ShriShankaracharya Technical Campus,

ShriShankaracharya Group of Institutions

(An Autonomous Institute affiliated to Chhattisgarh Swami Vivekanand Technical University Bhilai)

SCHEME OF EXAMINATION AND SYLLABUS

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Effective from the Session 2020-2021(Revised)

S. No.	Board of Study	Sub. Code	SUBJECT	PERIODS PER WEEK			SCHEME OF EXAM Theory/Practical			TOTAL MARKS	Credit L+(T+P) /2
				L	T	P	ESE	CT	TA		
1.	Mechanical Engg	ME229101	Advanced Mathematical Methods	3	2	-	100	20	20	140	4
2.	Mechanical Engg	ME229102	Advanced Thermodynamics	3	2	-	100	20	20	140	4
3.	Mechanical Engg	ME229103	Advance Fluid Mechanics	3	2	-	100	20	20	140	4
4.	Mechanical Engg	ME229104	Advanced Heat Transfer	3	2	-	100	20	20	140	4
5.	Elective-I			3	2	-	100	-	20	140	4
6.	Mechanical Engg	ME229191	Experiments in Thermal Engineering Lab 1	-	-	4	75	-	75	150	2
7.	Mechanical Engg	ME229192	Experiments in Thermal Engineering Lab 2	-	-	4	75	-	75	150	2
			Total	**15**	**10**	**8**	**650**	**100**	**250**	**1000**	**24**

L–Lecture, T –Tutorial, P – Practical, ESE, End Semester Exam, CT, Class Test TA – Teacher's Assessment

List of Electives-I

Elective I			
S No.	**Board of Study**	**Subject Code**	**Subject**
1	Mechanical Engg.	ME229121	Design of Heat Exchangers
2	Mechanical Engg.	ME229122	Advanced Finite Element Method
3	Mechanical Engg.	ME229123	Advanced I.C. Engines Technology
4	Mechanical Engg.	ME229124	Non-Conventional Energy Systems.
5	Mechanical Engg.	ME229125	Solar Energy Utilization
6	Mechanical Engg.	ME229126	Power Plant Engineering

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	Advanced Mathematical Methods ME229101	L = 3	T = 2	P = 0	Credits = 4
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	20	140	3 Hours

Course Objectives	Course Outcomes
1. To impart solution techniques to solve linear and non-linear algebraic equations. 2. To provide exposure to solve engineering problems involving differential equations	**At the end of this course, the students are expected to be able to:** **CO1:**Apply the methods for solving linear algebraic equations. **CO2:**Apply the methods for solving non-linear algebraic equations. **CO3:**Apply the methods to solve numerical differentiation and integration problems. **CO4:**Apply the methods for solving ordinary and partial differential equations. **CO5:**Design and develop computer programs for the various numerical methods to solve engineering problems

Unit-1 Solution of linear algebraic systems: Non-iterative method, Gauss elimination method, LU-factorization method, Matrix inversion method. Iterative method, Gauss Seidel iterative method, Jacobi method, ill -conditioning problems, Tridiagonalization, Hoseholder's method, QR-factorization. **[CO 1, 10 Hrs.]**

Unit-2 Solution of non-linear algebraic systems: Solution of equations by iterations, Fixed point iterations, Newton's method, Secant method, Bi-section method. **[CO 2, 9 Hrs.]**

Unit-3 Numerical differentiation: Methods for first order ODEs, Euler method, Runge-Kutta methods, Methods for higher order and systems of ODEs, Euler method, Runge-Kutta methods, Stiff systems.
Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Numerical double integration. **[CO 3, 10 Hrs.]**

Unit-4 Introduction to partial differential equations: 1ST Order PDEs, Mathematical classification second order PDEs, Characteristics.
Finite Difference Methods: Different discretization techniques of PDE equations, Backward, forward and central differencing discretization schemes, Euler's explicit, implicit and semi-implicit methods. **[CO 4, 10 Hrs.]**

Unit-5 Applications to model problems: Parabolic equations, heat equations, Elliptic equations, Laplace and Poisson's equations. Dirichlet problems, ADI method, Neumann and Mixed problems, Hyperbolic equation, wave equation, Upwinding differencing scheme of advection terms. **[CO 5, 9 Hrs.]**

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Introductory Methods of Numerical Analysis	S. S. Sastry	4th Edition, Prentice Hall of India Pvt Ltd
2.	Advanced Engineering Mathematics	E. Kreyszig	Willey Publication
3.	Numerical Methods for Scientist and Engineers	R. W. Hamming	---

