CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Instruction and Syllabi
of

M.E. (Mechanical)

Specialization:

THERMAL ENGINEERING

Full time

Chaitanya Bharathi Institute of Technology (Autonomous)
Chaitnaya Bharathi P.O., Gandipet, Hyd-500 075. Telangana
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2016-2017-CBCS

CHAITANYA BHARATHI INSTIUTE OF TECHNOLOGY

(AUTONOMOUS)-CBCS

Gandipet, Hyderabad – 500 075

INSTITUTE

Vision

To be a centre of excellence in technical education and research

Mission

To address the emerging needs through quality technical education and advanced research

DEPARTMENT

Vision

To be a Pace Setter in the field of mechanical Engineering by providing conducive environment for understanding and applying its principles to cater the needs of Society

Mission

To impart quality & innovative technical education to the students of mechanical engineering for their professional achievements in consultancy, R&D and to become successful entrepreneur enabling them to serve the society in general and the industry in particular

CHAITANYA BHARATHI INSTIUTE OF TECHNOLOGY

(AUTONOMOUS)

Gandipet, Hyderabad – 500 075

MECHANICAL ENGINEERING

Programme: M.E (Thermal Engineering)

Programme Educational Objectives:

1. To provide the students with a solid understanding of thermal engineering fundamentals and applications required to solve real life problems.

2. To motivate the students to excel in research and to practice the technologies in field of thermal engineering in a broad way.

3. To train the student with scientific and engineering knowledge so as to comprehend analyze the design products and systems pertaining to broad among thermal engineering

4. To indicate an altitude to face typical thermal engineering problems with confidence through multi-disciplinary team approach.

5. To provide student with an academic environment that is aware of professional excellence and leadership through interaction with practicing engineering and professional bodies.

Scheme of Instruction & Examination
M.E. (THERMAL ENGINEERING) – 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective-1	3	--	3	30	70	100	3
5.	Elective-2	3	--	3	30	70	100	3
6.	Elective-3	3	--	3	30	70	100	3
7.	Laboratory - I	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	**18**	**09**		**340**	**360**	**700**	**25**

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core-4	3	1		30	70	100	4
2.	Core-5	3	1		30	70	100	4
3.	Core-6	3	1		30	70	100	4
4.	Elective-4	3	--		30	70	100	3
5.	Elective-5	3	--		30	70	100	3
6.	Elective-6	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	**18**	**11**		**390**	**360**	**750**	**26**

Semester - III

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Seminar* (i) Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	**100**	**--**	**100**	**6**
	Total	**100**		**100**	**6**

Semester - IV

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Work	**100**	**100**	**200**	**12**

Note : Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only, 50 marks awarded by the project guide and 50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

With effect from the academic year 2016-2017

Scheme of Instruction & Examination of Post Graduate course in
Mechanical Engineering with specialization in **Thermal Engineering**

Course duration: 4 Semesters (Full Time)

