G. PULLA REDDY ENGINEERING COLLEGE (Autonomous): KURNOOL
Accredited by NBA of AICTE and NAAC of UGC
Affiliated to JNTUA, Anantapur

Scheme – 2017

TSES Syllabus

Two Year M.Tech Course Scheme of instruction
(Effective from 2017-18)

M.Tech I SEMESTER **TSES**

S. No	Course No	Course Title	L	T	P	Credits	End Exam marks	Internal Assessment marks	Total
1	BS803	Probability and Mathematical Analysis	3			3	60	40	100
2	ME801	Advanced Thermodynamics	3			3	60	40	100
3	ME802	Renewable Energy Sources	3			3	60	40	100
4	ME803	Alternative Fuels	3			3	60	40	100
5		Elective –I	3			3	60	40	100
6		Elective – II	3			3	60	40	100
7	AU801	Technical English	2			-	-	-	-
8	ME804	Thermal Science Laboratory I			3	2	50	50	100
		Total	20		3	20	410	290	700

M.Tech II SEMESTER **TSES**

S. No	Course No	Course Title	L	T	P	Credits	End Exam marks	Internal Assessment marks	Total
1	ME805	Finite Element Analysis	3			3	60	40	100
2	ME806	Advanced Heat Transfer	3			3	60	40	100
3	ME807	Gas Turbine Theory	3			3	60	40	100
4	ME808	Energy Conservation and management	3			3	60	40	100
5		Elective –III	3			3	60	40	100
6		Elective – IV	3			3	60	40	100
7	AU802	Research Methodology	2			-	-	-	-
8	ME809	Thermal Science laboratory II			3	2	50	50	100
		Total	20		3	20	410	290	700

M.Tech III & IV SEMESTER **TSES**

S. No	Course No	Course Title	L	T	P	Credits	End Exam marks	Internal Assessment marks	Total
1	ME901	Dissertation	-	-	12	12	50	50	100

List of Electives

Description	Subject title	Code
Elective I	(i) Fuel and Combustion Technology	ME811
	(ii) Bio-energy and Conversion Technologies	ME812
	(iii) Energy Conversion Technologies	ME813
Elective II	(i) Refrigeration And Cryogenics	ME814
	(ii) Solar Passive Architecture	ME815
	(iii) Aerodynamics	ME816
Elective III	(i) Design of Heat Transfer Equipment	ME817
	(ii) Computational Fluid flow and Heat transfer	ME818
	(iii) Energy systems and Modeling Analysis	ME819
Elective IV	(i) Design Of Air Conditioning Systems	ME820
	(ii) Optimization Techniques	ME821
	(iii) Energy Storage Systems	ME822

PROBABILITY AND MATHEMATICAL ANALYSIS (PMA)

I Semester : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
BS803	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand and apply partial differential equations in solving hydrodynamics and fluid mechanics problems.

CO2: Apply numerical solutions in engineering, science and also in many branches of applied mathematics, Example in fluid dynamics; boundary layer theory and heat transfer quantum mechanics.

CO3: Understand and apply probability in many fields of learning such as statistics, physical sciences and engineering

Partial Differential Equations

Homogeneous linear equations with constant coefficients, Rules for finding the complementary functions, Rules for finding the particular integral, Non-homogeneous linear equations, Two dimensional heat flow solution of Laplace equations only-Solution of Two dimensional wave equation

Special Functions

Besssel's equation. Series solution for Bessel's equation, Recurrence formulae for $J_n(x)$, Generating function, Jacobi series, orthogonality of Bessel's function, Legendre's equation, Series solution for Legendre's equation, Rodrigues formula, Legendre's polynomials generation function for $P_n(x)$, Recurrence relations for $P_n(x)$, Orthoganality of Legendre polynomials.

Numerical Analysis

Numerical Integration- Trapezoidal Rule, Simpson's one third rule, Simpson's three eighth rule, Solution of ordinary differential equations, Taylor's Method, Range-kutta Method (Second and Fourth order),Predictor-Corrector Methods, Milne's Method and Adam's Method, Solution of Partial differential equations, solution of Laplace equation and Poisson's equation

Probability

Bayes theorem, concept of Random variables, discrete and continuous variables. Distribution function of discrete and continuous random variables. Mean and variance of a random variable. Linear co-relation coefficient, Linear Regression correlation coefficient for a Bivarate frequencies Distribution.

Text Books :

1. N.P.Bali & Iyengar ,Engineering Mathematics ,Laxmi publications
2. Higher Engineering Mathematics-B.S.Grewal,Khanna Publishers.

Reference Books :

1. Kreyszig, Advanced Engineering Mathematics ,John Wiley Publications.

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

ADVANCED THERMODYNAMICS (ATD)

I Semester : TSES				Scheme : 2017			
Course Code	Hours/Week			Credits	Maximum Marks		
ME801	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs				End Exam Duration: 3 Hrs			

Course Outcomes : At the end of the course the student will be able to

CO1: Determine the available energy in chemical reactions can practice writing Maxwell's relations.

CO2: Know fugacity and activity of reactive system and can study relations for achieving equilibrium in non reactive systems.

CO3: Study of properties on non-reactive mixture of ideal gases.

Introduction

First law, Second law, Combined 1st and 2nd law, Entropy, 3rd Law, Absolute Temperature Scale.

Availability

Availability, Availability in chemical reactions, Irreversibility, Guy-stadola theorem, second law efficiency.

Reactive Systems

Degree of reaction, Reaction equilibrium, Heat of reaction, Temperature dependence, Gibbs function change, Fugacity and activity, Heat capacity of reactions gases, Combustion, Enthalpy of formation, Adiabatic flame temperature, First law and second law for reactive systems.

Phase and Chemical Equilibrium

Gibbs-Duhem relation, Equilibrium in non-reacting systems, Equilibrium in systems with chemical reaction, General equilibrium.

Real Gases

Introduction to real gasses, Inter molecular forces and their effects, Shape factor and its effect, Vander waal's equation, Redlich kwong equation, Beattie-bridgeman equation, Virial equation of state, Compressibility factor and Compressibility chart.

Properties of Non Reactive Mixtures of Ideal Gases

Introduction, Gibb's Dalton law, The Amagat's Leduc law, Molecular weight and gas constant of a mixture, Gravimetric and volumetric proportions, Internal energy, Enthalpy, Specific heats and Entropy of mixture, Process of gaseous mixture, General Thermodynamic relation: Maxwell relation –Classius claperyon equation

Text Books :

1. Y.V.C. Rao, An Introduction to Thermodynamics ,Wiley Easern Ltd
2. P.K. Nag, Engineering Thermodynamics; Tata Mc Graw Hill Publications
3. John R. Howell & Richard O.Buckius Fundamentals of Engineering Thermodynamics, Mc Graw Hill Publications.