Reference Books:

S. No	Title	Author(s)	Publisher
1.	Numerical Solution of Partial Differential Equations	G. D. Smith	Oxford University Press, 1985.
2.	Introduction to Numerical Analysis	F. B. Hildebrand	---
3.	Fundamentals of Engineering Numerical Analysis	1. P. Moin	---

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	ADVANCED THERMODYNAMICS ME229102	L = 3	T = 2	P = 0	Credits = 4
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	20	140	3 Hours

Course Objectives	Course Outcomes
To enable students: To apply basics thermodynamic concepts and enable to use thermodynamic relations. To**A**nalyze concept of entropy, exergy, real gases, ideal gases in detail. To Evaluate the thermodynamic systems in engineering for the needs in advanced thermodynamics	On successful completion of the course, the student will be able to: **CO1**Apply the basics of thermodynamics and able to use thermodynamic relations. **CO2 A**nalyze concept of entropy, exergy, real gases, ideal gases in detail. **CO3**Evaluate the thermodynamic systems in engineering for the needs in advanced thermodynamics

Unit 1 Review of I & II laws of thermodynamics, transient flow analysis, entropy balance, entropy generation. Exergy Analysis, concepts, exergy balance, exergy transfer, exergetic efficiency, exergy analysis of power and refrigeration cycles**. CO1, CO2 [7 Hrs.]**

Unit 2 Real Gases and mixtures, equations of state, thermodynamic property relations, residual property functions, properties of saturation states.**CO1, [7 Hrs.]**

Unit 3 Thermodynamic properties of homogeneous mixtures, partial molal properties, chemical potential, fugacity and fugacity coefficient, fugacity relations for real gas mixtures, ideal solutions, phase equilibrium, Rault's law **CO1, [7 Hrs.]**

Unit 4 Reacting Systems, I and II law analysis of reacting systems, absolute entropy and the third law, fuel cells, chemical energy, Exergetic efficiency of reacting systems, Chemical equilibrium, equilibrium flame temperature.**CO3, [7 Hrs.]**

Unit 5 StatisticalMechanics:Maxwell-BoltzmanStatistics,microstate&Macrostate,Thermodynamic probability**.CO1, [7 Hrs.]**

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Advanced Thermodynamic for Engineers	Wark K	John Wiley & Sons Inc. 1995
2.	Advanced Engineering Thermodynamics	Bejan A.,	John Wiley & Sons Inc.1988

Reference Books:

S. No	Title	Author(s)	Publisher
1.	Advaced Engineering Thermodynamics	Annamalai K. &Puri	CRC Press,2001
2.	Thermal Design & Optimization	John Wiley & Sons,1996	John Wiley & Sons,1996
3.	Fundamentals of Engineering Thermodynamics	Moran M.J. a& Shapiro H.N	John Wiley & Sons Inc.,1992

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	ADVANCED FLUIDMECHANICS ME229103	L = 3	T = 2	P = 0	Credits = 4
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	20	140	3 Hours

Course Objectives	Course Outcomes
To Understand • The basic concepts in computationalfluiddynamics. • Understand the basic elements in the use of thermal simulation. • For a given problem, be able to determine the appropriate differential equations of motion, initial conditions, and boundary conditions.	On successful completion of the course, the student will be able to: **CO1** Apply basic principles of fluid mechanics to solve real life engineering problems **CO2** Analyze the fluid dynamic systems by using modern tools and techniques. **CO3** Evaluate fluid systems for performance as per the desired needs based on industrial needs

Unit 1 Review of basic concept, concept of continuum, type of fluids, tensor analysis. Basic laws in integral form, Reynold's transport theorem, mass, momentum and energy equations in integral form and their applications.**CO1 [7Hrs.]**

Unit 2 Differential fluid flow analysis, continuity equation. Navier-Stokes equations and exact solutions, energy equation.**CO2 [7Hrs.]**

Unit 3 Ideal fluid flow analysis, two dimensional flow in rectangular and polar coordinates; continuity equation and the stream function; irrotationality and the velocity potential function; vorticity and circulation; plane potential flow and the complex potential function; vorticity and circulation; plane potential flow and the complex potential function. Sources, sinks doublets and vortices; Flow over bodies and D Alembert's paradox; aerofoil theory and its application. **CO3 [8Hrs.]**

