Chhattisgarh Swami Vivekanand Technical University, Bhilai

SCHEME OF TEACHING AND EXAMINATION

M. E. Mechanical Engineering (Thermal Engineering)

I[st] Semester

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	564111 (37)	Numerical Methods in Thermal Engineering	3	1	,	100	20	20	140	4
2.	Mechanical Engg	564112 (37)	Advanced Thermodynamics	3	1	,	100	20	20	140	4
3.	Mechanical Engg	564113 (37)	Advance Fluid Mechanics	3	1	,	100	20	20	140	4
4.	Mechanical Engg	564114 (37)	Advanced Heat Transfer	3	1	,	100	20	20	140	4
5.	Elective - I			3	1	,	100	20	20	140	4
6.	Mechanical Engg	564121 (37)	Computational Fluid Flow & Heat Transfer Lab	,	,	3	75	,	75	150	2
7.	Mechanical Engg	564122 (37)	Experiments in Thermal Engineering	,	,	3	75	,	75	150	2
			Total	**15**	**5**	**6**	**650**	**100**	**250**	**1000**	**24**

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

Table,I

List of Electives,I

Elective , I			
S.No.	**Board of Study**	**Subject Code**	**Subject**
1	Mechanical Engee.	564131 (37)	Design of Heat Exchangers
2	Mechanical Engee.	564132 (37)	Fluid Power Engineering
3	Mechanical Engee.	564133 (37)	Advanced I.C. Engines Technology
4	Mechanical Engee.	564134 (37)	Non Conventional Energy Systems.

Note (1) - 1/4[th] of total strength of students is required to offer an elective in the college in a particular academic session.

Note (2) - Choice of elective course once made for an examination cannot be changed in future examinations.

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Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Numerical Methods in Thermal Engg.** Code: 564111(37)
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit – I
Introduction: Concepts of consistency, stability and convergence of numerical scheme. Various finite difference and finite element methods and their applications to fundamental partial differential equations in engineering and applied sciences.

Unit– II
Case studies selected from fluid mechanics and heat transfer.

Unit– III
Finite Difference Method: Classification, Initial and Boundary conditions, Forward, Backward difference, Uniform and non-uniform Grids, Grid Independence Test. Basic finite difference schemes. Boundary treatments.

Unit-IV
Fourth order RK methods and Predictor-corrector methods and Nachsheim-Swigert iteration with applications to flow and heat transfer, Parabolic and hyperbolic problems. Model problems and stability estimates.

Unit – V
Discrete Fourier series. Von- Neumann stability analysis. Consistency, convergence and error estimates. Keller Box and Smith's method with application to thermal boundary layers. Convection dominated problem: The failure of standard discretization, Upwinding and Higher order methods.

Text Books:

1. Muralidhar K, Sundararajan T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 1995
2. Ghoshdasdidar P.S., Computer Simulation of flow and heat transfer, Tata McGraw-Hill Publishing Company Ltd., 1998
3. Patankar S.V., Numerical heat transfer fluid flow, Hemisphere Publishing Corporation, 1980
4. Anderson D.A., Tannehill I.I. and Pletcher R.H., Computational Fluid Mechanics and Heat Transfer, Hemisphere Publishing Corporation, New York, USA, 1984

References:

1. Fletcher C.A.J., Computational Techniques for Fluid Dynamics,
2. Fundamental and General Techniques, Springer-Verlag, 1987
3. Sengupta T.K., Fundamentals of Fluid Dynamics, University Press, Hyderabad

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Advanced Thermodynamics** Code: 564112(37)
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit – I
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.

Unit–II
Real Gases and mixtures, equations of state, thermodynamic property relations, residual property functions, properties of saturation states

Unit– III
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.

Unit-IV
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.

Unit – V
Statistical Mechanics: Maxwell-Boltzman Statistics, microstate & Macrostate, Thermodynamic probability.

Text Books:

1. Wark K., Advanced Thermodynamic for Engineers, John Wiley & Sons Inc. , 1995
2. Bejan A., Advanced Engineering Thermodynamics, John Wiley & Sons Inc. 1988

References:

1. Annamalai K. & Puri, Advaced Engineering Thermodynamics, CRC Press, 2001
2. Bejan A., Tsatsarones G. & Moran M., Thermal Design & Optimization, John Wiley & Sons, 1996
3. Moran M.J. a& Shapiro H.N., Fundamentals of Engineering Thermodynamics, John Wiley & Sons Inc., 1992

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Advanced Fluid Mechanics** Code: 564113(37)
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit – I
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.

Unit – II
Differential fluid flow anaysis, continuity equation. Navier-Stokes equations and exact solutions, energy equation.

Unit-III
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.

Unit-IV
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-Skan solutions, momentum integral equation, Halstein and Bohlen method, thermal boundary layers.