Reference Books :

1. Vanwylan, Engineering Thermodynamics, , Wiley & Sons.
2. Bejan, A Advanced Engineering Thermodynamics, , Wiley & Sons
3. V.M. Domkunduwar,Thermal Engineering by , Dhanapat Rai & Sons

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and

has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

RENEWABLE ENERGY SOURCES (RES)

I Semester : TSES				Scheme : 2017			
Course Code	Hours/Week			Credits	Maximum Marks		
ME802	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs				End Exam Duration: 3 Hrs			

Course Outcomes : At the end of the course the student will be able to

CO1: Know the working of flat plate collector, concentrating collectors to extract solar energy

CO2: Know the power generation through horizontal and vertical axis wind turbines.

CO3: Know the extraction methods of OTEC, Wave energy and power generation through MHD.

CO4: Aware of applications of solar energy

Solar Energy

The need for alternate energy sources, Potential of solar and wind energies, limitations, The Sun, Physical description, Reactions that generate thermal energy, An estimate of energy emitted by sun and energy that reaches the earth, Solar geometry, Extraterrestrial radiation – definition and analytical calculation procedures on different time scales, Terrestrial radiation and attenuation in the atmosphere, Terrestrial radiation components, Clearness index, Diffuse fraction, Measurement of solar radiation. Introduction to PV cell

Wind Energy

Power in wind - Availability – Types of wind turbines - Aerodynamics of Wind turbine – Momentum theory – Dynamic matching, Construction features of wind turbines - Rotor design considerations – Power extraction by a turbine -Applications of wind energy

Biomass energy - Bio fuel

Bio fuel classification- Biomass production for Energy farming- Direct combustion for heat- Pyrolysis- Thermo chemical process-Anaerobic digestion- Digester sizing- waste and residues- vegetable oils and biodiesels-Applications of Biogas-Social and environmental aspects

Wave and Tidal Energy

Concept of energy and power from waves – Wave characteristics – period and wave velocities - Different wave energy conversion devices (Tapchan, oscillating water column type); Principles of tidal power generation - components of power plant – Single and two basin systems – Estimation of energy – Maximum and minimum power ranges

Ocean and Geothermal Energy

OTEC Principle - Lambert's law of absorption - Open cycle and closed cycle – Major problems and operational experience –Fundamentals of geophysics - Classification of geothermal resource - Availability and estimation of thermal power - Extraction techniques.

Text Books :

1. Non conventional energy resources by – B H Khan
2. Renewable Energy Resources / John Twidell and Tony Weir / E & F.N.Spon
3. Renewable Energy Resources Basic Principles and Applications / G.N.Tiwari and M.K.Ghosal/ Narosa
4. Solar Energy - Principles of thermal collection and storage/ S.P. Sukhatme / TMH
5. Solar Energy Thermal Processes,/Duffie & Beckman
6. Solar Heating and Cooling / Kreith & Kreider

Reference Books :

1. Wind Energy Handbook / Tony Burton, David Sharpe, Nick Jenkins and Ervin Bossanyi / Wiley Publication
2. Wind Electrical Systems / S.N.Bhadra, D.Kastha and S.Banerjee / Oxford Publications

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

ALTERNATIVE FUELS (AF)

I Semester : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME803	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Learn extraction methods of various fuels like Gasoline, Diesel, Biogas, Hydrogen, CNG, Producer gas, Ethanol and Methonol etc.

CO2: Modifying the engine manifold to run under dual fuel mode.

CO3: Know rating of fuel and can compare rating of conventional fuels with biodiesel.

CO4: Learn performance parameters of IC engines.

Engine Performance Parameters

Introduction to IC engines, The First law analysis of engine cycle, Brake power, indicated power, friction power, mean effective pressure, engine efficiencies, performance calculations.

Properties of Petroleum Products

Introduction, Structure of petroleum, Knock rating of SI engine fuels, Octane number requirement , Specific gravity, Density, Molecular weight, Vapour pressure, Viscosity, Flash point, Fire point, Cloud point, Pour point, Freezing point, Smoke point & Char value, Aniline point, Octane Number, Performance Number, Cetane Number, Emulsification, Oxidation Stability, Acid Value /Number, Distillation Range, and Sulphur content.

Alternative Fuels for I.C. Engines

Need for alternative fuels such as Ethanol, Methanol, LPG, CNG, Hydrogen, Biogas and Producer gas and their methods of manufacturing.

Combustion - Dual Fuel Engine

Need and advantages, The working principle, Combustion in dual fuel engines, Factors affecting combustion in dual fuel engine, Use of alcohols, LPG, CNG, Hydrogen, Biogas and Producer gas in CI engines in dual fuel mode. Engine modifications required. Performance and emission characteristics of alternative fuels (mentioned above) in Dual Fuel mode of operation v/s Diesel operation.

Bio-Diesel

What are bio-diesels, Need of bio-diesels, Properties of bio-diesel V/s petro- diesel, Performance and emission characteristics of biodiesels v/s Petro diesel operation.
Environmental pollution with conventional and alternate fuels, Pollution control methods, emission norms in India.

Text Books :

1. R.P Sharma & M.L.Mathur,A Course in Internal Combustion Engines,D.Rai & Sons.
2. O.P. Gupt(2000), Elements of Fuels, Furnaces & Refractories, Khanna Publishers
3. V.M Domkundwar(1999),Internal Combustion Engines, I Edition, Dhanpat Rai & Co.,

Reference Books :

1. John B. Heywood, Internal Combustion Engines Fundamentals, McGrawHill International Edition,
2. Osamu Hirao & Richard Pefley(1988), Present and Future Automotive Fuels, Wiley Interscience Publication. NY.

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

TECHNICAL ENGLISH (TE)

I Semester: Common for All M.Tech Programmes						Scheme: 2017		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
AU802	**Foundation**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		2	**-**	**-**	**-**	**-**	**-**	**-**

Sessional Exam Duration: - **End Exam Duration: -**

Course Outcomes: At the end of the course students will be able to

CO 1: Write Technical Reports, Journal Papers and Project Reports.

CO 2: Write Job Applications, Resumes and Statements of Purpose.