Unit 4 Low Reynolds no. flow, approximation of N-S equation, approximate solutions of Navier-Stokes equation, Stokes and Oseen flows, hydrodynamic theory of lubrication. Large Reynolds number flow approximation, Prandtl's boundary layer equations, Blausius solutions,Falkner-Skansolutions,momentumintegralequation,HalsteinandBohlenmethod, thermal boundarylayers.**CO4 [8Hrs.]**

Unit5 Compressiblefluidflow,Onedimensionalisentropicflow,FannoandRayleighflows,chocking phenomenon, normal and oblique shocks**CO4 [5Hrs.]**

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Text Books

S. No.	Title	Author(s)	Publisher
1.	Fluid Mechanics	Kundu P.K. and Cohen I. M.	3rd Edition, Academic Press (Indian reprint),2004
2.	Advanced Engineering Fluid Mechanics	Murlidhar K. and Biswas G	2ndEdn., Narosa Pub.,2005
3	Foundation of Fluid Mechanics	Yuan S.W	Prentice Hall,1968

Reference Books

S. No	Title	Author(s)	Publisher
1	Boundary Layer Theory	Schlichting H and Gersten K	8thEdn., Springer,2001
2	Introduction to Fluid dynamics	Batchlor G.K	Cambridge,2000
3	Viscous Fluid Flow	White F.M,	McGraw Hill,2006
4	Fundamentals of Fluid Mechanics	Munson B.R, Young D.F &Okiishi T.H	5thEdn., Wiley,2006

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	**ADVANCEDHEATTRANSFER ME229104**	**L = 3**	**T = 2**	**P = 0**	**Credits = 4**
Evaluation Scheme	**ESE**	**CT**	**TA**	**Total**	**ESE Duration**
	100	**20**	**20**	**140**	**3 Hours**

Course Objectives	**Course Outcomes**
To enable Students to : • Understand and formulate, mathematical models related to Heat transfer • Analyze heat transfer in complex systems • Design and justify the thermal systems for different socio economic aspects.	On successful completion of the course, the student will be able to: **CO1** Formulation of the mathematical models of heat transfer Problems **CO2** Analyze heat transfer in complex systems **CO3** Design and justify the thermal systems for different socio economic aspects.

Unit 1 Heat conduction: General Equation; boundary & initial conditions, radial fins & fin optimization, transient heat conduction, moving boundaries & moving heat sources problems analysis, ablation heat transfer.**CO1 [7 Hrs.]**

Unit 2 Heat Convection:Boundary layers concepts, laminar & turbulent flows, conservation equation, non-dimensional analysis, B.L. equations, internal and external forced convection, Reynolds Analogy.**CO2 [7 Hrs.]**

Unit 3 **Natural convection:** combined free and forced convection; combined convection and radiation. **CO3 [7 Hrs.]**

Unit 4 Condensation and Boiling, Heat pipes.**CO4 [6 Hrs.]**

Unit 5 **Thermal Radiation**: Poljack's and Gehbart'smethods, and view factor Radiation in Enclosures with absorbing and emitting media, Flame Radiation, Solar Radiion.**CO4 [6 Hrs.]**

Text Books

S. No.	**Title**	**Author(s)**	**Publisher**
1.	Principles of Heat Transfer	Kreith, Frank, Bohn, M.S	6^{th}Edn, Brooks Cole Pub. Co.,2000
2.	Momentum, Heat and Mass Transfer Fundamentals	Kesseler D and Greenkorn RA,	Marcel Dekker, Incl.,1999
3.	Introduction to Heat Transfer	Arpaci V.S., Kao S.H. and Selamet A	Prentice Hall,2000

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Reference Books

S. No	Title	Author(s)	Publisher
1	Burmeister LC	Convective Heat Transfer	John Wiley & Sons Inc.,1983
2	Kays W.M., Crawford M.E. and Weigand B	Convective Heat and Mass Transfer	Tata McGraw Hill, 5
3	Ozisik M.N	Heat Conduction	John Wiley & Sons Inc.,1980
4	Siegel R and Howell J.K	Thermal Radiation Heat Transfer	Taylor & Francis,2002

ShriShankaracharya Technical Campus,

ShriShankaracharya Group of Institutions

(An Autonomous Institute affiliated to Chhattisgarh Swami Vivekanand Technical University Bhilai)