Sl. No	Syllabus Ref. No.	Subject	Scheme of Instruction Hours per week		Scheme of Examination			Credits
					Duration	Max. Marks		
			L	T/P	in Hours	End Exam	Internal Assessment	
		CORE SUBJECTS						
1.	16MEC 105	Finite Element Techniques	3	1	4	70	30	4
2.	16MEC 201	Fluid Flow and Gas Dynamics	3	1	4	70	30	4
3.	16MEC 202	Advanced Thermodynamics	3	1	4	70	30	4
4.	16MEC 203	Advanced Heat & Mass Transfer	3	1	4	70	30	4
5.	16MEC 204	Advanced I.C. engines	3	1	4	70	30	4
6	16MEC 205	Computational Fluid Dynamics	3	1	4	70	30	4
		ELECTIVES						
1.	16MEE105	Optimization Techniques	3	--	3	70	30	3
2.	16MEE107	Engineering Research Methodology	3	--	3	70	30	3
3.	16MEE201	Computer Aided Graphics and Design	3	--	3	70	30	3
4.	16MEE 202	Turbo Machines	3	--	3	70	30	3
5.	16MEE203	Fluid Power Systems	3	--	3	70	30	3
6.	16MEE 204	Design of Thermal Systems	3	--	3	70	30	3
7.	16MEE 205	Design of Gas Turbines	3	--	3	70	30	3
8.	16MEE 206	Advanced Energy Systems	3	--	3	70	30	3
9.	16MEE 207	Fuels and Combustion	3	--	3	70	30	3
10.	16MEE 208	Power Plant Control and Instrumentation	3	--	3	70	30	3
11.	16MEE 209	Design of Pumps and Compressors	3	--	3	70	30	3
12.	16MEE 210	Numerical Methods	3	--	3	70	30	3
13.	16MEE 211	Environmental Engineering and Pollution Control	3	--	3	70	30	3
14.	16MEE 212	Refrigeration Machinery & Components	3	--	3	70	30	3
15.	16MEE 213	Energy Management	3	--	3	70	30	3
16.	16MEE 214	Convective Heat Transfer	3	--	3	70	30	3
17.	16MEE 215	Thermal & Nuclear Power Plants	3	--	3	70	30	3
		DEPARTMENTAL REQUIREMENTS						
1.	16MEC 206	Thermal Systems Laboratory (Lab – I)	--	3	--	--	50	2
2.	16MEC 207	CFD Laboratory (Lab –II)	--	3	--	--	50	2
3.	16MEC 208	Seminar – I	--	3	--	--	50	2
4.	16MEC 209	Seminar – II	--	3	--	--	50	2
5	16MEC 210	Mini Project	--	2	--	--	50	1
6.	16MEC 211	Project Seminar	--	6	--	--	100	6
7.	16MEC 212	Project work	--	6	--	100	100	12

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 105	**FINITE ELEMENT TECHNIQUES**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. Identify mathematical model for solution of common engineering problems
2. Enable the students to formulate the design problems into FEA
3. Enable the students to perform engineering simulations using Finite Element Analysis software

Outcome (s)

Students are able to

1. implement finite element formulations to axial and quadratic elements and solve problems with hand calculations numerically
2. formulate numerically the truss, beam and frame elements and solve for deflection, strains and stresses
3. formulate numerically the plane and axisymmetric triangular elements and quadrilateral elements then solve for deflections, strains and stresses in structural mechanics problems
4. apply FE formulations to heat transfer of 1D and 2D elements and solve for temperature and heat flux in slabs, walls and plates
5. apply FE formulations to dynamic analysis of 1D and 2D elements and solve for eigen values and eigen vectors in bars and beams
6. apply FE formulations to 3D solids, plates and for non linear problems

1. FIELD PROBLMES AND MODELING — **Total Hrs 10**

Introduction to Finite Element Method of solving field problems. Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions

2. ANALYSIS OF TRUSSES AND FRAMES — **Total Hrs 10**

Analysis of plane truss with number of unknowns not exceeding two at each node.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element. Analysis of frames with two translations and a rotational degree of freedom at each node

3. TWO DIMENSIONAL STRESS ANALYSIS — **Total Hrs 10**

Finite element modeling of two dimensional stress analysis problems with constant strain triangles treatment of boundary conditions. Two dimensional four noded isoparametric elements treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.

Convergence requirements and geometric isotropy

4. HEAT TRANSFER PROBLEMS AND DYNAMIC ANALYSIS — **Total Hrs 10**

Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional, conduction analysis of thin plate,

Time dependent field problems: Application to one dimensional heat flow in a rod.

Dynamic analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors, Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

5. THREE DIMENSIONAL PROBLEMS IN SRESS ANALYSIS — **Total Hrs 10**

Finite element formulation of three dimensional problems in stress analysis,

Bending of elastic plates: Thin and Thick plate formulations, Introduction to non-linear problems and Finite Element analysis software's

Total hours to be taught

Text book (s)

1. Tirupathi R Chandrupatla and Ashok.D. Belegundu, Introduction of Finite Element in Engineering. Prentice Hall of India, 2004
2. Rao S.S.,The Finite Element Methods in Engineering, 2nd Edn Pergamon Press, 2001.
3. David.V.Hutton, " Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003

References:

1. Robert Cook , "Concepts and applications of finite element analysis", 4e, John Wiley and sons,2009
2. Reddy J.N., An Introduction to Finite Element Methods ,Mc Graw Hill Company, 1984
3. K..J Bathe, Finite element procedures, 2nd Edn,Prentice Hall of India,2007
4. Logan, D. L. (2011). First course in finite element method, (5th Ed.). Mason, OH: SouthWestern, Cengage Learning.

