostrand
2.R.F. Baroon "Cryoneic Systems, McGraw Hill New York
3.Arora C. P Refrigeration and Air conditioning "Tata McGraw Co. Ltd. New Delhi
4.Refigeration / Thermodynamics/ Heat transfer / Air conditioning Data Hand book
5.Roth A., Vacuum Technology, North-Holland, 3rd Edition.
6.Hanlon J.F, A user's guide to vacuum technology, Wiley-Interscience, 2nd ed.
7.Hoffman D.M., Singh Band, Thomas J.H. (Eds}; Handbook of vacuum science and technology, Academic press

M. E. MECHANICAL (Thermal Engineering) Part -II

6. SEMINAR-II

Teaching Scheme:
Tutorial/Practical: 2 Hr./Week/Student Term Work:25 Marks

Seminar II shall be delivered preferably on the topic of dissertation or at least the area of dissertation. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both side printed, well formatted preferably in IEEE format) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the guide along with other details if any.

M. E. MECHANICAL (Thermal Engineering) Part -III

1. IN-PLANT TRAINING

Term Work: 50

The student has to prepare the report of training undergone in the industry during vacation after part-II. It shall include the brief details of assignment completed by the candidate and general observation and analysis .The identified areas for undertaking the dissertation works shall form part of report the term work marks be based on report and departmental oral exam.

2.SEMINAR-III

T/P-1 Hrs/Week
Ext.Exam-50 Marks

Seminar III shall be based on the work carried out for dissertation. This may cover the points right from various areas considered and analyzed: the relevance feasibility and scope for finally selected topic, alternative solution and appropriate solution.
Each student has to prepare a write up of 25 pages of A4 size sheets and submit in duplicate as term work.
The student has to deliver a seminar talk in front of the teachers of the department and his classmates. The external examiner appointed by the university and examiner shall do an assessment. Based on the quality of work and preparation and understanding of the candidate. Some marks should marks should be reserved for the attendance of a student of a student in the seminars of other students.

3. PROJECT PHASE-I

Term Work: 50

The term work under this submitted by the student shall include.

1.Work diary maintained by the student and countersigned by his guide.

2.The contents of works diary shall reflect the efforts taken by the candidate for

(a) Searching the suitable project work

(b) Visit to different factories or organizations

(c) Brief report on journals and various papers referred

(d) Brief report on websites seen for project work

(e) The brief report of feasibility studies carried to come to final conclusion

(f) Rough sketches

(g) Design calculation etc. carried by the student.

The student has to make a presentation in front of panel of experts in addition to guide as decided by department head.

M. E. MECHANICAL (Thermal Engineering) Part -IV

1. PROJECT PHASE-II

Tut/Pract 5hrs per week

Exam Scheme.

Term Work-200 marks.

Oral Exam -100 marks.

The dissertation submitted by the student on topic already approved by university authorised on basis of initial synopsis submitted by the candidate shall be according to following guidelines.

Format of Dissertation report:

The dissertation work report shall be typed with double space on A4 size bond paper. The total number of pages shall not be more than 150 and not less than 60, figure, graphs, annexure etc. be added as per requirement.

The report should be written in the following format.

1. Title sheet
2. Certificate
3. Acknowledgement
4. List of figure, photographs, graphs, tables.
5. Abbreviations.
6. Abstract, final synopsis.
7. Contents.
8. Text with usual scheme of chapters.
9. Discussion of the result and conclusions.
10. Bibliography [The source of illustrative matter be acknowledged clearly at appropriate place.]

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan offers scholarships to international students who wish to study at Japanese universities as undergraduate or research (masters / PhD) students under the Japanese Government (MEXT) Scholarships Program. Normally the Application cycle of the MEXT Japanese Government Scholarship is announced in April. SOLAPUR UNIVERSITY, SOLAPUR FACULTY OF ENGINEERING & TECHNOLOGY Curriculum for M.E. Civil-Structures Choice Based Credit System (CBCS)-CGPA (WEF 2016-17). Semester III: Laboratory / Tutorial Courses. Course Name of the Course Engagement Hours Credits SA FA Total. Code L T P ESE ISE ICA 13 Lab.Â Solapur University, Solapur M.E. (CIVIL- STRUCTURES) â€“ I Choice Based Credit System (CBCS) 2. Mechanics of Structures Teaching Scheme: Examination Assessment Scheme: Lectures: 3 hours per week Theory: Tutorial: 1 hour per week ESE: 70 marks, ISE: 30 marks Credits: 4 Theory ESE duration: 4 Hours ICA: 25 marks â€¦ Help Center. less. Solapur university. Computer Science And Engineering. All Departments. 16 Documents. 145 Researchers. Akash.Â In this paper an algorithm for one-way hash function construction based on a two layer feed forward neural network along with the piece-wise linear (pwl) chaotic map is proposed. Based on chaotic neural networks, a Hash function is more. In this paper an algorithm for one-way hash function construction based on a two layer feed forward neural network along with the piece-wise linear (pwl) chaotic map is proposed. Based on chaotic neural networks, a Hash function is constructed, which makes use of neural networks' diffusion property and chaos' confusion property. B.E. (E&TC) Solapur University, Solapur B. E. (Electronics & Telecommunication Engg.) â€“ Part I & II w.e.f. Academic Year 2010-2011 B. E. (Electronics & Telecommunication Engg.) â€“ Part I Sr. No. 1 2 3 4 5 6 7 Subject Teaching Scheme T P Total L Computer Communication Network VLSI Design Mobile & Satellite Communication Random Signal Theory & Coding Elective â€“ I Seminar & Project Vacational Training Total Th.Â No. 1 2 3 4 5 Subject Broad Band Communication Audio Video Engineering Embedded Systems Elective â€“ II Project Total L Teaching Scheme T P Total Th. Examination Scheme TW POE OE Total 3 1 -. 4 100 25