Unit-V
Compressible fluid flow, One dimensional isentropic flow, Fanno and Rayleigh flows, chocking phenomenon, normal and obligue shocks.

Text Books:

1. Kundu P.K. and Cohen, I.M., Fluid Mechanics, 3rd Edition, Academic Press (Indian reprint), 2004
2. Murlidhar K. and Biswas G., Advanced Engineering Fluid Mechanics, 2nd Edn., Narosa Pub., 2005
3. Yuan S.W., Foundation of Fluid Mechanics, Prentice Hall, 1968

References:

1. Schlichting H and Gersten K, Boundary Layer Theory, 8th Edn., Springer, 2001
2. Batchlor G.K., Introduction to Fluid dynamics, Cambridge, 2000
3. White F.M, Viscous Fluid Flow, 3rd Edn., McGraw Hill, 2006
4. Munson B.R, Young D.F & Okiishi T.H, Fundamentals of Fluid Mechanics, 5th Edn., Wiley, 2006

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Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Advanced Heat Transfer** Code: 564114 (37)
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit – I
Heat conduction: General Equation; boundary & initial conditions, radial fins & fin optimization, transient heat conduction, moving boundaries & moving heat sources problems analysis, ablation heat transfer.

Unit – II
Heat Convection:Boundary layers concepts, laminar & turbulent flows, conservation equation, non-dimensional analysis, B.L. equations, internal and external forced convection, Reynolds Analogy.

Unit – III
Natural convection: combined free and forced convection; combined convection and radiation.

Unit – IV
Condensation and Boiling, Heat pipes

Unit – V
Thermal Radiation: Poljack's and Gehbart's methods, and view factor
Radiation in Enclosures with absorbing and emitting media, Flame Radiation, Solar Radiion.

Text Books:

1. Kreith, Frank, Bohn, M.S., Principles of Heat Transfer, 6th Edn, Brooks Cole Pub. Co., 2000
2. Kesseler D and Greenkorn RA, Momentum, Heat and Mass Transfer Fundamentals, Marcel Dekker, Incl., 1999
3. Arpaci V.S., Kao S.H. and Selamet A, Introduction to Heat Transfer, Prentice Hall, 2000

References:

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, 2005
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
5. Rohesnow & Chai, Heat Transfer

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Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Design of Heat Exchangers** Code: 564131(37)
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit – I
INTRODUCTION : Classification, Constructional details, Two and Multi-fluid heat exchangers, extended surfaces.

Unit – II
DESIGN OF HEAT EXCHANGERS: Engineering Design – Steps for Designing, Designing a Workable System, Feasible/Workable design and Optimum Systems, Economics, Equation Fitting, Probabilistic Approach to Design, Sizing and Rating Problems.

Unit – III
LMTD and ε-NTU approach of design. Design of Tubular, Shell & Tube, Finned (Radial and Longitudinal), Regenerative and Compact heat exchangers.

Unit – IV
OPTIMUM DESIGN: Criteria for optimization of heat exchangers, different constraints, feasible and optimum design, optimization based on Volume, Weight, Cost, Entropy generation and Thermoeconomics.
Brief introduction to some traditional and non-traditional optimization techniques.

Unit – V
PERFORMANCE BEHAVIOUR: Design Vs Simulation, Steady State Performance – Effectiveness, Transient Performance, Non-uniformities in temperature and flow. Three fluid/multifluid heat exchanger behaviour.

Text Books:

1. Kays W.M. and London A.L. “Compact Heat Exchanger”, Krieger Publishing Company,1998.
2. Rosenhow, Hartnett and Cho eds. “Handbook of Heat Transfer”, McGraw Hill Professional, New York 1998
3. Kraus Aziz and Welty, “Extended Surface Heat Transfer”, Wiley- Interscience. New York.2001

References:

1. Rao S.S.”Optimization theory and application”, 3rd Ed.Wiley-Interscience.1996
.
2. Hesselgreaves J.E., “Compact Heat Exchangers: selection, design and operation”, Pergamon Press.2001
3. Webb R.L. and Kim N.H., “Principles of Enhanced Heat Transfer”, Taylor and Fracis,2005

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Fluid Power Engineering** Code: 564132 (37)
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit – I
INTRODUCTION: Type of Fluid power control systems and its components, Physical properties of hydraulic fluids and governing equations.

Unit – II
Pumps and valves: Classification, Working and performance of gear, vane, piston pumps and their selection, Pressure intensifiers, Direction control valves, Pressure control valves, Flow control valves, Servo valves, Pressure switches.