CBIT	Autonomous Regulation	Semester-1			AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name			M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week		Credit	Maximum Marks		
16MEC 201	**FLUID FLOWS & GAS DYNAMICS**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will

1. understand different types of fluid flows and various functions related to fluids
2. learn important equations related to fluids
3. understand the concept of boundary layer
4. learn the concept of steady flow energy equation
5. understand the isentropic behavior of gas in nozzles
6. learn about shocks of fluids

Outcome (s)

Student will be able to

1. understand the concept of stream and velocity potential function
2. apply of the knowledge of equations for analysis in CFD
3. calculate thickness of boundary layer and shear stress
4. apply SFEE for various types of turbomachines
5. design nozzles and diffusers
6. estimate various parameters in fluids subjected to shocks

Unit	Total Hrs	
1. FLUID FLOWS	**Total Hrs**	**9**
Fluid flow: Classification of fluids. Lagrangian and Eularian Methods of Study of fluid flow. Velocity and acceleration vectors. Circulation and Vorticity. Stream lines. Stream tube. Path lines. Streak lines and Time lines. Stream function and Potential function		
2. LAW OF FLUID FLOWS	**Total Hrs**	**9**
Basic laws of fluid flow – Continuity. Euler's and Bernoulli's equations. Incompressible and Compressible flows. Potential and viscous flows. Navier – Stoke's equation and applications		
3. CONCEPT OF BOUNDARY LAYER	**Total Hrs**	**9**
Flow over an aerofoil – Lift and Drag coefficients. Boundary layer theory – laminar and turbulent boundary layers. Hydrodynamic and thermal boundary layer equations. Flow separation in boundary layers		
4. FUNDAMENTALS OF GAS DYNAMICS	**Total Hrs**	**9**
Gas dynamics: Energy equation for flow and non flow processes. Application of Steady flow energy equation for turbines, turbo-compressors, nozzles and diffusers. Adiabatic energy equation. Acoustic velocity, Mach Number. Stagnation properties. Relationships between static and stagnation properties. Various regimes of flow – Steady flow ellipse		
5. PRINCIPLES OF GAS DYNAMICS APPLICABLE TO SHOCKS	**Total Hrs**	**9**
Isentropic flow through variable area passages. Design of supersonic and subsonic nozzles and diffusers. Super sonic flows. Expansion and Shock waves. Normal and Oblique Shock waves. Prandtl-Meyer and Rankine-Hugoniot Relations. Simple problems on normal and oblique shock waves.		
Total hours to be taught		

Text book (s)

1. C P Kothandaraman, R Rudramoorthy, Basic Fluid Mechanics, New Age Intl. Publishers, 2014
2. S.M. Yahya, Fundamentals of Compressible flow, Wiley Eastern Ltd,2014
3. S. Radhakrishnan, "Fundamentals of Compressible flow," TMH,,2014

References:

1. Shapiro, Compressible fluid flow. Ronold Press, New York, 1956
2. Liepmen & Rosko, Elements of Gas Dynamics, Wiley, New York, 1956.
3. Zoeb Hussain, Gas Dynamics Though Problem