Course Content

1. Technical Reports –Formats and Styles
   a) Feasibility Report
   b) Factual Report
   c) Project Reports
2. Journal Papers- Formats
3. Paper Presentation Strategies
4. Statement of Purpose for Internships and Apprenticeships
5. Letter Writing- Job Applications, Resume Preparation
6. Common Errors in Research Papers

Reference Books:

1. Sangeeta Sharma & Binod Mishra, Communication Skills for Engineers and Scientists, PHI Learning Private Limited.
2. M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw-Hill Publishing Company Ltd., 2005.
3. Thomas S. Kane , The Oxford Essential Guide to Writing, OUP, 2010
4. Joan van Emden, A Guide to Technical Report Writing http://scisweb.ulster.ac.uk/~projects/guide-to-technical-writing-1.pdf

THERMAL SCIENCE LABORATORY 1

I Semester : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME804	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	-	-	3	2	50	50	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

List of the Experiments

1. To Conduct test a Composite wall To determine total resistance and thermal conductivity of composite wall. To plot temperature gradient on composite wall structure.
2. To conduct varies tests on parallel flow and counter flow heat exchanger. To determine the temperature distribution in parallel & counter flow heat exchanger. To find heat transfer coefficient in parallel & counter flow runs & obtain the effectiveness of heat exchangers
3. Temperature distribution along the length of pin fin forced convection. To study the temperature distribution using the length of a pin fin in forced convection
4. Performance test on Refrigeration tutor .To conduct performance test on refrigeration tutor using vapor compression refrigeration cycle. To find the theoretical COP. Actual COP Relative COP Carnot COP
5. Film wise drop wise condensation .To find overall heat transfer coefficient for drop wise and film wise condensation

Internal Assessment: 50 Marks

End Exam: 50 Marks

FINITE ELEMENT ANALYSIS (FEA)

II Semester : TSES				Scheme : 2017			
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
ME805	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**1**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs				**End Exam Duration: 3 Hrs**			

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the basics of Finite Element analysis

CO2: Analyze different elements like bar, truss, beam and triangular elements using FEM.

CO3: Solve problems related one dimensional heat transfer, fluid flow and torsion problems.

Introduction to FEM

Basic steps in FEM, types of elements, boundary conditions. Engineering design analysis- meaning and purpose-steady state, propagation and transient problems-basic concept of FEM – applicability of FEM to structural analysis, heat transfer and fluid flow problems –advantages and limitations of FEM.

Static Analysis

General procedure of FEM – skeletal and continuum structures – Discretization of domain – basic types of elements – concept of stiffness analysis – Direct approach – Formal approach using shape functions – Reyleigh – Ritz method – Formulation of element stiffness matrices – Truss, beam, triangular, quadrilateral and brick elements – Iso-parametric elements – Axisymmetric elements.

Dynamic Analysis

Equation of motion for dynamic problems – consistent and lumped mass matrices –Formulation of element mass matrices - free vibration problem formulation.

Solution Methods for Finite Element Equations

Handling of simultaneous equations – Gaussian elimination method – Choleski method-solving of eigen value problems – Jacobi & subspace iteration methods – direct integration and mode superposition methods – Interpolation techniques.

Heat Transfer and Fluid Flow Analysis

Basic equations of heat transfer & fluid flow problems – Galerkin methods- finite element formulation – one – dimensional and two – dimensional heat and fluid flow problems.

Finite Element Software Packages(Not for term end theory examination)

Finite element procedure- Finite element modeling techniques – Element distortion – Verifying and Interpreting results – Use of popular Finite Element analysis packages – Pre and Post processing of problems in structural engineering, solid mechanics and heat transfer – Quality checks in FEA- Report generation.

Text Books :

1. T.RChandraputla., A.D.Belegundu(1996) "Introduction to finite element in Engineering" Prentice Hall
2. S.S RAO(1989),"The finite element Method in Engineering", 2nd Edition., Press, Oxford
3. O.P.Gupta, "Introduction to finite and boundary element methods", Oxford IBH Publishers.

Reference Books :

1. L.J.Segerlind(1984)," Applied Finite Element Analysis", John Wiley,.
2. K.J Bathe(1982) "Finite Element Procedures in Ind., Engineering Analysis", Prentice Hall New Jersey
3. L.H Shames. &.C.L Dym(1995), "Energy and Finite Element Methods in Structural Mechanics", Wiley Eastern Ltd.,
4. Cook R.D. Malkes D.S. & Plesha, M.E., (1989)"Concepts and Application of Finite Element

Analysis" , John willey & Sons.

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

ADVANCED HEAT TRANSFER (AHT)

II Semester : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME 806	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Know the concept of shape factor, numerical method and Gaussiedel method of iteration in the analysis of the multi dimension heat flow. Also student can know unsteady state conductive heat transfer.

CO2: Solve convective problems based on laminar and turbulent fluid flow. Also student can have detail study on film wise and drop wise heat convection.

CO3: Know the method of determining radiative heat transfer between black and non black surfaces.

CO4: Estimate the mass transfer coefficient.

Steady State Conduction

Mathematical Analysis of Two-Dimensional Heat Conduction , Graphical Analysis, The Conduction Shape Factor , Numerical Method of Analysis , Numerical Formulation in Terms of Resistance Elements , Gauss-Siedel Iteration , Electrical Analogy for Two-Dimensional Conduction .

Unsteady-State Conduction

Introduction , Lumped Heat Capacity System, Transient heat flow in a semi infinite solid, convective boundary conditions, Multidimensional Systems , Transient Numerical method, Thermal Resistance and Capacity Formulation .

Convection

Energy Equation , Laminar external convection , Similarity Solution , Integral Method , Laminar Internal convection ,Concept of full development Heat transfer in developing flow , Turbulent forced convection , free convection from vertical surface , Rayleigh Benard convection .

Condensation and Boiling Heat Transfer

Introduction , Condensation Heat-Transfer Phenomena , The Condensation Number , Film Condensation Inside Horizontal Tubes , Boiling Heat Transfer , Simplified Relations for Boiling Heat Transfer with Water , The Heat Pipe

Radiation

Heat Exchange Between Non-black bodies ,Radiation Shields , Gas Radiation , Radiation network for an Absorbing and Transmitting Medium , Radiation Exchange with Specular surfaces , Radiation Exchange with Transmitting , Reflecting and Absorbing Media , Formulation of Numerical Solution

Mass Transfer

Introduction , Fick's Law of Diffusion , Diffusion in Gases , Diffusion in Liquids and Solids ,The Mass Transfer Coefficient , Evaporation Process in the Atmosphere

Text Books :

1. Heat Transfer By : J.P.Holman McGraw Hill Inc.
2. Introduction to Heat Transfer, Frank P. Incropera, David P. Dewitt, Wiley, 4th Edition
3. Heat and Mass transfer - A Practical approach, Yunus A Cengel, Tata-Mc-Graw Hill education private Limited, New Delhi, 2009.

Reference Books :

1. Kays, W.M. and M.E Crawford, Convective Heat and Mass Transfer ,Tata McGraw Hill , 1980 .

2. Bejan,A ,Convective Heat Transfer , John Wiley , 1984.
3. Heat and Mass Transfer, D.S. Kumar, S.K. Kataria & Sons

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

GAS TURBINE THEORY (GTT)

II Semester : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME807	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Know the methods of improving thermal efficiency and specific power output of a gas turbine cycle.

