National Institute of Technology, Raipur (C.G.)

M. Tech. in Mecanical Engineering with specialization in Thermal Engineering 2010

Course of Study & Scheme of Examination | **M. Tech. I Semester** | **Branch: Mechanical**

S.No.	Board of Studies	Sub. Code	Subject Name	Periods/week			Examination Scheme					Total Marks	Credits L+(T+P)/2
				L	T	P	TA	FE	SE	ESE	Pract. ESE		
1	Mechanical	ME41111ME	Advance Numerical Techniques	3	1	-	20	15	15	100	-	150	4
2	Mechanical	ME41112ME	Advance Thermodynamics	3	1	-	20	15	15	100	-	150	4
3	Mechanical	ME41113ME	Heat Transfer-I Conductive and Radiative Heat Transfer	3	1	-	20	15	15	100	-	150	4
4	Mechanical	ME41114ME	Air Conditioning System Design	3	1	-	20	15	15	100	-	150	4
5	Mechanical	ME41135ME	Elective-I	3	1	-	20	15	15	100	-	150	4
7	Mechanical	ME41126ME	Lab - I Experiments on Heat Transfer	-	-	3	75	-	-	-	50	125	2
8	Mechanical	ME41127ME	Lab-II Experiments in Air Conditioning Systems	-	-	3	75	-	-	-	50	125	2
			Total	15	5	6	250	75	75	500	100	1000	24

Elective-I

01. Heat Exchanger Design
02. Thermal System Simulation and Design
~~03. Creative Problem Solving Techniques~~
04. Noise Pollution and Monitoring Instrumentation
05. Power Plant Engineering
06. Compessible Fluid Flow
07. Finite Element Method
08. Material Processing for Turbo Machinery Components
09. Material Handling System
10. Experimental Stress Analysis
11. Maintnance of Thermal Power Plant Equipments
12. Aerodynamics
13. Industrial Food Preservation

National Institute of Technology , Raipur (C.G.)

M. Tech. in Mecanical Engineering with specialization in Thermal Engineering

Course of Study & Scheme of Examination				M. Tech. II Semester								Branch: Mechanical	
S.No.	Board of Studies	Sub. Code	Subject Name	Periods/week			Examination Scheme					Total Marks	Credits L+(T+P)/2
				L	T	P	TA	FE	SE	ESE	Pract. ESE		
1	Mechanical	ME41211ME	Computational Fluid Dynamics	3	1	-	20	15	15	100	-	150	4
2	Mechanical	ME41212ME	Heat Transfer-II Convective Heat Transfer	3	1	-	20	15	15	100	-	150	4
3	Mechanical	ME41213ME	Advance Fluid Mechanics	3	1	-	20	15	15	100	-	150	4
4	Mechanical	ME41234ME	Elective-II	3	1	-	20	15	15	100	-	150	4
5	Mechanical	ME41245ME	Elective-III	3	1	-	20	15	15	100	-	150	4
7	Mechanical	ME41226ME	Lab - I CFD Lab	-	-	3	75	-	-	-	50	125	2
8	Mechanical	ME41227ME	Lab - II Experiments in Thermal Engineering Lab	-	-	3	75	-	-	-	50	125	2
			Total	15	5	6	250	75	75	500	100	1000	24

Elective-II and III

01. Design of Thermal Systems
02. Gas Dynamics and Flow Through Turbomachines
03. Solar Energy Utilisation
04. Production and Operation Management
05. Conditioned Environment and Ventilation
06. Energy Management
07. Theory and Design of Gas Turbine
08. Vibrations and its Application for Design of Turbomachinery
09. General Computer Aided Design
10. Thermal Measurements
11. Advance Turbomachinery
12. Waste Heat Recovery
13. Renewable Energy Systems

National Institute of Technology , Raipur (C.G.)