<table>
<tr><td>CBIT</td><td>Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="3">M.E. Thermal Engineering</td></tr>
<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEC 202</td><td rowspan="2">ADVANCED THERMODYNAMICS</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">1. To review the basic laws of thermodynamics and create awareness of the importance of thermodynamic principles in engineering applications.
2. To understand the behavior of Real Gases vis-à-vis ideal gas.
3. To create awareness of the importance of combustion reactions in real time applications.
4. To understand thermodynamic applications in psychrometry, refrigeration.
5. To understand the basic principles power cycles and its relation with combustion processes.
6. To understand various methods of direct energy conversion</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">A student will be able to
1. apply various laws of thermodynamics to suit the engineering applications.
2. apply the knowledge of thermodynamics for the behavior of real gases.
3. understand the phenomenon of combustion in IC engines
4. select and design air conditioning or psychrometric process depending on application and comfort conditions
5. understand the application of power cycles to engineering practice.
6. understand various non-conventional energy conversion methods like fuel cells etc.</td></tr>
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1. LAWS OF THERMODYNAMICS	**Total Hrs**	**9**
Review of Thermo dynamic Laws and Corollaries – Transient Flow Analysis – Second law of thermodynamics – Entropy - Availability and unavailability – Irreversibility – Thermo dynamic Potentials – Maxwell Relations – Specific Heat Relations – Mayer's relation - Evaluation of Thermodynamic properties of working substance		
2. PSYCHROMETRY AND AIR CONDITIONING PROCESS	**Total Hrs**	**9**
P.V.T. surface – Equations of state – Real Gas Behaviour – Vander Waal's equation - Generalised compressibility Factor – Energy properties of Real Gases – Vapour pressure – Clausius – Clapeyron Equation – Throttling – Joule – Thompson coefficient Non-reactive Mixture of perfect Gases – Governing Laws – Evaluation of properties – Pychrometric Mixture properties and psychrometric chart – Air conditioning processes – Cooling Towers – Real Gas Mixture		
3. COMBUSTION REACTIONS	**Total Hrs**	**9**
Combustion – Combustion Reactions – Enthalpy of Formation – Entropy of Formation – Reference Levels for Tables – Energy of formation – Heat of Reaction – Aiabatic flame Temperature General product – Enthalpies – Equilibrium. Chemical Equilibrium of Ideal Gases – Effects of Non-reacting Gases Equilibrium in Multiple Reactions. The van Hoff's Equation. The chemical potential and phase Equilibrium – The Gibbs phase Rule		
4. POWER CYCLES	**Total Hrs**	**9**
Power cycles, Review Binary vapour cycle, co-generation and Combined cycles – Second law analysis of cycles – Refrigeration cycles. Thermo Dynamics off irreversible processes – Introduction – phenomenological laws – Onsagar Reciprocity Relation – Applicability of the phenomenological Relations– Heat Flux and Entropy Production – Thermo dynamic phenomena – Thermo electric circuits		
5. **DIRECT ENERGY CONVERSION**	**Total Hrs**	**9**
Introduction – Fuel Cells - Thermo electric energy – Thermo-ionic power generation -Thermodynamic devices Magneto Hydrodynamic Generations – Photo voltaic cells.		
Total hours to be taught		
Text book (s)		

1. Nag, P.K., "Basic and Applied Thermodynamics",TMH,2008
2. Holman, J.P., "Thermo Dynamics", Mc Graw Hill, 2008
4. Obert Edward. F. & Young Rober L, "Elements of Thermodynamics" McGraw Hills
5. Younus.A.cengel & Michael A. Boles " Thermodynamics an engineering approach sixth edition,TMH
6. Arian Bejan "Advanced Engineering Thermodynamics " 3^{rd} Edition Wiley Publications,2006

CBIT	Autonomous Regulation	Semester-1			AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name			M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week		Credit	Maximum Marks		
16MEC 203	**ADVANCED HEAT & MASS TRANSFER**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will

1. understand the basic principles of fins and unsteady state heat transfer applied to industries.
2. learn various equations and their application in engineering heat transfer
3. understand boundary layer concept and their applications
4. learn about phase heat transfer and their applications
5. understand the importance of radiation heat transfer
6. learn about mass transfer and its applications in process industries

Outcome (s)

