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

Solapur University, Solapur

M.E. Mechanical (Heat Power Engineering)

Part-I Sem I

Sr. No.	Name of the Subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1	Advanced Fluid Mechanics & CFD	3	2	25	100	--	125
2	Advanced Thermodynamics	3	1	25	100	--	125
3	Advanced Instrumentation Techniques	3	1	25	100	--	125
4	Advanced Heat & Mass Transfer	3	2	25	100	--	125
5	Design of experiments & Research methodology	3	1	25	100	--	125
6	Seminar - I	-	2	25	--	--	25
	Total	15	9	150	500	--	650

L-Lecture T/P-Tutorial/Practical T/W- Term Work TP-Theory Examination

Part-I Sem II

GROUP I

Sr. No.	Name of the Subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1	I. C. Engines –I	3	2	25	100	--	125
2	I. C. Engines –II	3	1	25	100	--	125
3	Design of thermal systems	3	1	25	100	--	125
4	Gas Turbines	3	1	25	100	--	125
5	Computational Techniques in Thermal Engineering	3	2	25	100	--	125
6	Seminar II	-	2	25	--	--	25
7	Inplant Training Report *	-	--	--	--	--	--
	Total	15	9	150	500	--	650

* In-plant training report for the training for at least two weeks undertaken in the vacation after Semester II is to be submitted in Semester III.

Part-I Sem-II

GROUP II

Sr. No.	Name of the Subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1	Refrigeration	3	2	25	100	--	125
2	Air Conditioning	3	1	25	100	--	125
3	Cryogenics	3	1	25	100	--	125
4	Design of Thermal Systems	3	1	25	100	--	125
5	Computational Techniques in Thermal Engineering	3	2	25	100	--	125
6	Seminar II	-	2	25	--	--	25
7	In plant Training Report *	-	--	--	--	--	--
	Total	**15**	**9**	**150**	**500**	--	**650**

* In-plant training report for the training for at least two weeks undertaken in the vacation after Semester II is to be submitted in Semester III.

Part-I Sem-II

GROUP III

Sr. No.	Name of the Subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1	Power Plant Engineering	3	1	25	100	--	125
2	Design of Thermal Systems	3	1	25	100	--	125
3	Design of Pumps, Blowers, Compressors	3	1	25	100	--	125
4	Energy Analysis & Management	3	2	25	100	--	125
5	Computational Techniques in Thermal engineering	3	2	25	100	--	125
6	Seminar II *	-	2	25	--	--	25
7	In-plant Training Report	-	--	--	--	--	--
	Total	**15**	**9**	**150**	**500**	--	**650**

*In-plant training report for the training for at least two weeks undertaken in the vacation after Semester II is to be submitted in Semester III.

SOLAPUR UNIVERSITY SOLAPUR

M. E. MECHANICAL (Heat Power Engineering)

Part-II Sem-I

Sr. No.	Name of the subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1	In-plant Training	-	-	50	-	-	50
2	Seminar-III	-	1	-	-	50	50
3	Dissertation-phase I	-	4	50	-	-	50
	Total	-	5	100	-	50	150

Part-II Sem-II

Sr. No.	Name of the subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1	Dissertation	-	5	200	-	100	300
	Total	-	5	200	-	100	300

9333

M. E. Mechanical (Heat Power Engineering) Part - I Sem-I

1. ADVANCE FLUID MECHANICS & CFD

Teaching Scheme:
Teaching: 3 Periods (60 min.) per week
Practical : 2 Period (120 min.) per week

Examination Scheme
Uni. Exam. : 100 marks
Term Work: 25 marks

1. **Fluid Motions with friction:** Hagen Poiseulli equation, Navier-Stokes equations.
2. **Boundary Layer Theory:** Reynolds principle of similarity, laminar and turbulent boundary layer, flow along a flat plate, Exact and integral methods of solutions, flow in a straight conduit, flow separation and control, hydrodynamic theory of lubrication.
3. **Turbulence:** Origin, nature of turbulent flow, energy distribution in turbulent flows. Derivation of stress tensor of apparent turbulent friction 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. Flow over aerofoils: Choice of suitable sections based on performance.
4. **Compressible Fluid Flow:** Fundamental equations of Gas-dynamics, propagation of shock waves, oblique shock waves (elementary treatment).
5. Philosophy of computational fluid mechanics:

   Introduction, impact of CFD, Application areas.
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.
7. Mathematical Behavior of PDE, the impact of CFD
   Suitable forms of Governing equations, Hyperbolic, Parabolic, Elliptic equations, Well-posed problems
8. Some simple CFD techniques
   a. Introduction, Lax-wendroff Technique, MacCormackls Techniques, Relaxation Technique, Numerical dissipation and dispersion, Alternating direction-implicit technique, pressure correction technique, Need for the staggered grid, pressure correction formula, boundary condition for pressure correction method, introduction to different plots of computer graphics
   b. Numerical solution for quasi one dimensional nozzle flows: subsonic-supersonic, isentropic flow and its CFD solution, shock capturing

9280

TERM WORK

1. Four to five Assignments on chapter 1 to 4
2. Four to five solutions to the problems based on the chapter 5 to 6 especially pipe and nozzle problems using CFD based software (FLUENT/STAAR-CD etc.)

BOOKS

1. **John D. Anderson,** "Computational Fluid Dynamics: The basics with application", McGraw Hill, New Delhi.
2. **Byron R. Bird, Warren E. Steward, Edwin N. Light Foot,** "Transport phenomenon, 2nd edition, , John Wiley & Sons.
3. **Schlichting,** Boundary Layer theory, Springer Pub.
4. **W. Kanzman,** Fluids Mechanics
5. **Streeter,** "Fluid mechanics", Tata McGraw Hill, New Delhi.
6. **James A. Fay,** Introduction to Fluid Mechanics, PHI private Ltd, New Delhi.
7. **Mohanty A.K.,** Fluid Mechanics, II edition, PHI private Ltd, New Delhi.
8. **E. Rathakrishnan,** Fluid Mechanics, II edition, PHI private Ltd, New Delhi.