CO2: Understand the working of various military profiles includes Ramjet, Pulse jet, Turbojet and Turboprop.

CO3: Draw velocity triangles of turbine blades and compressor blades.

Ideal Cycles and Their Analysis

Introduction , Assumptions in Ideal Cycle Analysis , The Simple Gas Turbine Cycle , The Heat Exchange Cycle , The Reheat Cycle , Reheat and Heat Exchange Cycle , Inter-cooled Cycles , Comparison of Various Cycles .

Practical Cycles and Their Analysis

Introduction, Assumptions, Stagnation Properties, Compressor and Turbine Efficiency, Heat Exchanger Effectiveness, Cycle Efficiency, Performance of Actual Cycle.

Jet Propulsion Cycles and Their Analysis

Introduction, Ramjet Engine, Pulse Jet Engine, Turboprop Engine, Turbojet Engine, Thrust and Thrust Equation, Efficiencies, Parameters Affecting Performance.

Centrifugal Compressors

Introduction, Principle of Operation, Blade Shapes and Velocity Triangles, Analysis of Flow through Compressor, Diffuser, Losses in Centrifugal Compressors, Compressor Characteristics, Surging and Choking

Axial Flow Compressors

Introduction, Geometry and Working Principle, Stage Velocity Triangles, Compressor Stage Efficiency , Degree of Reaction, Flow and Stage Losses, Performance Characteristics

Combustion Systems

Introduction, Combustion Theory Applied to Gas Turbine Combustor, Factors Affecting Combustion Chamber Design and Performance, The Process of Combustion in Gas Turbine, Mixing and Dilution, Combustion Chamber Arrangements

Impulse and Reaction Turbines

Introduction, A Single Impulse and Reaction Stage, Velocity Triangles of a Single Stage Machine, Expression for Work Output, Velocity and Pressure Compounding of Multistage Impulse Turbine, Multistage Reaction Turbines, Losses and Efficiencies, Performance Graphs.

Text Books :

1. V. Ganesan, “Gas Turbines”, Tata McGraw-Hill Publishing Company Ltd.

Reference Books :

1. Yahya Turbines, Pumps and Compressors”, TMH.
2. G.F.C. Rogers, Gas Turbine Theory, E-book

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and

has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

ENERGY CONSERVATION & MANAGEMENT (ECM)

II Semester : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME808	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Know the importance of energy conservation and techniques for energy conservation.

CO2: Know the process energy auditing for commercial, industrial and residential areas.

CO3: Understand the Cogeneration and waste heat recovery processes.

Energy Conservation

Introduction, principles of energy conservation, Rules for efficient energy conservation, Energy conservation schemes and planning, technologies for energy conservation, Energy conservation in – lighting, industry, residential and commercial sectors. Energy conservation in electric utility. Energy conservation measures (pie charts, sankey diagrams, load profiles).

Energy Management & Audit

Energy - management, action planning & policy. Qualities and functions of energy manager. Energy index, energy costs, Cost index. Energy performance.

Need, scope and methodology of energy audit. Types of energy audit-Preliminary energy audit and detailed energy audit, questionnaire for energy audit. Energy audit in building.

Economic Analysis of Energy Conservation

Economic analysis of investment, Economic analysis technique – payback period method, discounted cash flow method, net present value (NPV) method, present value index method, internal rate of return method and average rate of return method. Risk analysis.

Cogeneration

Introduction, benefits of cogeneration, basic thermodynamics cycles, classification of cogeneration system, techniques of cogeneration, Technical parameters of cogeneration.

Waste Heat Recovery

Introduction, Benefits of waste heat recovery. Waste heat recovery devices – Recuperators, Heat exchangers, Heat regenerators, heat wheels, Heat pipe, Economiser, heat pump, waste heat boiler, plate heat exchanger, Thermocompressor, Direct contact heat exchanger.

Energy Storage

Introduction, need of energy storage, Classification of energy storage – mechanical, chemical, electromagnetic, electrostatic and Thermal energy storage. Comparison of various energy storage system. Power factor – introduction, effects, methods of improving power factor.

Text Books :

1. Energy Management and Conservation Handbook - Frank Kreith, D. Yogi Goswami
2. Energy Conservation and management – Suredh kumar soni, manoj nair – Satyaprskashn new delhi.

Reference Books :

1. Energy Managemnt – W.R. Murphy, G Mckay - BH publications.
2. A Hand Book of Energy conservation and Management by Hemant Pathak

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to

answer any **Five** questions.

RESEARCH METHODOLOGY (RM)

I Semester : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
AU801	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	2	-	-	1	100	-	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: -		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand overview of research process, state the research problem and conduct a literature review of the concepts comprising the research questions.

CO2: Study the data collection methods and process the data statistically.

CO3: Understand the basic properties of estimators, analyse the estimated data and interpret the data in a research paper.

Meaning, Objective and Motivation in Research

Types of Research, Research Approaches, Research Process, Validity and Reliability in Research. Features of Good Design, Types of Research Design, Basic Principles of Experimental Design, Steps in Sampling Design, Characteristics of a Good Sample Design, Random Samples and Random Sampling Design.

Measurement and Scaling Techniques

Errors in Measurement, Tests of Sound Measurement, Scaling and Scale Construction Techniques, Forecasting Techniques, Time Series Analysis, Interpolation and Extrapolation.

Methods of Data Collection

Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules.

Statistical Processing

Correlation and Regression Analysis, Method of Least Squares, Regression Vs. Correlation, Correlation Vs. Determination, Types of Correlation and Their Specific Applications.

Hypothesis Testing

Tests of Hypothesis, Parametric Vs. Non-Parametric Tests, Procedure for Testing Hypothesis, Use of Statistical Techniques for Testing Hypothesis, Sampling Distribution, Sampling Theory Chi-Square Test, Analysis of Variance and Covariance, Multivariable Analysis

Interpretation of Data

Data interpretation, Layout of a Research Paper, Techniques o f Interpretation.

Reference Books :

1. C.R. Kothari, *Research Methodology (Methods & Techniques)*, New Age International Publishers.
2. R.Cauvery, V.K.Sudha Nayak, M.Girija, Research Methodology, S.Chand Publishers.

Question Paper Pattern:

Internal Assessment: -

THERMAL SCIENCE LABORATORY -II

II Semester : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME809	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

List of the Experiments

1. To conduct a test on blower .To determine overall efficiency at various value openings . To draw the graphs value opening Vs efficiency, discharge.
2. To conduct retardation test on 5 HP diesel engine . To determine friction horse power and find the mechanical efficiency of the engine .
3. To conduct heat balance test on 5 HP diesel engine with DC generator loading
4. To find the unaccounted heat losses .To conduct a test on 7.5 HP two stage air compressor . To adiabatic efficiency, isothermal efficiency, volumetric efficiency of a compressor . and draw the graphs pressure ratio Vs efficiencies.
5. To conduct & measure exhaust emissions on an internal combustion engine using "Automotive emissions analyser".To find emissions at various loads and compare their exhaust emissions .