M. Tech. in Mecanical Engineering with specialization in Thermal Engineering

Course of Study & Scheme of Examination				M. Tech. III Semester								Branch: Mechanical	
S.No.	Board of Studies	Sub. Code	Subject Name	Periods/week			Examination Scheme					Total Marks	Credits L+(T+P)/2
				L	T	P	TA	FE	SE	ESE	Pract. ESE		
1	Mechanical	ME41311ME	Non Conventional Energy Systems	3	1	-	20	15	15	100	-	150	4
2	Mechanical	ME41332ME	Elective-IV	3	1	-	20	15	15	100	-	150	4
3	Mechanical		Preliminary work on Dissertation	-	-	24	100	-	-	-	-	100	12
4	Mechanical		Comprehensive Examination	-	-	4	-	-	-	-	100	100	2
			Total	6	2	28	140	30	30	200	0	500	22

Elective-IV

01. Advance I C Engines
02. Alternative Fuels for I.C.Engines
03. Optimisation Techniques
04. Environmental Pollution and control
05. Combustion Generated Pollution in I C Engines
06. Refrigeration System Control and Pollution
07. Air Craft and Rocket Propulsion
08. Energy Conservation and Management
09. Nuclear Power Generation and Safety
10. Computer Integrated Manufacturing of Thermal Components
11. Solar Refrigeration and Air Conditioning
12. Creative Problem Solving Technique

The subjects mentioned in above list are liable to be increased/changed as per the specialisation of the faculties available time to time.

National Institute of Technology , Raipur (C.G.)

M. Tech. in Mecanical Engineering with specialization in Thermal Engineering

Course of Study & Scheme of Examination							M.Tech. IV Semester					Branch: Mechanical	
S.No.	Board of Studies	Sub. Code	Subject Name	Periods/week			Examination Scheme					Total Marks	Credits L+(T+P)/2
				L	T	P	TA	FE	SE	ESE	Pract. ESE		
1	Mechanical		Dissertation + Seminar	-	-	30	200	-	-	-	300	500	15
			Total	**0**	**0**	**30**	**200**	**0**	**0**	**0**	**300**	**500**	**15**

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech 1st

Subject: Advanced Thermodynamics

Total Marks in End Semester Exam: 100 Time: 3hrs

Recapitulation of Fundamentals: Basic definition and concepts; the laws of thermodynamics; entropy flow and entropy production; third law of Thermodynamics. Availability in steady flow open system and in a closed system; Exergy analysis of typical; Irreversibility and effectiveness.

Basic concepts of irreversible Thermodynamics: Onsagar theory, derivation of Onsagar equations, Onsagar Reciprocal Relation, Fluctuation theory, Regression of Fluctuations.

Properties of Pure substance: P-V-T surfaces, phase diagrams, phase changes, various properties diagram. First order transition and Clapeyron's equation, second order phase transition and Ehrenfest's equations; Maxwell's equation: equation for internal energy, enthalpy, entropy, specific heat and Joule-Thomson Coefficient.

Equation of State for real gases: Compressibility factor and generalized compressibility Chart, law of corresponding states, Pseudo-critical pressure and temperature, reduced co-ordinates, vander wall's equation of state and other equations of state.

Chemical thermodynamics: Gibb's theorem, Gibb's function of mixture of inert ideal gases. Chemical equilibrium, Thermodynamics equation for phase, degree of Reaction, equation of reaction, law of Mass Action, Heat of Reaction and Vant hoff Isober, Saha's equation for standard Gibb's function change Affinity.

Text Books

1. Thermodynamics- G.J. VanWylen
2. Thermodynamics- Cengel & Boles
3. Thermodynamics- P.K. Nag

Reference Books

1. Heat & Thermodynamics- M. Zemansky
2. Concept of Thermodynamics- O.R. Obert

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NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech 1st

Subject: Advanced Numerical Techniques

Total Marks in End Semester Exam: 100 Time: 3hrs

Error Analysis: Approximate numbers and Significant Figures, Bias, Accuracy, Precision, Error Round off & Truncation errors, Formulation of errors, Propagation of Uncertainties/errors. Solution of Transcendental & Algebraic Equations: Bracketing & Open Methods- Bisection, False Position, Newton Raphson Method, Secant Method. Gauss Elimination, Gauss Jordan Applications, Gauss Seidal, LU decomposition, Matrix Inversion.

Curve Fitting: Regression Analysis-Least Square Method, Linear Regression, Polynomial Regression, Fourier Regression, .Nonlinear Regression. Interpolation-Newton's Forward and backward Interpolation, Newton's Divided Difference Interpolation, Lagrange's Interpolation, Gauss's Central Difference Interpolation.

Numerical Differentiation & Integration: Newton Cotes Integration formulas-Trapezoidal, Simpson, Romberg, Gaussian Quadrature, Numerical Differentiation-Finite Difference Method.