2. ADVANCED THERMODYNAMICS

Teaching Scheme:
Theory: 3 Periods (60 min.) per week
Practical: 1 Period (60 min.) per week

Examination Scheme:
Uni. Exam. : 100 Marks
Term Work: 25 Marks

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.

2.Entropy: Entropy and disorder, entropy production, Limitations of second law of thermodynamics, Third law of thermodynamics and its corollaries.

3. Real Gases: Deviation from ideal gas behavior, equation of state for real gases. Reduced properties, 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.

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.

5. Exergy: Introduction, basic concepts of exergy, Comparison of energy and exergy, Exergetic efficiency and exergy charts, Elements of plant analysis, Exergy calculations. Exergy balance and analysis of exergy losses, Exergy analysis of simple processes such as expansion, compression, heat transfer process, mixing and separation processes.

6. Reactive Systems: Combustion with excess, different 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.

7. 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.

8. Statistical Thermodynamics: Quantum considerations, degeneracy, microstates, microstates and thermodynamic probability. The equilibrium distribution, microscopic interpretation of heat and work, partition function and its use.

TERM WORK

Eight to ten Assignments/Practicals / Tutorials based on above syllabus

REFERENCE BOOKS

1. **V. Wylen & E. Sonntag,** " Fundamentals of Classical Thermodynamics" , Wiley Eastern Limited, New Delhi,
2. **J. P. Holman, "Thermodynamics"** Mc Graw Hill, London.
3. **Adrian Bejan, George T.,Michael Moran,** "Thermal Design and Optimization", John Willey and Sons, Inc., pp 113-127, 1996.
4. **T. J. Kotas,** "The Exergy Method of Thermal Plant Analysis", Butterworth, 1985
5. **J. L. Threlkeld,** "Thermal environmental engineering",Prentice Hall,Inc. New Jersy. 1970
6. **S. Zagit & R. Petela,** "Exergy",Moscow publication.
7. **M. W. Zemansky,** "Heat and Thermodynamics",
8. **M. L. Mathur & S. C. Gupta,** "Thermodynamics for Engineers", Dhanpatrai and Sons Ltd., New Delhi.
9. **Howell & Buckins,** " Fundamentals of Engineering Thermodynamics"
10. **Lee-Sears,** "Engineering Thermodynamics",

M. E. Mechanical (Heat Power Engineering) Part - I Sem-I

3. ADVANCE INSTRUMENTATION TECHNIQUES

Teaching Scheme:
Teaching: 3 Periods (60 min.) per week
Tutorial: 1 Period (60 min.) per week

Examination Scheme
Uni. Exam. : 100 marks
Term Work: 25 marks

1. **The Generalized Measurement System:** The meaning of measurement. Fundamental methods of measurement, calibration, concept of generalized measurement system and its elements.

2. **Performance Characteristics:** Static characteristics, calibration, sensitivity, linearity, repeatability, hysteresis, threshold, resolution, span, accuracy, static error, drift, dead zone.

   Dynamics Characteristics: Speed of response, fidelity, meaning of lag and dynamic error.

   Instrument Types: Zero order, first order. Input types: Step input, ramp input sinusoidal input, Dynamic response of first and second order instrument. Types of errors, accuracy and precision, statistical analysis of data.

3. **Measurement of Force and Torque:** Mass, weight and force, mechanical systems. Elastic transducers. Hydraulic and pneumatic systems. Torque measurement, mechanical dynamometers, electric dynamometers and transmission dynamometers.

4. **Measurement of Speed:** Mechanical tachometers, electrical tachometers, contactless types tachometers, stroboscopic tachometers.

5. **Measurement of Pressure:** Pressure measuring transducers, strain gauge pressure cells measurement of high pressure, measurement of low pressure. Mcleod vacuum gauge. Thermal conductivity gauge. Calibration of pressure gauges.

6. **Measurement of Flow:** Obstruction meters, variable area meter, pressure probes, positive displacement meters. Turbine type flow meters, electromagnetic flow meter. Ultrasonic flow meter, Hot wire anemometer, laser anemometer. Flow visualization techniques. Shadowgraph Schlieren techniques and interferometric method.

7. **Measurement of Temperature:** Basic fixed points, expansion thermometers based on expansion of solids, liquids and gases, change of state thermometers. Pyrometric cones, electrical methods, resistance thermisters and thermocouples. Laws of thermocouples. Thermopiles, optical pyrometers, radiation pyrometer. Calibration of temperature measuring devices.

8. **Measurement of Head and Level:** Float operated, pressure gauge method, diaphragm box method, air-trap method, electrical conductivity method, capacitive level measurement.

9. **Measurement of Humidity and Moisture:** Psychrometer, hygrometer method for moisture in gases. Dew point method.

10. **Measurement of Vibration and Acoustics:** Vibration and its measurement, measurement of displacements, frequency and mode, seismic instruments, calibration of instruments.

11. **Engineering Data Acquisition and Processing Systems:** Modular system. Compact data loggers. Instrument interconnection systems. Sensor-based computerized data systems.

12. **Computer Aided Experimentation:** Introduction. Functional description of computer system. Sensors. Overall system configuration. Interfacing. Examples of computer algorithms and programmes.

TERM WORK:

Eight to ten Practical/Tutorials bases on above syllabus.

REFERENCE BOOKS:

1. **Beckwith, Buck,** " Mechanical Measurements", Addison Wesley publication.
2. **Eckman,** "Industrial Instrumentation", Wieley Estetn Pvt Ltd.
3. **Strohl, Radhakrishna,** "Mechanical Measurements", Wieley Estern Pub Ltd.
4. **Adam & Dove,** " Engineering Measurements and Instrumentation",
5. **Raven,** "Automatic Control Engineering", Mc Graw Hill Int.
6. **E. O. Doebellin,** "Measurement Systems", McGraw Hill Int., New Delhi.
7. **Johnson,** Process Control Instrumentation, PHI Ltd, New Delhi.
8. **A.K. Ghosh,** Introduction to Instrumentation and control, PHI Ltd, New Delhi.
9. **D.S.Kumar,** Mechanical measurements,

4. ADVANCED HEAT AND MASS TRANSFER

Teaching Scheme :
Theory: 3 Periods(60min.) per week
Practical: 2 Period(120 min.) per week

Examination Scheme :
Uni. Exam :100 Marks
Term Work: 25 Marks

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 state 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.