Question Paper Pattern:

Internal Assessment: 50 marks

External Assessment: 50 marks

FUEL AND COMBUSTION TECHNOLOGY (FCT)

I Semester(Elective-I) : TSES				Scheme : 2017			
Course Code	Hours/Week			Credits	Maximum Marks		
ME811	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs				End Exam Duration: 3 Hrs			

Course Outcomes : At the end of the course the student will be able to

CO1: Understand production of coke, coal, gasoline, diesel, water gas, coal gas etc.

CO2: Understand different combustion processes including fluidized bed combustion technique.

CO3: Understand better about stoichiometry, burner design, different furnaces and kilns.

Solid Fuels

General – Biomass – Peat- Lignite or brown coal- Sub-bituminous coal or black lignite-Semi anthracite-Anthracite-Cannel coal and boghead coal-Natural coke/SLV fuel – Origin of coal – Composition of coal – Analysis and properties of coal – Action of heat on coal – Oxidation of coal – Hydrogenation of coal – Classification of coal

Processing of Solid Fuels

Coal preparation – Storage of coal – Coal carbonization – Briquetting of solid fuels – Gasification of solid fuels – Liquefaction of solid fuels

Liquid Fuels

Petroleum – Origin of petroleum – Petroleum production – Composition of petroleum – Classification of petroleum – Nature of Indian crudes – Petroleum processing - Important petroleum products – Properties and testing of petroleum and petroleum products – Liquid fuels from sources other than petroleum – Gasification of liquid fuels – Storage and handling of liquid fuels

Gaseous Fuels

Types of gaseous fuels – Natural gas – Methane from coal mines –Producer gas – water gas – Carbureted water gas – Complete gasification of coal – Underground gasification of coal – Coal gas – Blast furnace gas – Gases from biomass – Refinery gases – Liquefied petroleum gases(LPG) – Oil gasification – Cleaning and purification of gaseous fuels

Theory of Combustion Process

Stoichiometry and thermodynamics; Combustion stoichiometry: Combustion thermodynamics, burners; Fluidized bed combustion process

Stoichiometry

Stoichiometry relations; Estimation of air required for complete combustion; Estimation of minimum amount of air required for a fuel of known composition; Estimation of dry flue gases for known fuel composition; Calculation of the composition of fuel & excess air supplied, from exhaust gas analysis; Dew point of products; Flue gas analysis (O_2, CO_2, CO, NO_x, SO_x).

Burner Design and Furnaces

Ignition: Concept, auto ignition, ignition temperature; Burners: Propagation, various methods of flame stabilization; Basic features and design of burners for solid, liquid, and gaseous fuels; **Furnaces**: Industrial furnaces, process furnaces, batch & continuous furnaces; Advantages of ceramic coating; Heat source; Distributions of heat source in furnaces; Blast furnace; Open hearth furnace, Kilns; Pot & crucible furnaces; Waste heat recovery in furnaces: Recuperators and regenerators; Furnace insulation; Furnace heat balance computations; Efficiency considerations

Text Books :

1. Samir Sarkar, Fuels and combustion, Orient Longman Limited
Reference Books :
1. D.A. Williams and G. Jones, Liquid fuels, Pergamon
2. E. Giffen and A. Muraszew, The atomization of liquid fuels, Chapman and Hall.
Question Paper Pattern:
Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions. **End Exam:** The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

BIO-ENERGY AND CONVERSION TECHNOLOGIES (BCT)

I Semester(Elective-I) : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME812	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the bio mass production and its conversion technologies

CO2: Understand the parameters affecting the performance of the Gassifier and a bio digester

CO3: Understand of power generation methods using bio mass.

Biomass Formation

Biomass resources: Classification and characteristics; Techniques for biomass assessment; Biomass estimation, Water-to-biomass resources, Advantages associated with biomass resources, Availability of biomass for energy generation.
Energy plantation: Concept, Objectives and advantages.
Waste land development: Extent of water lands in India, Nature of waste lands.

Thermo chemical Conversion

Different processes: Direct combustion, incineration, pyrolysis, gasification and liquefaction; Economics of thermochemical conversion.

Biological Conversion

Biochemistry and process parameters of biomethanation; Biogas digester types; Digester design and biogas utilization; Economics of biogas plant with their environmental and social impacts; Bioconversion of substrates into alcohol: Methanol & ethanol Production

Gasification

Gasification: Fuels for gasification, Properties of biomass - size, size distribution, bulk density, volatile matter, ash and ultimate analysis., Types of gasifiers, Design of a Down draft gasifier, Performance evaluation of a Down draft gasifier.

Power Generation

Use of producer gas in SI & CI engines, Reasons for derating, Gasifier engine system Problems associated with gasifer engine system

Performance of Dual Fuel Engine: Power capacity, Diesel substitution, Thermal efficiency, Smoothness of operation, Load following capability, Maintenance and durability, Exhaust emissions.

Text Books :

1. S.Rao Pauleka(1999), Energy technology, Khanna publishers Delhi
2. Noyes daa corporation1981, Biomass gasification principles and technology, Energy technology view no.67, USA
3. O.P Vimal and M.S bhatt, Wood energy systems , K.L publications, New Delhi
4. A.Kaupp and J.R Goss ,Friedr(1984), State of art for small scale gas producer engine systemsy, viewg ans Sohn verlags,

Reference Books :

1. Country Perspective from India, Oxford University Press, (1995)

2. R. C. Maheswari(1997) , Bio Energy for Rural Energisation , Concepts Publication,
3. Elsevier Applied SC, Biogas Technology : Transfer & Diffusion,London

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

ENERGY CONVERSION TECHNOLOGIES (ECT)

I Semester(Elective-I) : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME813	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the energy sources and the production methods of thermal, mechanical and electrical energy

CO2: Understand the storage techniques of mechanical, electrical, thermal and nuclear energy storage methods

Energy Classification, Sources, Utilization, Economics and Terminology

Introduction , Mass-Energy Dependence , Energy , Mass and Power Units , Energy Types and Classifications , Energy Sources , Energy Reserves , Energy Utilization , Energy Economics , Power Generation Terminology.

Principal Fuels for Energy Conversion

Introduction , Biomass Fuels , Fossil Fuels , Nuclear Fuels , Solar Energy

Production of Thermal Energy

Introduction , Conversion of Mechanical Energy , Conversion of Electrical Energy , Conversion of Electromagnetic Energy , Conversion of Chemical Energy ,Conversion of Nuclear Energy .