SCHEME OF EXAMINATION AND SYLLABUS

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	**DESIGN OFHEATEXCHANGERS ME229121**	**L = 3**	**T = 2**	**P = 0**	**Credits = 4**
Evaluation Scheme	**ESE**	**CT**	**TA**	**Total**	**ESE Duration**
	100	**20**	**20**	**140**	**3 Hours**

Course Objectives	**Course Outcomes**
• It provides exposure to different kind of heat exchanger, their working and selection for a given application. • Students will come to know about different techniques of heat exchanger analysis. • Student will be able to learn construction and thermal design methodology of shell and tube, Plate and compact heat exchanger	On successful completion of the course, the student will be able to: **CO1** Apply fundamental knowledge of mathematics, science, and engineering for the needs in heat exchanger designing. **CO2** Analyze theoretically and experimentally Heat Exchanger performance **CO3** Design systems as per the desired needs based on economical, social, environmental issues

Unit 1 **Introduction:** Classification, temperature distribution for parallel flow, counter flow, cross flow, heat exchanger, evaporators and condensers, concept of LMTD and overall heat transfer coefficient. F factors for various flow arrangement, comparison of different methods, NTU method for gauging exchanger performance, LMTD for parallel, counter and cross flow heat exchangers, methods of effectiveness. Important design considerations: material selection and optimization of heat exchangers, analysis, Vibrations induced by flow, International Standards for heat exchangers. **CO1 [7 Hrs.]**

Unit 2 **Design considerations:** Design methodology, Selection criteria, general selection guide lines, thermodynamic modeling and analysis, optimization, irreversibility's, heuristic approach for assessment, energy, exergy and cost balances in the analysis of heat exchangers, fouling and corrosion.**CO2 [7 Hrs.]**

Unit 3 **Shell and Tube heat exchangers** Tube layouts, Baffle spacing, types of shell and tube exchangers - The calculations of shell and tube exchangers shell side film coefficients - shell side equivalent diameter - The true temperature difference in a 1-2 exchanger. Influence of approach temperature on correction factory - Shell- side pressure drop - Tube side pressure drop- Analysis of performance of 1-2 exchangers and design calculation of shell and tube heat exchangers - Flow arrangements for increased heat recovery - The calculations of 2-4 exchangers - TEMA standards.**CO3 [8Hrs.]**

Unit 4 **Direct-contact heat exchanger**, cooling towers Relation between the wet-bulb and dew point temperatures - The Lewis number - Classification of cooling towers cooling-tower internals and the role of fill - Heat exchange heat transfer by simultaneous diffusion and convection - Analysis of cooling towers measurements - Design of cooling towers - Determination of the number of diffusion units - Calculation of cooling tower performance - The influence of process conditions upon design - The influence of operation tables. **CO3 [7 Hrs.]**

Unit 5 **Compact heat exchanger**Gasketed, brazed rating and sizing, design considerations, surface geometrics, pressure drop calculations, limiting cases for design.**CO4 [6 Hrs.]**

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Text Books

S. No.	Title	Author(s)	Publisher
1	Compact Heat Exchanger	Kays W.M. and London A.L.	Krieger PublishingCompany,1998.
2	Handbook of Heat Transfer	Rosenhow, Hartnett and Cho eds	McGraw Hill Professional
3	Extended Surface Heat Transfer	Kraus Aziz and Welty	Wiley- Interscience. NewYork.2001

Reference Books

S. No	Title	Author(s)	Publisher
1	Optimization theory and application	Rao S.S.	3rd Ed.Wiley-Interscience.1996.
2	Compact Heat Exchangers: selection, design and operation	Hesselgreaves J.E.,	Pergamon Press 2001
3	Principles of Enhanced Heat Transfer	Webb R.L. and Kim N.H.,	Taylor andFracis,2005

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	ADVANCED FINITE ELEMENT METHOD ME229122	L = 3	T = 2	P = 0	Credits = 4
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	20	140	3 Hours

Course Objectives	Course Outcomes
1. To learn basic principles of finite element analysis procedure 2. To learn the theory and characteristics of finite elements that represent engineering structures 3. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.	**CO 1**Synthesise information and ideas for use in the evaluation process. **CO 2** Develop governing equations of mechanical systems using domain knowledgeand mathematical principles and apply principles of variation and integral forms of solution to formulate finite element problem. **CO 3**Analyse and build FEA model for complex engineering problems. **CO 4**Perceive the fundamental theory of the finite elements. **CO 5** Develop skills to model the behavior of structures under mechanical and thermomechanicalloads.