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.

3. Radiation : Law of radiation, radiation pressure. 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.

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 relations for boiling heat transfer with water.

Heat transfer by natural convection- natural convection flow patterns; natural convection from vertical flat plate. Correlations for cylinders and plates. Correlation for enclosed spaces.

5. Heat Exchangers: Types, fouling factors, LMTD and NTU-effectiveness method. Heat exchanger design considerations. Design of double pipe, shell and tube heat exchangers. Use of baffles- types. Heat pipe heat exchangers.

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.

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 assignments involving computer programmes based on above syllabus.
8. One problem on Thermal analysis using FEM software packages.

REFERENCE BOOKS

1. J. P. Holman, "Heat Transfer", 7th edition, McGraw Hill, London.
2. S.P. Sukhatme, "A text book on Heat Transfer" Tata Mcgraw hill book company, ltd., New Delhi.
3. B. V. Karlekar and R. M. Desmond, Heat Transfer, 2nd edition, PHI, New Delhi.
4. Donald R pitts, Leighton E. Sissom, Schaums Outline Series, McGraw Hill, Singapore.
5. B.K. Dutta, "Heat Transfers and Applications", PHI, New Delhi.
6. W. M. Kays, A. L. London, "Compact Heat Exchangers", Mc Graw Hill Book Co., Inc., London.
7. Chapman, "Heat Transfer"
8. Simonson, "Engineering Heat Transfer", Mc Graw Hill, Int.
9. Eckert and Drabe, "Analysis of Heat and Mass Transfer", McGraw Hill, New York.

5. DESIGN OF EXPERIMENTS AND RESEARCH METHODOL

Teaching Scheme:
Theory: 3 Periods (60 min.) per week
Practical: 1 Period (60 min.) per week

Examination Sch
Uni. Exam. : 10
Term Work: 25

1. Research concept: concept, meaning, objectives, motivation, type approaches, research (Descriptive research, conceptual, theoretical experimental)
2. Formulation of research task: literature review: importance and met quantification of cause effect relations, discussions, field stu experiments, critical analysis of already generated facts, hypothetic future development and testing, selection of research task, p research.
3. Mathematical modeling and simulation: concept of modeling, c mathematical models, modeling with ordinary differential equati equations, partial differential equations, graphs. Simulation: ((quantitative, experimental, computer, fuzzy theory, statistica formulation of model based on simulation.
4. Experimental Modeling:
   a) Definition of experimental design, examples, single fact blocking and nuisance factors, guidelines for designing ex
   b) General model of process: input factors/ variables, (variables, controllable/uncontrollable variables, depende variables, compounding variables, extraneous variable validity.
   c) Process optimization and designed experiments: metho response surface, I order design, I order design. Deter combination of factors, method of steepest ascent, Tagu parameter design
5. Analysis of results (parametric and non parametric, descriptive data): types of data, collection of data (normal distribution, correlation coefficient) processing, analysis, error analysis, me methods: analysis of variance, significance of variance, analysis multiple regression, testing linearity/ non linearity of model, test model, testing model/ hypothesis.
6. Report writing: types of report, layout of research report, interpr style manuals, layout and format, style of writing, typing, refere tables, figures, conclusions, appendices.

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

TERM WORK

At least Ten assignments based on above syllabus.

REFERENCE BOOKS

1. **Willkinsion K.P.L. Bhandarkar**, "Formulation of Hypothesis", Himalaya Publishing Bombay.
2. **Schank Fr.** "Theories of Engg. Experiments", Tata McGraw Hill
3. **Douglas Montgomary**, "Design of experiments"
4. Introduction to SQC, John Willy and Sons
5. **Cochran and Cocks**, "Experimental Design", John Willy and Sons
6. **John W Besr and James V Kahn**, " Research in Education", PHI Publication
7. **Adler and Granovky**, " Optimization of Engg experiments " Meer publications.
8. **S S Rao**. " Optimization theory and applications", Wiley Eastern Ltd., New Delhi
9. **C R Kothari**, " Research Methodology", Wily Eastern, New Delhi.

6. SEMINAR - I

Teaching Scheme:
Tutorial/Practical: 2 Hr./week/student Term Work: 25 Marks

Seminar I may preferably be based on the literature survey on any topic relevant to Heat Power Engineering (should be helpful for selecting a probable title of dissertation).

Each student has to prepare a write up of about 25 pages of "A4" size sheets and submit it in duplicate as the term work.

The student has to deliver a seminar talk in front of the teachers of the department and his classmates, the teachers, based on the quality of work and preparation and understanding of the candidate, shall do an assessment of the seminar internally -jointly. Some marks should be reserved for the attendance of a student in the seminars of other students.

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3. DESIGN OF THERMAL SYSTEMS (Group I,II & III)

Teaching Scheme :
Theory : 3 hrs. per week
Practical : 1 hr. per week

Examination Scheme :
Uni. Exam. : 100 Marks
Term Work : 25 Marks

1. **Engineering Design :** Introduction. Decisions in an Engineering Undertaking - steps involved.
2. **Designing a Workable System :** Workable and optimum systems. Steps involved in arriving at workable system.
3. **Economics of Engineering Decisions :** Various factors involved.
4. **Mathematical Modeling :** Equation fitting. Modeling a thermal equipment – counter-flow heat exchanger, evaporators, condensers.
5. **System Simulation :** Uses of simulation. Methods of simulation.
6. **Optimization :** Levels of optimization. Mathematical representation of optimization. Optimization procedures.
7. **Mathematical Modeling of Thermodynamic Properties :** Need. Form of the equation. Criteria for fidelity of representation. Linear and non-linear regression analysis. Thermodynamic properties. Internal energy and enthalpy. Clapeyron equation. Pressure-temperature relationships at saturated conditions. Maxwell relations. Specific heats. p-v-T equations. Building a full set of data.
8. **Steady-State Simulation of Large Systems :** Newton-Raphson technique. Accelerating the solutions of linear equations. Quasi-Newton method. Influence coefficients.
9. **Introduction to Dynamic Behaviour of Thermal Systems.**

Term Work :

1. Any two assignments on above syllabus.
2. Development of computer program for simulation of a thermal system.

Reference Books :

1. Design of Thermal Systems – W. F. Stoecker, McGraw Hill International Edition.
2. Cryogenic Regenerative Heat Exchangers – Robert A. Ackermann, Plenum Press, New York.