Production of Mechanical Energy

Introduction , Conversion of Thermal Energy , Turbines , Electro mechanical Conversion

Production of Electrical Energy

Introduction , Conversion of Thermal Energy into Electricity , Conversion of Chemical Energy into Electricity , Conversion of Electromagnetic energy into Electricity , Conversion of Nuclear Energy into Electricity , Conversion of Mechanical Energy into Electricity .

Energy Storage

Introduction , Storage of Mechanical Energy , Storage of Electrical Energy, Storage of Chemical Energy , Storage of Nuclear Energy , Storage of Thermal Energy

Text Books :

1. Archie W.Culp , Jr, Principles of Energy Conversion , Tata McGraw –Hill

Reference Books :

1. H.A.Sorenson , Energy Conversion Systems , John Willey & sons
2. Bansal, K.Leeman, Renewable Energy sources & Conversion Technology, & Meliss

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

REFRIGERATION AND CRYOGENICS (RCG)

I Semester(Elective-II) : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME814	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Acquire knowledge on latest refrigeration systems like steam jet and pulse tube refrigeration systems

CO2: Understand the employing multiple compressors and evaporators in refrigeration systems

Vapour Compression Refrigeration Systems

Analysis of vapour compression refrigeration cycle – effect of suction temperature and condensing temperature on cycle performance – actual refrigeration cycle – effect of sub cooling the liquid – the effect of super heating the suction vapour- the effect of wet suction

Compound Vapour Compression System

Removing of flash gas – inter cooling – compound compression ultra water inter cooler- liquid flash cooler – flash inlet cooler

Multiple Evaporator and Compression Systems

One compressor system – individual compressors – compound compression – cascade systems.

Absorption Refrigeration Systems

Elementary properties of binary mixtures – simple theoretical absorption refrigeration systems – the practical ammonia absorption system- Three fluid absorption systems – the lithium bromide water absorption system

Latest Refrigeration Systems

Steam jet water vapour systems – thermoelectric refrigeration systems – vortex refrigeration system – pulse tube refrigeration

Refrigerants

Desirable properties – designation of refrigerants – inorganic, halo carbon refrigerants – inorganic halo carbon reactions- secondary refrigerants – reaction of refrigerants with moisture and oil – properties of mixtures of refrigerants – ozone depletion potential and global warming potential of CFC refrigerants – substitutes for CFC refrigerants

Liquification of Gases

Liquification of air - Lindae system – Analysis - Dual pressure cycle analysis-Liquefaction of Hydrogen and Helium - problems. Application of Lower temperature -Effects on the properties of metals-strength-Thermal properties-super conductivity-super fluidity.

Cryogenic Systems

Cooling by adiabatic de-magnetization - Gas separation and cryogenic systems- Separation of gases - Rectifying columns - Air separating- single and double columns Air separation plant. Storage and handling of cryogenic liquids - Dewars and other types of container

Text Books :

1. C.P. Arora, Refrigeration & Air-Conditioning by , TMH
2. R.F Barron ,Cryogenic Systems , Oxford University Press
3. Timmerhaus, Cryogenic Engineering
4. Huston, Cryogenic Engineering, McGraw Hill

Reference Books :

1. Stoecker W.F.Refrigeration & Air-Conditioning, and Jones, J.W., McGraw Hill
2. Manohar Prasad, Refrigeration & Air-Conditioning , New Age

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

SOLAR PASSIVE ARCHITECTURE (SPA)

I Semester(Elective-II) : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME815	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the thermal analysis and design for human comfort, passive cooling and heating concepts

CO2: **S**tudy how heat transmission occurred in buildings

CO3: Acquire knowledge on typical energy efficient landscape building suited to India climatic condition

Introduction

Introduction to architecture; Architecture as the art of science of designing buildings; Building science and its significance; Energy management concept in building

Thermal Analysis and Design for Human Comfort

Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces; Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel.

Heat Transmission in Buildings

Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag. Design of daylighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance

Bioclimatic Classification

Bioclimatic classification of India; Passive concepts appropriate for the various climatic zones in India; Typical design of selected buildings in various climatic zones; Thumb rules for design of buildings and building codes

Energy Efficient Landscape Design

Modification of microclimatic through landscape element for energy conservation; Energy conservation through site selection, planning, and design; Siting and orientation

Text Books :

1. M.S.Sodha, N.K. Bansal, P.K. Bansal, A. Kumar and M.A.S. Malik(1986), Solar Passive Building, Science and Design, Pergamon Press,.
2. J.R. Williams(1983), Passive Solar Heating, Ann Arbar Science,

Reference Books :

1. R.W.Jones, J.D. Balcomb, C.E. Kosiewiez, G.S. Lazarus, R.D. McFarland and W.O.Wray(1982), Passive Solar Design Handbook, Vol. 3, Report of U.S. Department of Energy(DOE/CS-0127/3),.
2. J Krieder and A Rabi (1994), Heating and Cooling of Buildings : Design for Efficiency, McGraw-Hill
3. R D Brwon, T J Gillespie (1990), Microclimatic Landscape Design, John Wiley & Sons, NewYork

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

AERODYNAMICS (ADY)

I Semester (Elective-II): TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME816	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Study the elementary flow pattern and their superposition.

CO2: Acquire the knowledge on theory of airfoil.

CO3: Study the generation of lift and drag force of analytically.

Fluids and Fluid Forces

Equations for incompressible inviscid flows, Fluid circulation and rotation, Vorticity, Kelvin's theorem, Velocity potential, Stream function, Equation of a stream line, Complex potential, Blasius theorem for force and moment on bodies, Elementary flow patterns and their superposition.

Lift, Drag and Pitch

Flow past a cylinder, Magnus effect, Kutta condition, Vortex theory of lift, Conformal transformation, The Jowkowski transformation, Lift on arbitrary cylinder, Aerodynamic center, Pitching moment.

Aerofoils

Introduction to Aerofoils, Low speed flows over aerofoils-the vortex sheet, Thin aerofoil theory, Symmetric aerofoil, Tear drop theory, Camber line at zero angle of attack, Characteristics of thin aero foils, Motion in three dimensions, Flow past slender bodies.

Theory of Wings

Finite wings, Downwash and induced drag, Prandtl-Lachester theory, Biot- Savarat law, General series solution, Glauret method, Multhop's method, Horseshoe effects, Ground effects, Lineraised compressible flows in two dimensions, Flow past a wavy wall, Similarity rules, Aerofoil in compressible flows.

Text Books :

1. Kuethe, A. M. and Chow, C., Foundations of Aerodynamics, Fourth Edition, Wiley Eastern, 1986
2. Katz, J. and Plotkin, A., Low Speed Aerodynamics, McGraw-Hill, 1991.
3. Milne-Thomson, L. M., Theoretical Hydrodynamics, Macmillan, 1958
4. Anderson Jr., J. D., Fundamentals of Aerodynamics, McGraw Hill, 1988.