UNIT 1 Finite Element Formulation: Introduction, Weighted Residual Method, weak form of WRstatement, Principle of stationary total potential (PSTP),Rayleigh – Ritz Method.**CO1 [7 Hrs]**

UNIT 2 One Dimensional Finite Element Analysis: General form of total potential for 1-D and finiteelement equations, Linear bar element, Quadratic bar element, Cubic bar element, Higherorder elements, Beam Element, Frame elements, Applications of one dimensional elements,Natural co- ordinates and Co-ordinate transformation, Numerical integration.**CO2 [8 Hrs.]**

UNIT 3 Two Dimensional Finite Element Analysis: Introduction, Simple three nodded triangularelement, four nodes rectangular element, six nodes triangular element, serendipity and higher order 2-D elements, Iso-parametric element.**CO3 [7 Hrs.]**

UNIT 4 Axisymmetric elements, Structural mechanics applications of 2-D and axisymmetricelements, Incorporation of Boundary conditions, Solution of static Equilibrium Equations.Heat transfer applications in 2-D.**CO4 [6 Hrs.]**

UNIT 5 Dynamic AnalysisIntroduction, Equations of motion based on weak form and using Lagrange approach,Consistent and lumped mass matrix, Solution of Eigen value problems, transient vibrationAnalysis**CO4 [7 Hrs.]**

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Textbook of Finite Element Analysis	P Sheshu	PHI 2004
2.	Finite Element Methods for Engineers	U S Dixit	Cengage Learning, 2011.

Reference Books:

S. No.	Title	Author(s)	Publisher
1.	. Concepts and Application of Finite Elements Analysis	, Cook, Malkus and Plesha	Wiley.
2.	Finite Element Methods for Engineers	J N Reddy	McGraw Hill International Edition..

ShriShankaracharya Technical Campus,

ShriShankaracharya Group of Institutions

(An Autonomous Institute affiliated to Chhattisgarh Swami Vivekanand Technical University Bhilai)

SCHEME OF EXAMINATION AND SYLLABUS

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	ADVANCED I C ENGINE ME229123	L = 3	T = 2	P = 0	Credits = 4
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	20	140	3 Hours

Course Objectives	Course Outcomes
To make the student understand 1. Engine operating parameters like fuel-air mixtures, temperature and cycles 2. supercharging, turbo charging and flow through ports and valves 3. combustion process in SI engine and CI engine and emissions formation during the combustion cycle and their treatment. 4. metering and flow of charge in SI engines 5.modern trends in IC engines	**CO1** Apply knowledge of mathematics, science, and engineering for the needs in I.C.Engine. **CO2** Analyze different I C engine systems and its design **CO3** Evaluate the performance of I.C. Engines under different conditions and interpret the reports.

UNIT 1 Introduction – Historical Review – Engine Types – Design and operating Parameters. Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles – Real Engine cycles - differences and Factors responsible for – Computer Modeling. **CO1**

GAS EXCHANGE PROCESSES: Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging. Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows. **[8Hrs.]**

UNIT 2 ENGINE COMBUSTION IN S.I ENGINES: Combustion and Speed – Cyclic Variations – Ignition – Abnormal combustion Fuel factors, MPFI, SI engine testing.**CO 2 [7 Hrs.]**

COMBUSTION IN CI ENGINES: Essential Features – Types off Cycle. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system.

UNIT 3 POLLUTANT FORMATION AND CONTROL: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.**CO3 [7 Hrs.]**

UNIT 4 ENGINE HEAT TRANSFER: Importance of heat transfer, heat transfer and engine energy balance, Convective heat transfer, radiation heat transfer, Engine operating characteristics. Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen.**CO3 [7 Hrs.]**

UNIT5MODERN TRENDS IN IC ENGINES: Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio – fuels, HCCI and GDI concepts.**CO3 [6 Hrs.]**

Text Books:

S. No.	Title	Author(s)	Publisher
1.	I.C. Engines	V. Ganeshan	TMH publications
2.	I.C. Engines Fundamentals	Heywood	TMH publications
3.	I.C. Engines	G.K. Pathak& DK Chevan	Standerd Publications

Reference Books:

S. No.	Title	Author(s)	Publisher
1.	I.C. Engines	R K Rajpoot	Laxmi publications
2.	Computer Simulation of C.I. Engine Process	V. Ganeshan	University Press

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	NON CONVENTIONAL ENERGY SYSTEMS ME229124	L = 3	T = 2	P = 0	Credits = 4
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	20	140	3 Hours

Course Objectives	Course Outcomes
To make students capable to: • Apply knowledge of mathematics, science, and engineering for the needs in non-conventional energy systems. • Analyze the nonconventional energy systems for their feasibility and socio feasible impact • Design & develop different types of renewable energy systems.	**CO1** Apply knowledge of mathematics, science, and engineering for the needs in non conventional energy systems. **CO2** Analyze the nonconventional energy systems for their feasibility and socio feasible impact **CO3** Design & develop different types of renewable energy systems.