5. COMPUTATIONAL TECHNIQUES IN THERMAL ENGINEERING
(Groups I, II & III)

Teaching Scheme :
Theory : 3 hrs. per week
Practical : 2 hrs. per week

Examination Scheme :
Uni. Exam. : 100 Marks
Term Work : 25 Marks

Study of the following numerical techniques with applications :

1. **Solution of linear simultaneous equations** : Gauss elimination, Gauss-Jordan, Matrix inver Gauss-Siedal, Eigen value problem.

2. **Non-linear equations** : Iterative method, Half interval search technique, Regula-falsi meth Newton-Raphson method, Methods for simultaneous non-linear equations, Algebraic and Transcend equations, Lin-Bairstows method.

3. **Numerical integration** : Area and Volume Integration : Trapezoidal rule, Simson's rules, Gauss Quadrature, Newton-Cotes Quadrature formulae.

4. **Numerical solutions of ordinary differential equations** : Taylor's method, Eular's method, Modi Eular's method, Runge-Kutta method, Methods for simultaneous and higher order equations.

5. **Curve fitting** : Principle of least squares, fitting a straight line, fitting a parabola, fitting an exponen curve, fitting a curve of the form $y = a x^b$.

6. **Finite differences and solution of partial differential equations** : Forward difference, Backw difference, Central difference expressions for first and second derivative terms.

7. **Applications of finite difference technique in conduction and convection heat transfer** (1D and 2D problems).

8. **Introduction to Finite Element Method** : Solutions of boundary value problems, Integ formulations for numerical solutions, One dimensional linear element, Applications of FEM in 1D 2D conduction and convection heat transfer problems.

Term Work :

Numerical problems and computer programs based on above syllabus.

Reference Books :

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

4

1. I. C. ENGINES – I (Group I)

Teaching scheme
Teaching: 3 hrs. per week
Practical : 2 hrs. per week

Examination scheme
University Examination: 100 Marks
Term Work : 25 Marks

1. **Cycle analysis:** Ideal cycle, fuel air cycles and actual cycles, comparison. Numerical problems on Otto, Diesel and Dual cycles.
2. **Four stroke engines:** Constructional features of engines and components with reference to the engine speed, load, power to weight ratio, number of cylinders, cylinder arrangement, engine size, type of valves, pistons, crankshafts, connecting rods, etc
3. **Two stroke engines:** Scavenging methods, charging and scavenging efficiencies, comparison with four stroke applications, port timing diagrams, power to scavenge.
4. **Air capacity:** Ideal air capacity, volumetric efficiency, actual induction process, effect of design on volumetric efficiency, estimating air capacity, valve timing diagrams for constant and variable speed S.I and C.I. engines.
5. **Combustion:** Combustion in S.I. and C.I. engines and comparison with respect to following points: combustion theory, detonation or knocking, its effect and method of control, effect of engine variables on knocking, types of combustion chambers.
6. **Petroleum fuels:** Refining process and products, knock rating of S.I. fuels, fuel characteristics, variable compression engine, motor and research methods, measurement of knock intensity, LPG as SI engine fuel, additives.
7. **Supercharging:** Supercharging of S.I. and C.I. engines and limitations. Turbo-charging (Buchi system), Methods of turbo-charging four-stroke, two-stroke engines, limitations.
8. **Testing, maintenance and trouble shooting:** Types of tests, rating, engine specifications, methods of air and friction measurement, measurement of piston temperature, methods of recording test data, heat balance sheet and performance calculations, effect of operating parameters on performance, similitude and its effect on performance, periodic inspection, preventive maintenance programs, operating records and their use and trouble shooting, I.S. standards for testing.
9. **Air Pollution:** S.I. and C.I. engine pollutants, effect of engine variables on air pollution, measurement and control. New trends in engine design to control pollution. New standards for air pollution control.
10. **Alternative fuels for I.C. engines:** Manufacture of Methanol and Ethanol. Hydrogen as I.C. engine fuel. Comparison of properties of alcohols and gasoline, engine performance with pure alcohols and alcohol–gasoline blends. Alcohol as diesel-fuel, vegetable oils as diesel-fuel, bio-gas as diesel-fuel.
11. **Gas burning Engines:** Gas Diesel Engines: Ignition and combustion in gas burning engines. Dual-Fuel engines: modification of the oil injection system and governors. High-compression spark-ignited gas engines: special features and uses.

Term Work

Practical :

1. Trial on multi-cylinder petrol engine with Morse test.
2. Trial on diesel engine.
3. Trial on multi-fuel engine or computerized test rig.
4. Measurement of pollutants from S. I. and C. I. engines
5. Determination of higher calorific value of alcohol-gasoline blends in different proportions using Bomb calorimeter.

Tutorials : Any five tutorials based on the above syllabus.

Reference Books :

1. I.C. Engines by Obert.
2. A Course in I. C. Engines by Mathur and Sharma, Dhanpatrai Publications.
3. I.C. Engine Fundamentals by J. B. Heywood, McGraw Hill.
4. The I.C. Engine by C. Fayette Taylor and Edward S. Taylor, International Textbook Co.
5. I.C. Engines by Ferguson.
6. I.C. Engines by Benson and Whitehouse Vol – I and II
7. I.C. Engines by Stone Richard.