Student will be able to

1. apply the equations pertaining to unsteady state heat transfer and knowledge in extended surfaces
2. evaluate mass, momentum and energy equations with approximate and exact methods
3. apply heat transfer knowledge in calculation of boundary layer thickness and various dimensionless numbers
4. evaluate heat transfer coefficients under phase change phenomena
5. apply the knowledge of radiation heat transfer in various fields like solar engineering, design of reactors etc,
6. apply the knowledge of mass transfer in process industries

1. BRIEF INTRODUCTION TO DIFFERENT MODES OF HEAT TRANSFER — Total Hrs 9

Brief Introduction to different modes of heat transfer; Conduction: General heat conduction equation-Initial and Boundary conditions Steady State Heat Transfer: Simplified heat transfer in 1D and 2D – Fins.Transient heat conduction; Lumped system analysis- Heisler charts-semi infinite solid-use of shape factors in conduction - 2D transient heat conduction – product solutions

2. FINITE DIFFERENCE METHODS FOR CONDUCTION — Total Hrs 9

Finite Difference methods for Conduction: 1D & 2D steady state and simple transient heat conduction problems – implicit and explicit methods. Forced Convection: Equations of Fluid Flow – Concepts of Continuity, momentum equations – Derivation of Energy equation - Methods to determine heat transfer coefficient: Analytical Methods - Dimensional Analysis and concept of exact solution. Approximate Method – Integral analysis

3. EXTERNAL FLOWS — Total Hrs 9

External flows: Flow over a flat plate: Integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometrics for Laminar and Turbulent flows. Internal flows: Fully developed flow: Integral analysis for laminar heat transfer coefficient – Types of flow – Constant Wall Temperature and Constant Heat Flux Boundary Conditions - Hydrodynamic & thermal entry lengths; use of empirical correlations

4. FREE CONVECTION & RADIATION — Total Hrs 9

Free convection: Approximate analysis on laminar free convective heat transfer – Boussinesque Approximation - Different geometries – combined free and forced convectionBoiling and condensation: Boiling curve – Correlations- Nusselt's theory of film condensation on a vertical plate – Assumptions & correlations of film condensation for different geometrics

5. **MASS TRANSFER** — Total Hrs 9

Radiation Heat Transfer: Radiant heat exchange in grey, non-grey bodies, with transmitting, reflecting and absorbing media, specular surfaces, gas radiation – radiation from flames. Mass Transfer: Concepts of mass transfer – Diffusion & convective mass transfer Analogies – Significance of non-dimensional numbers

Total hours to be taught

Text book (s)

1.Necati Ozisik "Heat Transfer" TMH 1998
2. Incropera Dewitt Fundamentals of Heat & Mass Transfer – John Wiley 2007
3. Yunus Cengel Heat Transfer: A basic approach – TMH 2008
4. R.C.Sachdeva Fundamentals of Engineering Heat & Mass Transfer" New Age International Publications 2010
5. J.P.Holman "Heat Transfer" Tata Mc Graw Hill, 2008

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 204		L	T	P	C	E	I	Total
	ADVANCED I.C. ENGINES	3	1	0	4	70	30	100

Objective (s)

1. importance of combustion phenomena in I.C. Engines
2. phenomena of the engine performance and decrease the pollutants knocking in SI and CI engines
3. concept of formation and control of different exhaust emissions from IC engines.
4. use of alternate fuel technology to improve
5. suggested modifications in I.C. engine to suit bio-fuels
6. basic concepts of recent trends with change of engine configuration

Outcome (s)

1. Describe the phenomena of combustion and knock in SI engines
2. Understand the normal and abnormal combustion in CI engines
3. Explain the sources and formation of various pollutants from IC engines
4. Understand how the undesirable exhaust emissions from IC engines are controlled
5. Demonstrate an understanding of technological, environmental and social impacts of alternative fuels
6. Explain modern concepts like Lean burn, stratification, HCCI and GD

1. SPARK IGNITION ENGINES	**Total Hrs**	**9**

Spark ignition engine mixture requirements – Fuel – Injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – Factors affecting knock – Combustion chambers

2. COMPRESSION IGNITION ENGINES	**Total Hrs**	**9**

Stages of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers – Normal and Abnormal Combustion – Knock in C.I Engines-Basic Concepts and Study of Fuel Spray – Introduction to Turbo charging