Unit 1 Solar Radiation: Solar thermal process, heat transfer devices, solar radiation measurement, estimation of average solar radiation.**CO1 [6 Hrs.]**

Unit 2 Solar energy collection & storage: Solar water heating, Air heater, stratified storage, well mixed storage, comparison, Hot water system, practical consideration, solar ponds, Non-convective solar pond, extraction of thermal energy and application of solar ponds, Solar distillation & drying, Solar Power generation**CO 2 [7 Hrs.]**

Unit 3 Biomass Energy System: Photosynthesis, Biomass resource, Availability of biomass-agro, forest, animal, municipal and other residues; bioconversion technologies; cooking fuels, biogas, producer gas, power alcohol from biomass; power generation, Internal engine modifications and performance; system economics.**CO3 [7 Hrs.]**

Unit 4 Wind energy: The nature of wind & wind data, Wind measurement, Aerofoil Design, Wind energy Potential, Wind energy resources and modeling, Horizontal and Vertical Axis Wind mills, wind farms, performance and economics of wind energy.**CO3 [7 Hrs.]**

Unit 5 OTEC: Ocean temperature differences, OTEC systems. Recent OTEC developments. Wave energy: fundamentals, availability, wave energy, conversion systems: Tidal energy: fundamentals, availability, Tidal-energy conversion systems. Geothermal energy: Hot springs and steam ejection, site selection, origin and types of geothermal energy and utilization, power plants, advance concepts.**CO3 [7 Hrs.]**

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Solar Energy Principle of Thermal Collection and Storage	Sukhatme	Tata McGraw Hill, 1990
2.	Wind Energy Systems, Prentice Hall Inc., New Jersey	Johnson G.L	Prentice Hall Inc., New Jersey
3.	Principles of Solar Engineering	J.M. Kriender,	McGraw Hill, 1987

Reference Books:

S. No.	Title	Author(s)	Publisher
1.	Solar Engineering	Mangal V. S.	Tata McGraw Hill, 1992
2.	Renewable Energy Source and Conversion Technology	Bansal N. K.	Tata McGraw Hill, 1989
3	Solar Thermal Engineering	P.J. Lunde,	John Wiley & Sons, New York, 1988

ShriShankaracharya Technical Campus,

ShriShankaracharya Group of Institutions

(An Autonomous Institute affiliated to Chhattisgarh Swami Vivekanand Technical University Bhilai)

SCHEME OF EXAMINATION AND SYLLABUS

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	**SOLAR ENERGY UTILIZATION ME229125**	**L = 3**	**T = 2**	**P = 0**	**Credits = 4**
Evaluation Scheme	**ESE**	**CT**	**TA**	**Total**	**ESE Duration**
	100	**20**	**20**	**140**	**3 Hours**

Course Objectives	Course Outcomes
After studying this course, student should be able to: • Explain the principles that underlie the ability of various natural phenomena to deliver solar energy • Outline the technologies that are used to harness the power of solar energy • Discuss the positive and negative aspects of solar energy in relation to natural and human aspects of the environment.	**CO1** Design and analyze of working effect of related parameters of solar flat plate collectors. **CO**2 Understand and analyze interrelated parameters and various heat transfer involved within a of solar Distillation units **CO3** Develop mathematical model and evaluate heat transfer involved in solar Drying/Cookers **CO4** Understand working, Modelling, application, types and parametric studies of solar air heaters **CO5** Analyze the economic analysis of solar thermal equipment that includes payback period, deprecation etc.