2. I. C. ENGINES – II (Group I)

Teaching scheme
Teaching: 3 hrs. per week
Tutorial : 1 hr. per week

Examination scheme
University Examination: 100 Marks
Term Work : 25 Marks

1. **Carburetion and Injection** : Carburetion : Mixture characteristics, distribution, carburetor system carburetion and stratified charge engines, S. I. Engine fuel injection system and types, Modern carburet designs and air pollution control, altitude compensation.
Stratified charged engine : General characteristics, methods of stratification, applications, advantages an disadvantages.
Injection systems : Bosch distribution pump, Cummins PT injection system, spray characteri quantity of fuel per cycle, types of nozzles, injection timing, fuel line hydraulics, determination o pressure-time and velocity-time functions; effect of elasticity of pipe and fuel.
2. **Lubrication and Cooling Systems** : Lubrication system : Lubrication principles, properties o lubrication oil, classification, additives, lubrication systems, types of pumps and filters, crank cas ventilation.
Cooling system : Heat transfer in I. C. engines, piston and cylinder temperatures, heat rejected to coolant comparison of air and water cooling, temperature distribution for air and water cooled engine across th cylinder wall, cooling systems - types and components, water treatment, antifreeze additives.
3. **Ignition system** : Requirements; battery ignition, magneto ignition and electronic ignition systems centrifugal and vacuum advance; spark plug types and selection, firing order and its importance.
4. **Intake and exhaust systems** : Functions, components, piping layouts, materials and sizing, exhaust purifiers.
5. **Governing system** : Types, limiting speed, variable speed, hydraulic, pneumatic and electrical governors.
6. **Introduction to Engine Design** : Engine selection, basic data for design like power, torque, speed, mep, air consumption, fuel consumption, stroke to bore ratio, heat distribution, exhaust temperature, power to weight ratio, rating and de-rating for four-stroke and two-stroke engines.
7. **Design Considerations**: Combustion chamber design considerations for S.I. and C.I. engines. Thermal and mechanical design of cylinder, piston, piston rings, cylinder head, valves, mechanical design of connecting rod, crank shaft and crank case. Design considerations for fuel injection and governing systems, cooling and lubrication systems.
8. **Simulation of I.C. Engine Processes** : Simulation, S.I. Engine simulation with air as working medium, simulation with adiabatic combustion. Definitions of progressive combustion model, gas-exchange process model and heat transfer process model.
9. **Other Engine Designs** : Wankel Engine : Working principle, engine geometry, engine scaling, lubrication, cooling, induction, ignition systems, combustion in rotary engine, performance, advantages and applications.
Stirling engine : Working principle of two-piston engine, advantages and disadvantages.

Term Work Any four assignments based on above theory. Exercise on mechanical design of main components of I. C. Engine. Computer program for engine simulation model.

Reference Books.
1. I.C. Engines by Obert.
2. A Course in I. C. Engines by Mathur and Sharma, Dhanpatrai Publications.
3. I.C. Engine Fundamentals by J. B. Heywood, McGraw Hill.
4. Diesel and High Compression Gas Engine Fundamentals by Edgar J. Kates, Taraporewala and Sons.
5. Computer Simulation of Spark Ignition Engine Processes by V. Ganesan, Uni. Press.
6. Auto Design by R. B. Gupta.
7. High Speed Combustion Engines by P. M. Heldt, IBH Publications.
8. I.C. Engines by V. L. Maleev, McGraw Hill.
9. I.C. Engines by Lester C. Lichty, McGraw Hill.
10. The I.C. Engine by C. Fayette Taylor and Edward S. Taylor, International Textbook Co.
11. I.C. Engines by Ricardo.
12. Machine Design by R. K. Jain, Khanna Publishers.

7

4. GAS TURBINES (Group I)

Teaching scheme
Teaching: 3 hrs. per week
Tutorial: 1 hr. per week

Examination scheme
University Examination: 100 Marks
Term Work: 25 Marks

1. Introduction: Historical development, comparison with reciprocating I.C. Engines. Applications of gas turbine power plants
2. Thermodynamic cycles for gas turbines: Air standard Brayton cycle, Calculation of the thermal efficiency, cycle air-rate, cycle work-ratio, optimum pressure ratio for maximum work output of the cycle. Simple open cycle gas turbine. Modification of gas turbine cycle with inter-cooling, reheating and regeneration and effect on thermal efficiency and specific output. Closed cycle gas turbine and semi-closed cycle gas turbine. Their comparison with open cycle.
3. Compressors: Types commonly used for gas turbine power plants. a) Centrifugal compressors. Principle of operation, work done and pressure rise. Vane-less space, slip factor, power input factor and Mach number at intake to impeller. b) Axial flow compressors: Working principal, work done, degree of reaction, poly-tropic efficiency, overall performance. Choking, surging and stalling in compressors. Analytical calculations for blade angles, efficiency, work and flow quantities. Constructional details and performance of the compressors.
4. Fuels and combustion chambers: Requirement of combustion chamber, combustion process, pressure loss and pressure loss factor. Combustion chamber geometry and types. Solid, liquid and gaseous fuels used for gas turbine power plants. Fuel burning arrangements and ignition.
5. Turbines: Impulse and reaction turbines, turbine efficiencies, nozzle efficiency, blade efficiency, mechanical and overall efficiency. Theory of impulse and reaction turbines, Number of stages and limitations. Constructional details of shafts, bearings, blades and casings. Cooling of blades. Lubrication and governing of turbines.
6. Materials for gas turbines: Factors influencing selection of materials. Materials used for different components like compressor components, combustion chamber, disc and rotors, turbine blades, nozzle guide vanes, turbine casing and heat exchangers.
7. Component matching and performance evaluation: Performance characteristics, dimensionless numbers, linking components. Equilibrium points and procedure to find it. Transient operation.
8. Jet propulsion and Rocket propulsion: Theory of Jet propulsion, features and types of different jet engines, performance efficiencies and applications. Types of rocket power plants and their applications.

Term Work.
Any eight tutorials based on the above syllabus.