Numerical Solution of Ordinary Differential Equation: Types of Differential equations, Picard's Series Method, Taylor Series Method, Euler's Method, Modified Euler's Method, Runge Kutta Method, Predictor Corrector Method, Milnes Method, Application to Initial & Boundary value Problems.

Numerical Solution of Elliptical Partial Differential Equation: Introduction to PDE Elliptic, Parabolic & Hyperbolic Equation. Finite Difference Schemes, Forward, Backward, Central Difference, Application to Laplace & Poisson's Equation, Iterative & Relaxation Techniques, Laplacian Operator in Cartesian, polar and other coordinate systems.

Numerical Solution of Parabolic & Hyperbolic Partial Differential Equation Solution of Parabolic Equations, Implicit & Explicit Schemes, Crank Nicholson, ADI scheme. Solution of Hyperbolic Equations.

Note: Computer Programs for the above methods are to be practiced using any high level language.

Text Books:

1. Numerical Mathematical Analysis by James B. Scarborough, Oxford and IBH Publishing Ltd.
2. Numerical Methods by B.S.Garewal, Khanna Publishers Ltd.

Reference Books:

1. Numerical Methods in Engineering by Salvadori and Baron, Prentice Hall, India.
2. Numerical Methods for Engineers by Steven C Chapra and Raymond P Canale, TMH Publications.

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NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech 1st

Subject: Air Conditioning System Design

Total Marks in End Semester Exam: 100 Time: 3hrs

Cooling and Heating Load Calculations-I: Estimation of Solar Radiation

Introduction, Solar: radiation, constant and irradiation geometry and various related basic and derived angles, Angle of incidence for horizontal, vertical and tilted surfaces, Calculation of direct, diffuse and reflected radiation using ASHRAE solar radiation model including effect of clouds.

Cooling and Heating Load Calculations-II: Solar Radiation through Fenestration Ventilation and Infiltration: Fenestration, Need, effect on air conditioning systems, Estimation, concepts SHGF and Shading Coefficient, external shading, calculations of shaded area, windows with overhangs, Infiltration and Ventilation, causes, estimation of heat transfer rate.

Cooling and Heating Load Calculations Heat Transfer through Building –III

Fabric Heat Gain/Loss: Heat transfer through buildings, one-dimensional, steady state and unsteady state heat transfer through homogeneous, non-homogeneous walls, air spaces, composite walls, opaque walls, roofs. The analytical and in brief numerical methods used to solve the 1-D, transient heat transfer problem, semi-empirical methods, physical significance of decrement and time lag factors, typical tables of CLTD for walls and roof.

Selection of Air Conditioning Systems: Introduction to thermal distribution systems, their functions. Selection criteria and classification of air conditioning systems, working principle, advantages, disadvantages and its applications for various air/water flow systems.

Transmission of Air in Air Conditioning Ducts

Describe an Air Handling Unit (AHU), its functions, need for studying transmission, airflow through ducts, Bernoulli and modified Bernoulli equations, Static, dynamic, datum and total head, Fan Total Pressure (FTP) and power input to fan, estimation of pressure loss, through ducts, estimation of dynamic pressure drop in various types of fittings.

Text Book

1. Refrigeration And Air Conditioning by Stooker W.F
2. Refrigeration And Air Conditioning by C.P.Arora, Tata McGraw-Hill

Reference Books

1. Refrigeration And Air Conditioning by Ahmadul Ameen, PHI Publication
2. Hand Book of Air Conditioning and Refrigeration by Shan K. Wang, Tata McGraw-Hill

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NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech 1st

Subject: Heat Transfer – 1(Conductive & Radiative)

Total Marks in End Semester Exam: 100 Time: 3hrs

Introduction to Heat Transfer: Typical heat transfer situations, Modes of heat transfer, Introduction to laws, some heat transfer parameters, Fourier's law and thermal conductivity, Differential equation of heat conduction, boundary conditions and initial conditions.

Steady State Situations in Conduction: Plane wall, cylinder, sphere (simple and complex situations), concept of thermal resistance, concept of U, critical radius, variable thermal conductivity, heat generation, pin fins, other fin configurations, steady state one dimensional and two dimensional problems.