UNIT 1 **Introduction:** Solar thermal process, heat transfer devices, solar radiation measurement, estimation of average solar radiation. Flat Plate Collectors-Introduction, Classification, Evolution, Material involved, Losses, its Optimization, various heat transfer coefficients, Testing and performance, Evolution of evacuated tubes solar collector.**CO1 [7 Hrs.]**

UNIT 2 **Solar Distillation**. Introduction, working principle, Thermal efficiency, Instantaneous. efficiency, Overall thermal efficiency, Heat transfer, External heat transfer, Top loss coefficient, Bottom and Side loss coefficient, Internal heat transfer, Radiative loss coefficient, Convective loss coefficient, Evaporative loss coefficient, Determination of distillate output, Passive solar stills, Effect of various parameters, Other designs, Modified internal heat transfer**CO2 [7 Hrs.]**

UNIT 3 **Solar Crop Drying and Cooker.**Introduction, Working principal, Classification, Energy Balancing, Modeling, Moisture content, Drying characteristics curves, Energy requirement, Designing Solar cooker: Working, Comparison, various phases of cooking, various shapes, Performance evaluation**CO3 [7 Hrs.]**

UNIT 4 **Solar Air Heaters.**Description and classification, Conventional heaters, Double exposure heaters, Air heaters with flow above and both sides of the absorbers, Two pass solar air heater, Heater with finned absorber, Yee-Corrugated absorber, Reverse absorber heater, with porous absorber, Testing of solar air collector, Parametric studies, Application of air heaters, Comparison and performance of liquid and air collector**CO4 [7 Hrs.]**

UNIT 5 **Economic Analysisof Solar Equipments**. Introduction, Cost analysis, Cash flow diagram, Cost comparison with equal and unequal duration, Payback time with and without interest, Benefit cost analysis, Affect of depreciation, Cost comparison after taxes. **CO5 [7 Hrs.]**

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Solar energy	G. N. Tiwari	Narosa Publication
2.	Solar distillation practice for water desalination systems	G.N. Tiwari and A.K. Tiwari,	Anamya publishers.
3.	Solar Energy Principle of Thermal Collection and Storage	Sukhatme	Tata McGraw Hill, 1990

Reference Books

S. No.	Title	Author(s)	Publisher
1.	Solar Thermal Engineering	P.J. Lunde,	John Wiley & Sons, New York, 1988
2.	Principles of Solar Engineering	J.M. Kriender,	McGraw Hill, 1987

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	POWER PLANT ENGINEERING ME229126	L = 3	T = 2	P = 0	Credits = 4
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	20	140	3 Hours

Course Objectives	Course Outcomes
1. Analyze different types of steam cycles and estimate efficiencies in a steam power plant 2. Describe basic working principles of gas turbine and diesel engine power plants. 3. Define the performance characteristics and components of such power plants 4. List the principal components and types of nuclear reactors. 5. Evaluate cycle efficiency and performance of a gas cooled reactor power plant 6. Classify different types of coupled vapor cycles and list the advantages of combined cycles power plant	**On Successful completion of course student will be able to** **CO1** Apply the principles of thermodynamics to analyze the performance of steam, gas,combined and modern power plants **CO2** Design and develop power plant components for optimum performance **CO3** Select appropriate site and technology for hydroelectric and nuclear power plants. **CO4** Evaluate economic and environmental implications on power plants

UNIT 1 **Introduction**: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants. **CO1**

Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostaticprecipitator.**[7 Hrs.]**

UNIT 2 **Steam generators and their accessories:** High pressure Boilers, Accessories, Fluidized bed boiler.**CO2**

Condensers: Direct Contact Condenser, Surface Condensers, Effect of various parameters on condenser performance, Design of condensers, Cooling towers and cooling ponds

Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal,using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combinedcycles.**[8 Hrs.]**

UNIT 3 **Hydro Electric Power Plants**: Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plantsdesign, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of powerplants.**CO3, [6 Hrs.]**

UNIT 4 **Nuclear Power Plants:** Principles of nuclear energy, basic nuclear reactions, nuclear reactorsPWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.**CO3, [6 Hrs.]**

UNIT 5 **Power Plant Economics**: load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing,Problems. .**CO4, [7 Hrs.]**

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Power plant engineering	Arrora&Domkundwar	DhanpatRai& Sons, New Delhi, 2008
2.	Power plant Technology	M.M. Ei-Wakil	McGraw Hill Com.,1985
3.	Power plant engineering	PCSharma’	S.K.Kataria& Sons NewDelhi,2010

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	EXPERIMENTS IN THERMAL ENGINEERING LAB 1 ME229191	L = 0	T = 0	P = 4	Credits = 2
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	20	140	3 Hours