3. POLLUTANT FORMATION AND CONTROL	**Total Hrs**	**9**

Pollutant – Sources – Formation of carbon monoxide, Unburnt hydrocarbon, Aldehydes, NOx, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters and Particulate Traps- Methods of measurements and Introduction to emission norms

4. ALTERNATIVE FUELS	**Total Hrs**	**9**

Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas- Properties, Suitability, Merits and Demerits as fuels, Engine Modifications

5. RECENT TRENDS	**Total Hrs**	**9**

Modification in I.C. engine to suit bio-fuels- Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition (HCCI) engines and GDI concepts

Total hours to be taught		

Text book (s)

1. Obert, E.F.Internal Computation Engines Harper & Row, Publishers N.Y3rd edition 1973
2. GILL, P.W.and Smith (Jr,J.H, fundamentals of Internal combustion Engines, Oxford & IBH publishing Co.New Delhi, 1967.

References:

1. Heywood, J.B, Internal Combustion engine fundamentals, McGrave Hills, Book Co, New York, 1988.
2. Taylor C.F.and Taylor, E,S,The Internal Combustion Engine in Theory and Practice, M.I.T.Press, 1968
3. Mathur,M.L.and Sharma,R.P.,Internal Combustion Engine,Dhanpat Rai & Sons, Delhi, 5th Edition,1990
4. Ganeshan, V., Internal Combustion engines, Tata Mc Graw Hills Publishing Co.Ltd, New Delhi 1984

CBIT	Autonomous Regulation							
Department	Mechanical Engineering	Programme Code & Name			M.E. Thermal Engineering			
				Semester-I				
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEC 205	**COMPUTATIONAL FLUID DYNAMICS**	3	1	0	4	70	30	100

Objective (s)	1. To understand the basic equations and concept of CFD. 2. To make the students to learn concept of PDEs and finite difference methods. 3. To study various types of grid generation and errors in numerical solution. 4. To learn the Crank-Nihcolson, Implicit and Explicit methods 5. To prepare the students with Jacobi, Gauss Seidel and ADI methods 6. To enkindle the students importance of FVM
Outcome (s)	Students will be able to 1. derive CFD governing equations and turbulence models. 2. apply elliptical, parabolic and hyperbolic PDEs and forward, backward and center difference methods . 3. understand errors, stability, consistency and develop O,H and C grid generated models. 4. evaluate the use of Crank-Nihcolson, Implicit and Explicit methods. 5. analyze problem by Jacobi, Gauss Seidel and ADI methods. 6. solve conduction and convection problems using FVM

1	**BASIC EQUATIONS IN FLUID DYNAMICS**	**Total Hrs**	**9**
Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-ε turbulence Model.			
2	**CLASSIFICATION OF PDEs**	**Total Hrs**	**9**
Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference.			
3	**GRID GENERATION**	**Total Hrs**	**9**
Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria.			
4	**FINITE DIFFERENCE SOLUTIONS**	**Total Hrs**	**9**
Finite difference solutions-Parabolic PDEs – Euler, Crank Nicholson, Implicit methods, Elliptic PDEs – Jacobi, Gauss Seidel, ADI, methods. FD- solution for Viscous incompressible flow using Stream function – Vorticity method & MAC method			
5	**FINITE VOLUME METHOD**	**Total Hrs**	**9**
Introduction to Finite volume method. Finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLE Algorithm.			
	Total hours to be taught	**45**	

Text book (s)

1	John D Anderson, 'Computational Fluid Dynamics', Mc Graw Hill, Inc., 2015**.**
2	H.K.Versteeg - 2015, Malala Shekara, Introduction to " Finite Volume Method" Pearson
3	Muralidhar K, Sundararajan T, 'Computational Fluid flow and Heat transfer', Narosa Publishing House, 2003
4	Patankar, S.V, 'Numerical Heat transfer and Fluid flow', Hemisphere Publishing Company, New York,1980