Transient Conduction: Lumped capacitance model, one dimensional transient problems – analytical solution, one dimensional Heisler charts, product solutions, one dimensional transient problems – Explicit and implicit.

Fundamentals of Radiation: Basic ideas, spectrum, basic definitions, laws of radiation, black body radiation, Planck's law, Stefan Boltzman law, Wien's displacement law, Lambert cosine law.

Radiation Exchange: Radiation exchange between black surfaces, shape factor, radiation exchange between gray surfaces – Radiosity – irradiation method, parallel plates, Enclousers (non-participating gas), gas radiation.

Text Books

1. Heat Transfer – HOLMAN – TMH
2. Heat Transfer – P.K. Nag – TMH
3. Heat and Mass Transfer – Cengel – McGraw Hill.

Reference Books

1. Fundamentals of Engg. Heat and Mass Transfer – R.C SACHDEVA – New Age International
2. Heat Transfer – Ghoshdastidar – Oxford University Press – II Edition
3. Heat and Mass Transfer – R. K Rajput – S. Chand & Company Ltd.
4. Fundamentals of Heat Transfer & Mass Transfer – Incropera & Dewitt – John Wiley Publications

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NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech 1st

Subject: Compressible Fluid Flow

Total Marks in End Semester Exam: 100 Time: 3hrs

Fluid Flow Concepts and Basic Equations: Fundamental Aspects of Compressible Flow, Speed of Sound, Mach Waves, Mach number and Mach angle, Fundamental Equations, Continuity Equation, Momentum Equation, Energy Equation, Equation of State (Entropy Consideration).

One Dimensional Isentropic Flow: Difference between Isentropic and Adiabatic Flow, Stagnation and Critical states (Enthalpy, Temperature, Pressure, Density acoustic speed), various regions of flow, Reference velocities.

Variable Area flow: Introduction, Equations for Variable Area Flow, Effects of Area Changes on Flow, Impulse Function, Mass flow rate, Operating Characteristics of Nozzles, Convergent nozzle , Convergent-Divergent nozzle, Use of gas tables, Convergent-Divergent Supersonic Diffusers, Transonic Flow over a Body.

Adiabatic Flow in a duct with Friction: Introduction, Flow in Constant Area Duct, Friction Factor Variations, Fanno Line, Variation of flow properties, Tables for Fanno flow, Isothermal flow with friction. Flow with Heat Transfer: Introduction, One Dimensional Flow in Constant Area Duct, Entropy Temperature Relations, Rayleigh flow relations, Variation of flow properties, Tables and Chart for Rayleigh flow, Variable Area Flow with Heat Addition, Isothermal Flow with friction in a constant area duct.

Normal Shock Waves: Introduction, Shock Waves, Normal Shock wave Relations in Terms of Mach number, Prandtl-Mayer Relation, Tables for Normal shock waves, Impossibility of a shock in subsonic flow, Strength of shock wave, Pitot Tube in Supersonic Flow, Moving Normal Shock Waves. Oblique Shock Waves: Introduction, Oblique shock Waves Relations, Variations of flow parameters, Gas Tables for oblique shock waves.

Text Books

1. The Dynamics and Thermodynamics of Compressible Fluid Flow by Shapiro, A.H.
2. Fundamentals of Compressible Flow by Yahya, S.M.

Reference Books

1. Compressible Fluid Flow by Osthuizen and Carscallen
2. Gas Dynamics with Propulsions by Kulshrestha, S.K.
3. Fluid Mechanics by Streeter.

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NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech II Sem

Subject: Heat Transfer-II

Total Marks in End Semester Exam: 100 Time: 3hrs

Principles of Convection: Convection Boundary layers, Velocity Boundary layers, Thermal Boundary layers, Significance of Boundary layers, Laminar and turbulent flow, Significance of dimensionless parameters, Reynold-Colburn Analogy, Drag & heat transfer.

External Forced Convection: Parallel flow over flat plat, flow errors Cylinders & Spheres, flow across tube banks,(aligned and staggered), Correlations for all the mentioned cases.

Internal Flow: Hydrodynamic considerations, flow conditions, Velocity profiles in fully developed region, Laminar flow inside tubes, turbulent flow in tubes, bulk temperature flow through tube annulus, correlation related to mentioned cases.

Natural Convection: Equations of Motion, Grashof's No, natural convection over surfaces, plates, cylinder, spheres(all cases), natural convection inside enclosures combined free and forced convection, correlations related to mentioned cases.