Reference Books :

1. Houghton, E. L. and Brock, A. E., Aerodynamics for Engineering Students, Second Edition, Edward Arnold, 1970.

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

DESIGN OF HEAT TRANSFER EQUIPMENT (DHE)

II Semester (Elective-III) : TSES			Scheme : 2017
Course Code	Hours/Week	Credits	Maximum Marks

ME817	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	1	-	3	40	60	100

Sessional Exam Duration : 2 Hrs | **End Exam Duration: 3 Hrs**

Course Outcomes : At the end of the course the student will be able to

CO1: Familiarize with the fundamentals of heat exchangers.

CO2: Learn use of Kay and London chart in the design procedure of heat exchangers

CO3: Acquire knowledge on the study of heat pipe.

Heat Exchangers

Introduction , Mean Temperature Difference, Temperature distribution and Heat flow in Condenser, Temperature distribution and Heat flow in Evaporator, Analysis of regeneration Heat Exchanger, Overall Heat Transfer Coefficient, Fouling or Scaling of Heat Exchangers, NTU method to study the Performance of Heat Exchangers.

Design of Heat Exchangers

Introduction, Classification of Heat Exchanger, Aspects of Heat Exchanger, Double Pipe Heat Exchanger, Shell and Tube Heat Exchanger, Design of Heat Exchanger, Compact Type, Regenerative , Direct Contact Heat Exchanger and Special Type Heat Exchangers, Fouling , Material selection and Optimization of Heat Exchanger.

Heat Pipe

Aerofoils, Low speed flows over aerofoils-the vortex sheet, Thin aerofoil theory, Symmetric aerofoil, Tear drop theory, Camber line at zero angle of attack, Characteristics of thin aero foils, Motion in three dimensions, Flow past slender bodies.

Condensers and Evaporators

Condenser: Shell and tube condenser, plate condenser, air cooled condenser, direct contact condenser, condenser for refrigeration and air-conditioning

Evaporator: Evaporator for refrigeration and air-conditioning, standards for evaporators and condensers

Cooling Towers

Cooling towers – basic principle of evaporative cooling, Classification of cooling towers.

Text Books :

1. S.Domkunduwar and S.C.Arora , " Heat and Mass Transfer ",Dhanpati rai publications
2. D.Q. Kern , " Process heat transfer " .
3. B. Linhoff, " Process Integration for Efficient use of Energy"
4. Heat pipes , " Pd Dunn and Da Reay"

Reference Books :

1. Heat Transfer by A.F. Mills

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

COMPUTATIONAL FLUID FLOW AND HEAT TRANSFER (CFH)

II Semester (Elective-III): TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME818	L	T	P	C	Continuous	End Exam	TOTAL

					Internal Assessment		
	3	1	-	3	40	60	100

Sessional Exam Duration : 2 Hrs | **End Exam Duration: 3 Hrs**

Course Outcomes : At the end of the course the student will be able to

CO1: Solve problems related to heat flow and stress on elements of in 2-D and 3-D flow

CO2: Learn procedure of Lax-wendroff technique, MacCormack's technique etc.

CO3: Learn application of CFD in the analysis of flow through nozzle.

Introduction

Models of the flow , Governing equations , Continuity equation , Momentum equation , Energy equation , Initial and Boundary conditions .

Discretization

Introduction to finite differences ,Differences equation , Forward , backward and central difference schemes , explicit and implicit methods , Error and Analysis of stability , upwind schemes .

CFD *Techniques*

Lax-wendroff technique , MacCormack's technique , Alternating direction implicit technique , Pressure correction technique , Philosophy of pressure correction formula , SIMPLE algorithm .

Application

Numerical solutions of Quasi-One-Dimensional nozzle flow , CFD solution of Subsonic-Supersonic , Isentropic nozzle flow , MacCormack's technique .

Heat Transfer

Conduction heat transfer : Steady and Unsteady state , boundary conditions , Convective heat transfer : Governing equations , models of convection problems , Radiative heat transfer : Basic concepts , radiosity method , Monte-Carlo method , Problem solving using iterative and direct methods .

Text Books :

1. K Muralidhar & T.Sunderarajan(1995) , "Computational Fluid Flow and Heat Transfer" , Narosa Publication

Reference Books :

1. Yogesh Jaluria & Kenneth E. Torrance(1986) , " Computational Heat Transfer " Hemisphere Publishing Corporation ,.
2. Patankar S.V(1980) , "Numerical Heat Transfer and Fluid Flow " , Hemisphere Publishing Corporation

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

ENERGY SYSTEMS MODELING AND ANALYSIS (ESMA)

II Semester(Elective-III) : TSES					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
ME819	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL

	3	**1**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs				**End Exam Duration: 3 Hrs**			
Course Outcomes : At the end of the course the student will be able to							
CO1: Acquire knowledge on mathematical modeling and equation fitting methods used in the design of thermal systems							
CO2: Understand Mathematical optimization of problems includes water chilling, LP problems to Thermal systems.							
CO3: Acquire knowledge on Lagrange multipliers equations and linear regression analysis.							
Introduction							
Overview of various technologies and conventional methods of energy conversion, Designing a Workable System: Workable and optimum systems, Steps in arriving a workable system, Creativity in concept selection, Workable Vs Optimum system							
Equation Fitting							
Mathematical modeling, Polynomial representation, Functions of two variables, Exponential forms, Best fit Method of least squares							
Modeling of Thermal Equipment							
Counter flow heat exchanger, Evaporators and Condensers, Heat exchanger effectiveness, Effectiveness of a counter flow heat exchanger, NTU, Pressure drop and pumping power							
System Simulation							
Classes of simulation, Information flow diagrams, Sequential and simultaneous calculations, Successive substitution, Newton Raphson method							
Optimization Techniques:							
Mathematical representation of optimization problems, A water chilling system, Optimization procedure, Setting up the mathematical statement of the optimization problem, Dynamic Programming: Characteristic of the Dynamic programming solution, Apparently constrained problem, Application of Dynamic programming to energy system problems, Geometric Programming: One independent variable unconstrained, Multivariable optimization, Constrained optimization with zero degree of difficulty ,Linear Programming: Simplex method, Big-M method, Application of LP to thermal systems							
Lagrange Multiplier's Method							
The Lagrange multiplier equations, Unconstrained optimization, Constrained optimization, Sensitivity coefficients							
Search Methods							
Single variable – Exhaustive, Dichotomous and Fibonacci, Multivariable unconstrained - Lattice, Univariable and Steepest ascent							
Mathematical Modeling							
Thermodynamic properties-Need for mathematical modeling, Criteria for fidelity of representation, Linear regression analysis, Internal energy and enthalpy, Pressure temperature relationship at saturated conditions, Specific heat, P-V-T equations							
Text Books :							
1. W.F.Stoecker (1989),"Design of Thermal Systems" McGraw Hill, 3rd Ed.							
2. B.K.Hodg(1990),"Analysis and Design of Thermal systems",Prentic Hall inc.,.							
3. I.J.Nagrath & M.Gopal, "Systems Modelling and Analysis", Tata McGraw Hill.							
Reference Books :							
1. D.J. Wide(1978), "Globally Optimal Design", Wiley- Interscience,							
Question Paper Pattern:							
Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.							