Course Objectives	Course Outcomes
Course Objectives 1. To introduce the students about the techniques used to measure properties of various substances. 2. To educate the student about use of numerical techniques and commercial tools available for analysis of thermal system. 3. To prepare the student to do experiment and calculate the various parameters in the field of Fluid Mechanics, Heat Transfer. 4. To train the students to analyze the performance of various thermal systems systems.	**CO 1** Conduct experiments on conduction, convection and radiation of heat; collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures. **CO 2** Develop to gain basic knowledge on Fluid Statistics, Fluid Dynamics, and closed conduit flows, hydro-electric power stations. **CO3** Student will be able to design various components of pumps and turbines and study their characteristics.

Group I.- Heat and Mass Transfer CO 1

01 Determination of thermal conductivity: Composite wall apparatus
02 Determination of thermal conductivity- Solids.
03 Determination of thermal conductivity- fluids
04 Determination of forced convection heat transfer coefficient
05 Determination of free convective heat transfer coefficient
06 Determination of Emissivity of a given surface
07 Heat transfer through extended surfaces.
08 Determination of Stefan –Boltzmann constant: Stefan –Boltzmann Apparatus
09 Pool Boiling and critical heat flux
10 Performance study of cooling tower
11 Unsteady state heat transfer apparatus.

Group II - Fluid MechanicsCO 2, CO 3

12 Measurement of lift and drag force of Aerofoil model, symmetric or asymmetric model on wind tunnel.
13 Prediction of boundary layer thickness over flat plate
14 Trial on Centrifugal (parallel / series) pump.
15 Trial on Pelton/Francis Turbine

Note:*Any 12 Experiments to be conducted(Minimum 2 from each group)*

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)

Subject Name & Code	**EXPERIMENTS IN THERMAL ENGINEERING LAB 2 ME229192**	**L = 0**	**T = 0**	**P = 4**	**Credits = 2**
Evaluation Scheme	**ESE**	**CT**	**TA**	**Total**	**ESE Duration**
	100	**20**	**20**	**140**	**3 Hours**

Course Objectives	**Course Outcomes**
Course Objectives **1.** To educate the student about use of simulation techniques for analysis of thermal system. 2. To prepare the student to do experiment and calculate the various parameters in the field of heat transfer, refrigeration and air conditioning , IC engine. 3. To analyze the performance of various fluid systems 4. To develop skills to perform the experimentation and analysis in the field of thermal systems	After the completion of the course, students should be able to **CO 1:** Identify the various fuel characterizations through experimental testing. **CO 2:** Analyze the performance characteristics of an internal combustion engines **CO 3:** Evaluate the performance parameters of refrigeration systems **CO4**: Analyze the air compressor characteristics and other power plant systems.

GroupI -I C. Engine. **CO 1, CO 2**

1. Trial on 2-Stroke Engine.
2. Trial on 4-Stroke Engine.
3. Trial on Kirloskar Engine – Bio fuel and variable CR.
4. Thermal analysis of IC engine.
5. Design of IC engine..

Group II - Refrigeration. **CO 3**

6. Trial on refrigeration tutor.
7. Trial on cascade system.
8. Trial on ICE plant
9. Design/Simulation of refrigeration systems.
10. Design/Simulation of compressors
11. Performance study of Cold room
12. Trial on multi evaporator system
13. Performance study of refrigeration system using different types of heat exchangers.
14. Trial on Fault simulator
15. Trial on water cooler
16 Design / simulation of Cryogenic system.

Group III Steam Power Engineering. **CO 4**

16. Trial on Steam power plant.
17. Design/Simulation of a thermal system such as gas turbine systems, steam power plant
18. Design/Simulation of thermal system components such as heat Exchanger
19. Design/Simulation of pumps
20. Design / simulation of solar thermal system. Gr. IV Air-Conditioning
21. Trial on Air Conditioning Tutor
22. Design / simulation of Flow through duct.
23. Design / simulation of air conditioning systems
24. Trial on Central AC plant

***Note:**Any 12 Experiments to be conducted(Minimum 2 from each group)*

ShriShankaracharya Technical Campus,

ShriShankaracharya Group of Institutions

(An Autonomous Institute affiliated to Chhattisgarh Swami Vivekanand Technical University Bhilai)

SCHEME OF EXAMINATION AND SYLLABUS

SEMESTER 1, MTech, MECHANICAL(THERMAL ENGINEERING)