Unit – III
Hydraulic Actuators: Linear and rotary actuators, Gear, vane and piston motors, Performance of Hydraulic motors, Hydrostatic transmission.
Hydraulic circuit design and analysis: Control of single-acting and double-acting cylinders, Study of various circuits like regenerative, unloading, counterbalance, speed control etc., maintenance of hydraulic circuits.

Unit – IV
Pneumatic control systems: air preparation and components, Compressors and conditioners, Air control valves and actuators.
Pneumatic circuit design and analysis: Design considerations, Pressure and energy loss, Basic Pneumatic systems, Vacuum and accumulator systems, Circuit analysis.

Unit – V
Fluid logic control system: Principles, Basic fluidic devices, fluid sensors, Boolean algebra, fluidic control of fluid powers systems.

Text Books:

1. Esposito Anthony, " Fluid Power with Applications" 5th Edition, Anthony Esposito 2007
2. Burrow, C.R.,"Fluid Power Servomechanism" Van Nostard Reinhold Co. New York.1972

References:

1. Dudley A, Pippenger, John J. Pease, Basic Fluid Power, Prentice Hall Inc., N.J. (USA), 1987
2. Dudley, Fluid Power with application, Prentice Hall, 1980
3. Fluid Logic, Festo

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Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Advanced IC Engine Technology** Code: 564133(37)
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit – I
SI Engine, Introduction, carburetion, mixture requirements, Fuel supply, Ignition, Stages of combustion, Normal and abnormal combustion, factors affecting knock, Combustion Chambers.

Unit – II
CI engine, Injection systems, Mechanical and electronic, Combustion in CI engines, stages of combustion, Factors affecting combustion, Direct and indirect injection systems, Combustion Chambers.

Unit – III
Basic concepts of engine simulation, governing equations, simulation of various engine processes for SI and CI Engines.

Unit – IV
Different types of combustion chamber; Engine instrumentation, Types of pollutants –Euro and Bharat norms, Emission control methods in SI and CI engines, catalytic converters, EGR, Modern evaporative emission control system; Lean Burn Engines, Stratified charge Engines, homogeneous charge compression ignition engines.

Unit – V
Engines for special applications, Mining, Defence, Off, highway, Tractor, Bulldozer etc. Submarines, Race car Engine systems, Flexible fuel systems. Surface ignition.

Text Books:

1. Heywood J.B., Internal Combustion Engine Fundamentals, McGraw Hill
2. Ganesan V., Internal Combustion Engines, II Edition, 2002

References:

1. Mathur M.L. and Sharma R.P., A course in internal Combustion Engines, Dhanapat Rai Publications, New Delhi
2. Mathur R.B. and Sharma R.P., Internal Combustion Engines
3. Ramalingam K.K., Internal Combustion Engine Fundamentals, Scitech Publications.
4. Smith D, Auto Fuel Systems, The Good Heart Willox Company, Inc.
5. Ganesan V, Computer Simulation of spark ignition process: University Process, Hyderabad, 1993
6. Ganesan V, Computer Simulation of compression ignition engine, Orient Long man.

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Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Non-Conventional Energy Systems** Code: 564134(37)
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit – I
Solar Radiation: Solar thermal process, heat transfer devices, solar radiation measurement, estimation of average solar radiation.

Unit – II
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

Unit – III
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.

Unit – IV
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.

Unit – V
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.

Text Books:

1. Sukhatme, Solar Energy Principle of Thermal Collection and Storage, Tata McGraw Hill, 1990
2. Johnson G.L., Wind Energy Systems, Prentice Hall Inc., New Jersey
3. J.M. Kriender, Principles of Solar Engineering, McGraw Hill, 1987
4. Tiwari G.N., Tiwari A.K., Solar Distillation Practice, Anamaya Publishers, New Delhi

References:

1. Mangal V.S., Solar Engineering, Tata McGraw Hill, 1992
2. Bansal N.K., Renewable Energy Source and Conversion Technology, Tata McGraw Hill, 1989
3. P.J. Lunde, Solar Thermal Engineering, John Wiley & Sons, New York, 1988
4. Duffie J.A., Beckman W.A., Solar Engineering of Thermal Processes, Wiley & Sons, 1990

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Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Computational Fluid Flow & Heat Transfer Lab** Code: 564121(37)
Total Practical Periods**: 40**
Total Marks in End Semester Exam. : **75**

One Lab/Field/Industrial oriented Project/Problem will be allotted to each student related to subject taught in 1st semester.

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Semester: **I M.E (Thermal Engg.)** Branch: **Mechanical Engineering**
Subject: **Experiments in Thermal Engineering** Code: 564122 (37)
Total Practical Periods**: 40**
Total Marks in End Semester Exam. : **75**

Lab Experiments in the field of:-

1. **Fluid Mechanics**
2. **Heat Transfer**
3. **Refrigeration & Air Conditioning**

Results be presented after due uncertainty analysis.