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

DESIGN OF AIR CONDITIONING SYSTEMS (DACS)

II Semester(Elective-IV): TSES					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
ME820	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**1**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		
Course Outcomes : At the end of the course the student will be able to							
CO1: Learn using psychometric chart to determine heating and cooling load of an air conditioning system.							

CO2: Design fan & duct systems, cooling & dehumidifying coils.
CO3: Understand control of air conditioning systems.
Psychrometry
Psychrometry and psychrometric properties – Psychrometric relations – Psychrometric processes
Heating and cooling load calculations
Introduction – Thermal comfort – Estimation of heat loss and heat gain – Design conditions – Infiltration and ventilation loads – Procedure for estimating heating loads and cooling loads
Air conditioning systems
Thermal distribution systems – Single zone system – Design calculations – Multi zone system – Water systems – Variable air volume systems – Unitary system
Fan and duct systems
Pressure drop in straight and rectangular ducts – Sudden enlarge and contraction – Design of duct systems – Velocity method – Equi-friction method – Fan laws – Air distribution in rooms
Cooling and dehumidifying coils
Types of cooling and dehumidifying coils – Calculating the surface area of the coil – Actual coil condition curves – Solving for outlet conditions
Air conditioning controls
Pneumatic control hardware, Direct and reverse acting thermostat – Temperature transmitter with receiver controller – Dampers – Out door air control –Summer, winter changeover – Humidistat and humidifiers
Text Books :
1. C.P.Arora, Refrigeration & Air-Conditioning , TMH .
2. Stoecker W.F., and Jones, J.W., Refrigeration & Air-Conditioning, McGraw Hill
Reference Books :
1. Manohar Prasad, Refrigeration, Air-Conditioning , New Age
2. Domkunduwar and Arora, Refrigeration & Air-Conditioning, Dhanpatrai & Sons
Question Paper Pattern:
Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions. **End Exam:** The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

OPTIMIZATION TECHNIQUES (OT)

II Semester(Elective-IV): TSES					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
ME821	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**1**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		
Course Outcomes : At the end of the course the student will be able to							
CO1: Formulate the engineering problem in mathematical form which can be solved by suitable optimization algorithm							

CO2: Solve the Engineering problem which involves non-linear constraints.

CO3: Understand dynamic programming and genetic algorithm

Optimization

Introduction, Historical Development, Engineering Applications of Optimization, Classification of Optimization problems.

Linear Programming

Introduction, Graphical solution of linear programming problem, Computational procedure of simplex method, Simplex method computations, Artificial variable technique, Special cases in simplex method application – Degeneracy, unbounded solution, infeasible solution, Definition of the dual problem, solution of the dual problem

Non-linear Programming Techniques

One dimensional minimization methods, Unimodel function, Elimination methods, Exhaustive search , Dichotomous search, Interval halving method , Fibonacci method, Golden section method

Kuhn-tucker conditions

Kuhn-Tucker conditions, sufficiency of Kuhn-Tucker conditions

Integer Programming

Simple applications of integer programming, solution methods of integer programming- Branch and Bound Algorithm, Cutting Plane Algorithm

Dynamic Programming

Elements of dynamic programming model, Back ward recursive equation, Examples of Dynamic Programming models and computations.

Genetic Algorithm

Introduction, Difference between Genetic Algorithm and Traditional Methods, Simple Genetic Algorithms, Similarity Templates (Schemata), Genetic algorithm operators –selection, crossover and mutation, Simple applications of GA.

Text Books :

1. S.S Rao(1995), "Optimization", Wiley Eastern, New Delhi.
2. S.D.Sarma, "Operations Research" ,Kedarnath and Ramanath &Co.
3. David E.Goldberg," Genetic algorithms" ,Pearson Education

Reference Books :

1. Hamdy A.Taha ,"Operations Research ", Prentice Hall of India
2. Kalyanmoy Deb(2000) "Optimization for engineering design", Prentice Hall, New Delhi,

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.

ENERGY STORAGE SYSTEMS (ESS)

II Semester(Elective-IV): TSES					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
ME822	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**1**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		
Course Outcomes : At the end of the course the student will be able to							
CO1: Understand methods of storing mechanical energy, compressed gas energy, electrical energy including pumped storage and flywheel storage.							
CO2: Understand preservation of food, green house heating, drying and heating process in industries.							
Introduction							
Need of Energy Storage, Different modes of Energy Storage.							
Energy Storage							

Potential Energy: Pumped Hydro Storage, KE and Compressed gas system: Flywheel Storage, Compressed air energy Storage, Electrical and magnetic energy storage: Capacitors, Electromagnets and battery storage systems, Chemical Energy Storage: Thermo-Chemical, Bio-Chemical, Electro-Chemical, Fossil fuels and synthetic fuels and Hydrogen storage.

Sensible Heat Storage

SHS mediums, Stratified storage systems, Rock-bed storage systems, Thermal storage in buildings, Earth storage, Energy storage in aquifers, Heat storage in SHS systems, Aquifers storage.

Latent Heat Thermal Energy Storage

Phase Change Materials(PCMs), Selection Criteria Of PCMs, Stefan Problem, Solar Thermal LHTES Systems, Energy Conservation Through LHTES Systems, LHTES Systems in Refrigeration and Air Conditioning Systems, Enthalpy formulation, Numerical heat transfer in melting and freezing process.

Application of Energy Storage

Food Preservation, Waste Heat Recovery, Solar Energy Storage, Green House Heating, Power Plant Applications, Drying and Heating for Process Industries.

Text Books :

1. H.P.Garg et al, D Reidel (1885)"Solar Thermal Energy Storage", Publishing Co.
2. V Alexiades & A.D.Solomon(1993) "Mathematical Modeling of Melting and Freezing Proces" , Hemisphere Publishing Corporation,
3. WashingtonNarayan R, Viswanath B(1998), Chemical and Electro Chemical Energy System, Universities Press

Reference Books :

1. A. Ter-Gazarian(1994), "Energy Storage for Power Systems", Peter Peregrinus Ltd.London
2. B.Kilkis and S.Kakac (1989),"Energy Storage Systems",(Ed),KAP,London,1989

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and has to answer any **Five** questions.