Reference Books :

1. Gas Turbine Theory by H. Cohen, GFC Rezers and HIH Saravanamutto.
2. Jet Aircraft Power Systems by Jack Casamassa, Ralph Bent
3. Gas Turbines by V. Ganesan
4. Gas Turbines and Propulsive Systems by P. R. Khajuria and S.P. Dubey

1. REFRIGERATION(GROUP II)

Teaching Scheme :
Theory : 3 hrs. per week
Practical : 2 hrs. per week

Examination Scheme :
Uni. Exam. : 100 Marks
Term Work : 25 Marks

1. Review of laws of thermodynamics. Methods of refrigeration. Reversed Carnot cycle and Joule Air refrigeration systems and their analysis.
2. Vapour compression cycle. Modifications of the cycle. Irreversibilities in vapour compression cy Multi-pressure systems, multi-evaporator systems and cascade systems. The analysis of above sys with the help of T-s and p-h charts. Energy efficiency ratio. System rating conditions.
3. Properties of binary mixtures. Enthalpy concentration chart of binary mixtures. Rectification of b mixtures. Simple vapour absorption systems and modifications. Analysis of vapour absorption sys with the help of enthalpy concentration chart. Solar absorption refrigeration system.
4. Refrigerants - desirable properties. Ashrae designation, study of common refrigerants, ino nic halo-carbon refrigerants, azeotropes, mixtures of refrigerants, comparison and selection of refriger Secondary refrigerants - brines and glycols - properties and corrosion, refrigerant-absorbent pairs. O depletion by halocarbon refrigerants, recent developments to replace R-12, R-22.
5. Load calculations : Calculation of overall heat transmission coefficients, heat gains from walls, and floors, air charge load, product and occupancy load, heat gains from people, light and other sou short method calculations.
6. Equipment - types, construction and capacities of the following equipments / components a) compressors, b) condensers and c) evaporators. Study of valves, strainers, driers, sight glasses separators, automatic purgers, heat exchangers and accumulators.
7. Study of refrigerant flow - control devices such as capillary and expansion valves, study of control devices like temperature controller, pressure controller, oil pressure cutout, evaporator pres regulator, solenoid valves, relief valves, reversing valves, check and regulating valves, high side and side float valve and float switches.
8. Charging and testing - methods of dehydration, charging, leak detection and testing.
9. Applications of refrigeration - food preservation, causes of spoilage of food products. Rol refrigeration in food preservation. Theories and methods of chilling, processing and storage of chilled frozen food, such as dairy, meat, fishery, poultry, fruits, vegetables, bakery, beverages. Refriger warehouse. Domestic refrigerators, water coolers, display cases, walk-in coolers and reach cabi drugs and medicines, blood and skin storages. Ice manufacturing.
Refrigeration in chemical industry, metallurgy, and civil construction. Refrigeration in road, rail marine and air transport.

Term Work :

Practical :

1. Trial on vapour compression cycle.
2. Trial on ice plant.
3. Trial / study on vapour absorption system.

Tutorial : Minimum four tutorials bases on above syllabus.

Reference Books :

1. Refrigeration - Dossat
2. Refrigeration - C. P. Arora
3. Ashrae handbooks
4. Refrigeration and Air Conditioning - Stockers.

3. CRYOGENICS (GROUP II)

Teaching Scheme :
Theory : 3 hrs .per week
Practical : 1 hr. per week

Examination Schem
Uni. Exam. : 100 M
Term Work : 25 M

1. **Introduction** : Historical developments, Advances, Low temperature, Properties of Measurement of low temperatures.
2. **Applications** : Industrial liquified gases, food pandling, manufacturing, nuclear, space re electronics, biology and medicine, physics, low temperature metallurgy, cold treatment to properties, cryogenic surgery, specialized systems for cryosergical applications.
3. **Gas Liquification System** : Performance parameters. Ideal system. Simple Linde-Hamso Modified to precooled dual pressure, cascade system. Claude system, Kapitza Heylandt system expanders, precooled and dual pressure. Claude liquification system for Neon, Hydrogen and Philips refrigerator, Vuilleumier, Solvey and Gifford-McMalion refrigerators, magnetic cooling.
4. **Equipment** : Heat exchangers, compressors and expanders, losses in real machine, regenerato
5. **Separation** : Ideal separation system. Properties of mixtures, simple condensation and eva principles of rectification, air separation system, hydrogen separation systems, helium separation gas purification methods.
6. **Cryocoolers** : Types - Stirling, G-M and pulse tube.
7. **Insulations** : Introduction. Expanded foam, gas filled powders and fibres, vacuum i evaluated powder and fibres. Opacified powder, multilayer insulation, comparison. Vapour vessels.
8. **Storage and Transfer** : Introduction. Basic storage vessels, suspension system, piping, drai valves, vacuum insulated line joints, cryogenic valves.
9. **Vacuum Technology** : Importance, flow regimes, flow rates, systems for production of hig pumps, vacuum gauges. Diffusion pumps, cryopumping, refrigeration for cryopumpin developments like cryosorption pumping.

Term Work :

Any six practicals / tutorials based on above syllabus.

REFERENCE BOOKS :

1. Cryogenic Systems (2nd Edition) - Randall F. Barron (Oxford University Press, New Y
2. Cryogenic Engineering – Thomas M. Flynn, Marcel Dekker, Inc., New York.
3. Cryocoolers (Part I – Fundamentals) – Graham Walker. Plenum Press, New York.
4. Cryogenics – Research and Applications – Marshall Sittig, D. Van Nostrand Co., Inc.,

M. E. Mechanical (Heat Power Engineering) Part - I Sem-II

2. AIR CONDITIONING (GROUP II)

Teaching Scheme
Theory: 3 Hrs per Week
Practicals: 1 Hrs/ Week

Examination Scheme
Uni.Exam :100 Marks
Term work: 25 Marks

1. **Applications**: comforts residences, stores, public buildings, surface transportation, Aircrafts, Shopes. Industrial processes and product air conditioning, heating of industrial buildings, laboratories and engine test facilities, clear space, and computer rooms, printing plants, textile processes. Hospital, environmental control for animals and plants, drying and stowing from crops and photographic materials.
2. **Comforts**: - Air temperature and human health, Thermal exchange of human body with environment metabolisms. Body regulatory processes against heat and cold. Physiological hazards resulting from exposure to extrevr heat and cold, Acclimatization. effective temperature, comfort chart, variation of effective temperature with air velocity, heat stress index, ventilation requirements.
3. **Psychometry**: - Fundamental properties of air and water vapour mixtures- definitions, equations and explanations, psychometric tables and charts, psychometric processes and their analysis. SHF, effective surface temperatures and bypass factor, Air quantity required, Analysis of combination of processes, psychometric systems.
4. **Load Analysis** :- Inside design conditions, outside design conditions, sensible heat load and latent heat load, heat gains from infiltration, ventilation, solar radiation from walls, occupants and other sources, Heating load , load estimation chart.
5. **Equipments**: - Cooling coast, heating costs, air washers, humidifiers, dehumidifiers.
6. **Systems** : - Classification – all air system, air water system, unitary system, heat recovery system, radiation panel system, heat pump.
7. **Air Distribution**: - Principles. Pressure losses over equipment and ducts, recommended velocities. Duct systems, duct sizing, air distribution in rooms, supply air and returned air outlets, sizing the outlets, location of outlets. Air curraitis.
8. **Ventilation**: Need, decay equation.
9. **Odours** : Detection, sources, removal methods.
10. **Filtration** : Contaminants, Classification, types of air cleaning devices.
11. **Automatic Control** : Total system design, Control theory, Types of control system, Components, applications.