CBIT	Autonomous Regulation		
Department	Mechanical Engineering	Programme Code & Name	M.E. Thermal Engineering

Semester-I

Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 201		L	T	P	C	E	I	Total
	COMPUTER AIDED GRAPHICS AND DESIGN	3	0	0	3	70	30	100

Objective (s)

1. Understand the basics of computer aided design.
2. To impart knowledge on design process
3. Recognize and explain the uses of wireframe and surface entities
4. Understand solid modeling representation schemes
5. Understand and apply various Geometric transformations
6. Understand various advanced modeling concepts

Outcome (s)

Students are able to:

1. apply design concepts in design , analysis and can visualize the models through the graphics standards .
2. implement Various transformations on geometric models for manipulation
3. recognize various wireframe entities and model them.
4. apply surface modeling techniques for the generating various parts and implement
5. differentiate various solid modeling techniques
6. able to perform modeling using the software by understanding advanced modeling concepts

1	**INTRODUCTION TO CAD**	**Total Hrs**	**9**

Criteria for selection of cad workstations, Shigle design process, Design criteria, Geometric modeling , Entities, 2d and 3d primitives, Computer Aided Design , Iterative Design ,CAD process
Geometric Transformations : 2d Translation , Scaling, Rotation, Reflection and shearing, Homogeneous Coordinates , Rotation and Scaling about arbitrary points , 3D transformations
Windowing - View ports -Clipping transformations
Graphics standards: GKS , IGES , PDES and their relevance

2	**MODELING of CURVES**	**Total Hrs**	**9**

Analytic curves : Lines, Circles, Ellipse, Conics.
Synthetic curves – Cubic, Bezier, B-Splines, NURBS. Curve Manipulations
Wireframe Modeling and its advantages and Limitations

3	**SURFACE MODELING**	**Total Hrs**	**9**

Analytic Surfaces: Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder.
Synthetic Surface - Cubic, Bezier, B-spline, Coons ,Surface Manipulations , Surface Modeling Techniques

4	**SOLID MODELING**	**Total Hrs**	**9**

Boundary Representation (B-rep) & Constructive Solid Geometry (CSG) Modeling
Graph Based Model, Boolean Models, Instances, Cell Decomposition & Spatial – Occupancy Enumeration,

5	**SOLID MODELING USING SOFTWARE**	**Total Hrs**	**9**

Feature Based Modeling, Conceptual Design ,Modeling of oil storage tanks, Cylinder head , Piston, Cylinder liner, Crank Shaft, Exhaust manifold ,Catalytic Converter

Total hours to be taught	**45**

Text book (s)

1	Ibrahim Zeid, “CAD/CAM, Theory and Practice”, McGraw Hill, 1998.
2	Foley, Van Dam, Feiner and Hughes, “Computer Graphics Principles and Practice”, 2nd Ed., Addison – Wesley, 2000.

Reference Book(s)

1	E. Micheal, “Geometric Modelling”, John Wiley & Sons, 1995.
2	Hill Jr, F.S., “Computer Graphics using open GL”, Pearson Education, 2003.

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE105	**OPTIMIZATION TECHNIQUES**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. To Understand the need of the optimization methods.
2. To introduce the fundamental concepts of Optimization Techniques
3. To provide students with the modeling skills necessary to describe and formulate optimization problems
4. To make the learners aware of the importance of optimizations in real scenarios
5. To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable
6. Get a broad picture of the various applications of optimization methods used in engineering.

Outcome (s)

1. Formulate and solve Linear programming problem
2. Apply different techniques to solve Non Linear programming problem
3. Implement constrained optimization techniques
4. Analyze dynamic programming and integer programming problems
5. Develop schedule for projects and apply PERT/CPM techniques
6. Apply Queuing theory to real life situations