Heat exchanges: Design of Parallel flow, Counter flow, Cross-flow, Multipass-Cross flow, Heat Exchangers, LMTD, method design, Effectiveness-NTU method, Compact heat exchangers, heat exchanger optimization.

Text Books:

1. Heat Transfer –J.P. Holman,
2. Fundamentals of heat transfer-David Incropera
3. Heat Transfer-R.C. Sachdeva

Reference Books:

1. Heat transfer-Kays & Crawford
2. Process Heat transfer-D.Q. Kern

(R Sachdeva) Subject Teacher

(Dr. S. Sanyal) M.O.D. Mech.

(Prof. A.M. Rawani)

07/04/11

(Dr A.K. Tiwari) P.G. Coordinator

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech II Sem

Subject: Advance Fluid Mechanics

Total Marks in End Semester Exam: 100 Time: 3hrs

Fluid Kinematics: Concept of Continuum and definition of fluid, Body and surface forces, Scalar and Vector field, Eulerian and Lagrangion description of flow. Motion of fluid element: Translation, rotation, linear strain rate, shear strain rate, Vorticity and Rotationality Comparison of solid body rotation and Line vortex, Vortex flow.

Integral Relations for a Control Volume: Basic physical laws of fluid Mechanics, Systems versus Control volume, Reynold Transport theorem, Conservation of mass, Linear momentum equation, momentum flux, correction factor, Angular momentum theorem, Energy equation, Kinetic energy Correction factor, Friction less flow & Bernoullis equation.

Differential Analysis of fluid flow: Continuity equation, stream function in cylindrical coordinate, Cauchy's equation of linear momentum. Navier stokes equation, Differential analysis of fluid flow problems, Calculation of the pressure field for a, Known velocity field, Exact Solution of Continuity and Navier-Stroke Equations.

Approximate Solutions of the Navier-Strokes Equation: Introduction, Creeping flow, Drag on sphere in Creeping flow, approximation for inviscid Regions flow, Irrotational flow approximation, two dimensional irrotational region of flow, Boundary layer approximation, Boundary layer equations, Boundary layer with pressure gradients.

Potential flow: Introduction and Review, Line source & sink at the origin, Line Irrotational Vortex, Superposition, source plus an equal sink, sink plus a vortex at the origin, Rankine half body, Circulation flow past a vortex, vortex sheet, Doublet flow past a circular Cylinder.

Text Book:

1. Fluid Mechanics: F.M. White McGraw Hill
2. Fluid Mechanics: Som and Biswas, T.M.H.

Reference Book:

1. Fluid Mechanics: P.K. Kundu & Ira M. Cohen
2. Fluid Dynamics: G.K. Batchelor

G K Sahu
(Subject Teacher)

(Prof. A.M. Rawani)

07/04/2011
P.G. Coordinator

Dr. S. Sanyal
(HOD, Mech Engg.)

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech II

Subject: Design of Thermal Systems

Total Marks in End Semester Exam: 100 Time: 3hrs

Introduction to Engineering Design, Thermal Systems, Basic Considerations in Design, Conceptual Design, Steps in the Design Process, Computer-Aided Design of Thermal Systems, Material Selection, Properties and Characteristics for Thermal Systems

Modeling of Thermal Systems, Types of Models, Interaction between Models, Mathematical Modeling, Physical Modeling and Dimensional Analysis, Curve Fitting

Numerical Modeling and Simulation, Solution Procedures, Numerical Model for a System, System Simulation, Methods for Numerical Simulation

Acceptable Design of a Thermal System, Design of Systems from Different Application

Economic Considerations, Introduction, Calculation of Interest, Worth of Money as a Function of Time, Series of Payments, Raising Capital, Economic Factor in Design, Cost Comparison, Rate of Return, Application to Thermal Systems

Optimization in Design, Basic Concepts, Mathematical Formulation, Optimization Methods, Calculus Methods, Search Methods, Optimization of Thermal Systems, Optimization of Unconstrained Problems, Conversion of Constrained to Unconstrained, Optimization of Constrained Problems

Text Book:

1. Design & Optimization of Thermal Systems – Yogesh Jaluria -CRC Press
2. Optimization for Engineering Design –Kalyanmoy Deb- PHI

Reference Book:

1. Design of Thermal Systems-W.F. Stoecker- TMH Publication

25/03/11
Prof V. K. Gaba.
subject Teacher

Dr. S. Sanyal
HOD Mech.