Term Work:-
Any six practical / tutorials based on above syllabus.

Reference Books:

1. Carrier Handbook
2. Ashrae Handbook
3. Air Conditioning – Jones
4. Refrigeration and Air conditioning – Stockers.

Typed By :- Sanjay D. Patil M.E (Heat Power) -II Semester,PVPIT

13

(1) Power Plant Engineering : (Group-III)

Teaching Scheme :
Teaching scheme – 3Lect / week.
Tut/ Practical – 1 hr/ week.

Examination Scheme :
Theory Paper - 100marks.
Term Work - 25Marks.

1. Resources and development of Power India.
Sources of Energy, Energy consumption as a measure of Prosperity, Availability of commercial or conventional energy sources in India.

2. Hydro – Electric Power plants:
Introduction, site selection, Elements of hydroelectric power plant, classification of Hydro- electric power plants, types of hydraulic turbines, selection of turbines, hydro plant auxiliaries, Hydro plant controls, Electrical and Mechanical equipments in hydro-plant, Hydropower development in India.

3. Thermal Power Plants:
Introduction, classification, Lay out 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 boilers, Water walls, Boiler accessories & Trim.

4. Diesel Engine Power Plant:
Introduction, Adv. & Disadvantages, Applications, Site Selection, Essential components of Diesel Power plant, Operation of diesel power plant, Types of Diesel engines used for Diesel power plants, Layout of a Diesel Engine power plant.

5. Nuclear Power Plants:
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 plants.. Applications of Nuclear power plants, Safety Measures for Nuclear Power Plants, Nuclear Power Plants in India.

6. Variable Loads on Power Plants:
Industrial Production and Power generation comparison, Ideal and Real Load curves, Effect of variable load on Power Plant Design and operation, Methods of meeting the load.

7. Power Plant Economics:
Economics in Plant Selection, Factors affecting economics of Generation & Distribution of Power, Economics of Hydro-electries, combined hydro & steam power plants, Performance & Operating characteristics of Power Plants, Economic Load Shearing, Tariff for Electrical Energy.

8. Peak Load Plants:
Introduction, Requirements, Various, types of Peak load Plants.

9. Combined Operation of Different Power Plants:
Advantages of combined operations of plants, load division between power stations, Hydraulic plant in combination with steam plant, hydro-electric and gas turbine combination, co-ordination of different types of plants.

10. Instrumentation & Control:

Classification of Instruments, Pressure, Temperature, Liquid level, Flow, PH, Speed, Humidity m
instruments, Gas Analyzers.

11. Major Electrical Equipments in Power Plants:

Generator, Transformers, Cooling of Generators & Transformers, Switch Gears, Protection of El
Systems, control room, Transmission of electrical Power.

12. Pollution and its Control:

Air and Water pollution by thermal power plants & its control, Pollution due to Nuclear Power Pl
its control, Standardization for environmental protection.

Term Work :

Any six practical / tutorials based on above syllabus.

References:

1. Power Plant Engineering.
   F T Morse, D van Nostrand Co.

2. Power Plant Engineering.
   R K Rajput, Laxmi Publications, New Delhi.

3. Power Plant Engineering.
   Arora, S Domkundwar, Dhanpatrai and Sons, Delhi.

4. Non Conventional Energy Sources
   G D Rai, Khanna Publication, Delhi.

(3) Design of Pumps, Blowers & Compressors : (Group-III)

Teaching Scheme :
Teaching scheme 3 Lect / week.
Tut/ Practical – 1hr / week.

Examination Scheme
Theory Paper - 100 marks
Term Work - 25 Marks.

1. General Theory of Hydro-Dynamic Machines. Introduction, Momentum equation, classification of Hydro-dynamic machines, Eulers –Momentum Equation for roto-dynamic Machines.

2. Design of Centrifugal and Reciprocating Pumps: (a) Centrifugal Pumps: Components, Definition of Heads, Efficiencies of Centrifugal Pumps, No. of Stages, Velocity Triangles, Minimum starting speed, Pressure coefficient, No. of blades, Maximum Permissible Suction Height, Priming Devices, Cavitations in Centrifugal Pump, and its prevention. (b) Reciprocating Pumps: Working, Indicator Diagram, Effect of Piston Acceleration, Pipe friction on indicator diagram, Other losses, Cavitations, Multi-cylinder Pumps, Air- vessels and their design, Specific work of a reciprocating pumps.

3. Pumps Drives: (a) Electric Motors, Steam, Hydraulic and gas Turbines, speed varying devices, Power transmission devices. (b) Installation, Operation and Maintenance of pumps, Pump location, alignment, grouting, piping, expansion joints, suction strainers, venting and draining, relief valves. (c) Pump testing Test the requisites, test procedures, test measurements, discharge, head, Power, speed. IS code for pumps, pumps testing.

4.(a) Axial fan and Propellers : Fan applications, Fan stage parameters, Types of axial fan, stages, propellers. (b) Centrifugal fan and blowers: Fan stage parameters, Design parameters, Drum type Fans, partial flow fans, losses, fan drives and noise.

5. Centrifugal compressor: Method of operation, Theory of Operation, Compressor with losses, adiabatic efficiency, Pressure coefficient, Power in put, limitations of centrifugal compressors.

6. Design of Centrifugal Compressors: General problems, Inlet duct, Impeller inlet, Impeller Diameter Specific Speed, Type of Impeller, Impeller out let width, Impeller passages, The vane less diffuser, the vaned diffuser.

7. Axial Flow Compressor: Axial flow Compressor, Elementary air foil theory, application of axial flow compressors, the isolated air foil, flow with friction, static pressure increased produced by rotor, blade losses, lift coefficient compressible flow, cascade principle, velocity triangles for cascade, Lift and drag coefficients, cascade tests, compressor with varying axial velocity, Parameters for axial flow compressors, flow pattern of compressors.

8. Design and Axial Compressors: Design problem, estimation of stage characteristics, Pressure rise, Blade design, blade design-charts, General relations, flow coefficient, Reynolds No., pressure ratios & pressure coefficient, Diameter ratio, Mach Number, Lift coefficient, solidity, stress, Performance.

Term Work : Any six practical / tutorials bases on above syllabus.

References:

1. Turbines, Compressors & Fans. -- S M Yahya, Tata Mc Graw Hill, New Delhi.
2. Centrifugal pumps Design and Applications. -- Vat. S. Lobanoff & Ross, Gulf Publishin Co., London.
3. Hydraulic Machines – Theory & Design. -- V P Vassandani, Khanna Publisher, Delhi.
4. Pump Handbook. -- Igor J. Karassik & others, Mc Graw Hill Book Co., Delhi.
5. Pumps, Fans & Compressors. -- V M Cherkassky, Mir Publishers, Moscow.
6. The Theory and Design of Gas Turbines & Jet Engines. -- E T Vincent, Mc Graw Hill Book Co., Delhi.

(16)

4. Energy Analysis and Management (Group – III)

Teaching Scheme :
Teaching scheme –3 Lect / week.
Tut/ Practical – 2 hr / week.

Examination Scheme :
Theory Paper - 100 marks
Term Work - 25 Marks

1. Energy Scenario : - World's Production and Reserves of commercial energy sources. India's Production and Reserves Energy Alternatives.

2. Alternative Energy Sources and Technologies : - (a) Solar Energy :- Devices for thermal collection and storage, Thermal applications, Liquid flat plate collectors, performance analysis, testing procedures concentrating collectors- various types, orientation and tracking modes, performance analysis of cylindrical parabolic concentrating collector, effect of various parameters on collector performance. (b) Other Methods for Solar Energy / Wind Energy utilization:- Applications, Geothermal Resources. Geothermal Electrical Power Plants, Classification and types, Vapor dominated, Liquid dominated Geothermal Power Plants. Scope for Geothermal systems in India.

3. Economical & Environmental Aspects of Alternatives: - Initial & annual costs, Definitions of annual solar savings, Life cycle savings, Present worth calculations, Repayment of loan in equal Annual installments, Annual solar savings, Cumulative Solar Savings and Life cycle savings, Pay-back period. Environmental Problems Related with utilization of Geothermal and Wind energy.

4. Energy Auditing: - Introduction, Types, Preliminary audit, Intermediate and Comprehensive audit. Procedure of auditing, Case studies and Recommendations.

5. Energy Conservation: - Importance, Principles, Planning for Energy Conservation – Electrical energy Thermal energy, Human & animal muscle energy. Waste Recovery/ Recycling, Cogeneration.

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.

Term Work - 6 assignments / exercises based on above.

References:

1. Solar Energy. - S P Sukhatme, Tata Mc Graw Hill Pub. Co. Ltd., New Delhi.

2. Hand Book of Industrial Energy Conservation.- S. David Hik, Van. Nostrand Rein hold Co. New York.

3. Handbook of Energy Technology. - V. Daniel 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 Mc Graw Hill Pub. Co.Ltd. Delhi.

9

6. Seminar – II (Group I, II & III)

T/P -2hrs per week
Term work – 25.

Seminar – II Shall be based on tentative topic of dissertation such as review paper on some specific well defined area/ specialized stream of Mechanical Engineering.

Each student has to prepare a write up of about 25 pages of "A4" size sheets and submit in duplicate as the term work

The student has to deliver a seminar talk in front of the teachers of the department and his classmates, the teachers, based on the quality of work and preparation and understanding of the candidate, shall do an assessment of the seminar internally -jointly. Some marks should be reserved for the attendance of a student in the seminars of other students.

7. In-plant Training. (Group I,II & III)

The student has to undergo in-plant training of at least two weeks in the vacation after semester – II. The college department shall take necessary steps for placing the student in industry engaged in area of specialization.

M. E. Mechanical (Heat Power Engineering) Part - II Sem-I

1. In-plant Training.

Term work - 50

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

2. Seminar – III.

TP – 1hr per 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 of work for finally selected topic, alternative solution and appropriate solution.

Each student has to prepare a write up of about 25 pages of "A4" size sheets and submit in duplicate as the 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 internal examiner shall do an assessment, based on the quality of work and preparation and understanding of the candidate. Some marks should be reserved for the attendance of a student in the seminars of other students.

3. Dissertation Phase – I

Tut. / Pract. - 4hrs per week.
Term work - 50 marks.

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 work diary shall reflect the efforts taken by candidate for (a) searching the suitable project work. (b) visits 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 calculations etc. 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 (Heat Power Engineering) Part - II Sem-II

1. Dissertation :-

Tut. Pract. 8hrs per week 6

Exam Scheme.

Term Work – 200 marks.

Oral Exam - 100 marks.

The dissertation submitted by the student on topic already approved by university authorities on basis initial synopsis submitted by the candidate shall be according to following guide lines.

Format of Dissertation report

The dissertation work report shall be typed with double space on A4 size bond paper. The total No. of pages shall not be more than 150 and not less than 60. figures, graphs, annexure etc be ...ed as per requirement.

The report should be written in the following format.

1. Title sheet.
2. Certificate
3. Acknowledgement
4. List of figures/ Photographs/ Graphs/ Tables.
5. Abbreviations.
6. Abstract/ Final Synopsis.
7. Contents.
8. Text with usual scheme of chapters.
9. Discussion of the results and conclusions.
10. Bibliography. [The source of illustrative matter be acknowledged clearly at appropriate place]