(Prof A. M. Kawani)

7/4/11
(Dr. A. K. Tiwari)
PG. Co-ordinator.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech 2nd

Subject: Solar Energy Utilization

Total Marks in End Semester Exam: 100 Time: 3hrs

Flat-Plate Collectors:

Introduction, Classification, evolution, material involved, losses, its optimization, various heat transfer coefficients, testing and performance , fins and its efficiency, thermal analysis, configuration of FPC, inclination , effect of heat capacity and dust, Evolution of evacuated-tube solar collector.

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.

Solar crop drying and cooker:

Introduction, working, classification, energy balancing, modeling, moisture content, drying characteristic curves, energy requirement, designing.

Solar cooker: working, comparison, various phases of cooking, various shapes, performance evaluation.

Solar air heaters:

Description and classifications, conventional heaters, double exposure heaters, air heater with flow above and both side of the absorber, two pass solar air heater, heater with finned absorber, vee-corrugated absorber, reverse absorber heater, with porous absorber, testing of solar air collector, parametric studies, applications of air heater, comparison of performance of liquid and air collector.

Economic analysis of solar equipments:

Introduction, cost analysis, Cash flow diagrams, cost comparison with equal and unequal duration, Pay back time with and without interest, benefit cost analysis, Effect of depreciation, cost comparison after taxes.

Text Books

1. Solar Energy: - By G.N.Tiwari, Narosa publication
2. Solar distillation practice for water desalination systems: By G.N.Tiwari and A.K.Tiwari, Anamaya Publishers.

Reference

1. Solar Energy by Duffi and Beckman
2. Solar Energy By Sukhatme

04/03/2011
Subject Teacher (Prof A.M. Rawani)

Dr. S. Sanyal.
H.O.D. Mech. Engg.

राष्ट्रीय प्रौद्योगिकी संस्थान रायपुर
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Phone: (0771) 225 42 00
Fax: (0771) 225 46 00
Email: directornitrr@rediffmail.com
Website: www.nitrr.ac.in

Subject: Computational Fluid dynamics

Max. Marks : 100 in ESE

Prerequisites: (i) Fluid Mechanics & Heat transfer Fundamentals (ii) Turbulence modelling, (iii) Applied computational methods

Subject code: Credits: L-T-P:

Syllabus:

Prerequisites: (i) Fluid Mechanics & Heat transfer Fundamentals (ii) Turbulence modelling, (iii) Applied computational methods

Conservation equations, Classification of equations, Idealisations & approximations in flow/transport phenomenon, theory of visualisation, Methods of Discretization, Boundary conditions, components & properties of Numerical Solution Methods, Turbulence modelling briefing.

Solution of Generalised Transport equation - Method for steady Diffusion and Convection- Diffusion problems, various differencing schemes, implementation of boundary conditions, the Algebraic equation system, examples.
Method for Unsteady problems - Implicit, explicit & semi explicit formulations, examples

Methods of Flow Field calculation – Necessity, Solution of inviscid flow, simple viscous flow, boundary layer flow and Navier-stokes equation, Variable grid arrangements, Pressure calculation, Vorticity based method, SIMPLE, SIMPLER & SIMPLEC algorithms, Fractional time step method and artificial compressibility method, examples

Numerical grid generation - Type of elements, Shape function, interpolation functions, Numerical grid generation: Non orthogonal & orthogonal grids, Algebraic & elliptic grid generation, Transformation of equation, fixed grid, deformable grid & Moving grid formulation, grid generation for complex geometries & advanced cases, examples.

Algebraic Equation System solution methods -Direct methods, Indirect Methods, Coupled equations & its solutions, Convergence criterion &, types of solvers, Problem with mesh independence, Post processing of results, Iteration errors Error Analysis & estimation, recommended practices in CFD.

Introduction to advanced topics (if time permits).

Satish Kumar Dewangan
Subject Teacher.
Assistant Professor
Applied Mechanics Department
National Institute of Technology
RAIPUR (C. G.) 492010

Text books:

(i) S.V. Patankar, Numerical Heat transfer & Fluid flow, Hemisphere publishing company, 1980
(ii) Malalashekhara & Versteeg, an introduction to Computational Fluid Dynamics (Finite Volume Method),
(iii) Ferzier & Peric, Computational Methods for Fluid Dynamics, Springer, 1996
(iv) Farrashkhalvat & Miles, Basic Structured Grid generation

REFERENCE BOOKS:

(i) Huebner & Thornton, Finite Element Methods for Engineer s, John-Wiley, 2nd edition 1992
(ii) J.N. Reddy & D.K. Gartling, The Finite Element Method in Heat Transfer and Fluid Dynamics, CRC press, 1994
(iii) A.J. Baker, Finite Elements computational Fluid mechanics, Hemisphere publishing company, 1983
(iv) P.S. Ghoshdastidar, Computer simulation of flow & heat transfer, TMH publishing company Ltd New Delhi, 1998

7/4/11
(A.K. Tiwari)
PC-Co-ordinate

Dr. S. Sanyal
H.O.D Mech. Engg

(Prof. A.M. Rawani)

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech 3rd

Subject: Non Conventional Energy Systems

Total Marks in End Semester Exam: 100 Time: 3hrs

Geothermal Energy :- Historical background Origin and types of geothermal energy Hydro, Thermal, Geopressured, Petro - thermal systems, Operational and environmental problems, vapor dominated systems, liquid dominated systems, petro thermal systems, Hybrid systems.

Wind Energy : - Principale of wind power, Total, maximum and actual power, forces on the blade, wind turbine operation site characteristics, wind turbines basic systems and their performance, magnuseffect, madras rotor wind machine, aero electric plant.

OTEC :- Ocean temperature differences, The open or Claude cycle, modifications of the open OTEC cycle, The closed or Anderson OTEC cycle, Recent OTEC developments.

Wave and Tialal Energy :- Ocean waves, wave motion, energy and power from waves, wave conversion by floats, high pressure accumeter wave machines, other wave machine, Dolphin the wave power M/c, Dam atoll concept, Multiple pantoon raft. The tides, simple single pool tidal system, modulated single pool tidal system. The two pool tidal system.

Bio mass conversion :- Bio mass and its conversion, Direct combustion, thermo chemical conversion, biochemical conversion.

Books Recommended :-

(1)Power plant technology M.M. Eiwakil

(2)Non-Conventional Energy Resources - B H Khan Tata MCGraw Hill

Reference

4/11/2011 4/11/2011

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

DEPART OF MECHANICAL ENGINEERING

M.Tech in Thermal Engineering

Semester: M.Tech 3rd

Subject: Solar Refrigeration and Air Conditioning

Total Marks in End Semester Exam: 100 Time: 3hrs

Potential and scope of solar cooling and heating. Types of solar cooling systems, solar collectors and storage systems for solar refrigeration and air conditioning. Comparison of conventional VCRS with VARS, Solar operation of vapor absorption and compression refrigeration cycles and their assessment. Thermal modeling for solar refrigeration and air conditioning systems.

Vapor Absorption Refrigeration, principle, basic, theory of mixtures, temperature concentration and enthalpy concentration diagrams, various processes involved, mass and energy balancing across each component involved.

Actual ammonia absorption system, Lithium bromide absorption system, analysis of both, enthalpy concentration diagram, energy balance of various components of absorption system. Calculations using enthalpy concentration chart for above both systems. Comparison between Ammonia – Water Absorption System and Water-Lithium Bromide Absorption System

Solar thermoelectric refrigeration and air conditioning, Solar desiccant cooling systems. Adsorption Based Cooling Systems, Scope of Desiccant Cooling, Desiccants, Desiccant based cycles, Hybrid Desiccant Cooling Systems

Advance solar cooling and heating systems, passive cooling and heating, using earth air heat exchanger, solar chimney, Natural ventilation by metallic solar wall, PMV for predicting thermal comfort, Solar economics of cooling systems

Text Books

1. Solar refrigeration and space conditioning: By S C Kaushik, Divyajyoti Prakashan
2. Refrigeration and Air Conditioning:- By Ramesh Chandra Arora , PHI publication.

Reference

3. Basic Refrigeration and Air Conditioning: By P N Ananthanarayanan, McGraw-Hill.
4. Refrigeration and Air Conditioning: By Arora Domkundwar, Dhanpatrai & Sons.

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