1. LINEAR AND TRASPORTATION PROBLEMS	**Total Hrs**	**9**
Statement of Optimization Problem, Linear Programming: Simplex Method, Revised Simplex Method, Sensitivity Analysis, Parametric Programming, and Transportation Problem		
2. NON-LINEAR PROBLEMS	**Total Hrs**	**9**
Nonlinear Programming: Approach, Convergence and Scaling of Design variables; Unconstrained Optimization Direct Search Methods: Random Search, Univariate, Simplex Method; Indirect Search Methods: Steepest Descent, Conjugate Gradient, Newton, Quasi Newton, DFP Methods;		
3. NON-LINEAR PROGRAMMING	**Total Hrs**	**9**
Constrained Optimization Direct Methods: Lagrange Multipliers, Kuhn-Tucker, conditions, Beal's method, Indirect Method: Penalty Function and Applications		
4. DYNAMIC PROGRAMMING	**Total Hrs**	**9**
Introduction to Dynamic Programming; Concept of Sub optimization and the principle of optimality; Linear and Continuous Dynamic Programming with Applications; Introduction to Integer Programming; Cutting Plane Method; Branch and Bound method; Introduction to Genetic Algorithms, particle swarm optimization		
5. PROJECT SCHEDULING	**Total Hrs**	**9**
Sequencing and Scheduling, Project Scheduling by PERT-CPM; Probability and cost consideration in Project scheduling; Queuing Theory, Single and multi server models; Queues with combined arrivals and departures; Queues with priorities for service		
Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. Rao,S.S. Engineering "Optimization Theory and Practice", New Age Int. Pub., 3rd Ed., 1996.
2. Haug,E.J.and Arora, J.S., "Applied Optimal Design", Wiley Inter Science Publication, NY, 1979.

Reference(s)

1. Douglas J. Willde, "Globally Optimal Design", Jhon Wiley & Sons, New York, 1978
2. Johnson Ray C., "Optimum Design of Mechanical Elements", John Wiley & Sons, 1981.
3. S.D. Sharma, S.D. "Operations Research", Khanna Publications, 2001.
4. David Goldberg, "Genetic Algorithms", pearson publications, 2006.
5. Maurice cleric, "Particle Swarm Optimization", ISTE Publications, 2006
6. Prem Kumar Gupta, "Operations Research", S Chand publications, 2008

CBIT	***Autonomous Regulation***		
Department	Mechanical Engineering	Programme Code & Name	M.E. CAD/CAM & Thermal Engineering

Semester-I

Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEE 207	**ENGINEERING RESEARCH METHODOLOGY**	3	0	0	3	70	30	100

Objective (s)

1. To motivate the students to choose research as career.
2. To make the students to formulate the research problem.
3. To identify various sources for literature review and data collection.
4. To prepare the research design
5. To equip the students with good methods to analyze the collected data
6. To write a report and interpret the results

Outcome (s)

Students will be able to

1. define research problem
2. review and asses the quality of literature from various sources.
3. understand and develop various research designs.
4. collect the data by various methods: observation, interview, questionnaires.
5. analyze problem by statistical techniques: ANOVA, F-test, Chi-square
6. improve the style and format of writing a report for technical paper/ Journal report

1	**Research Methodology:**	**Total Hrs**	**9**

Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general.
Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem, Technique involved in Defining a Problem.

2	**Literature Survey**:	**Total Hrs**	**9**

Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.
Literature Review: Need of Review, Guidelines for Review, Record of Research Review.

3	**Research Design:**	**Total Hrs**	**9**

Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

4	**Data Collection:**	**Total Hrs**	**9**

Methods of data collection, importance of Parametric test, testing of proportions, testing of variance of two normal population, and Non Parametric test, relation between Spearman's r's and Kendall's W
Data Analysis: Tests for significance: Chi-square, ANOVA, F-test.

5	**Interpretation and report writing:**	**Total Hrs**	**9**

Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report.
Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Text Book (s):

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011

References:

3. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004
4. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
5. P. Ramdass and A. Wilson Aruni, Research and Writing across the Disciplines, MJP Publishers

CBIT	Autonomous Regulation								
Department	Mechanical Engineering	Programme Code & Name				M.E. (THERMAL ENGINEERING)			
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
		L	T	P	C	End Exam	Internal Assessment	Total	
16MEE 202	**TURBO MACHINES**	3	0	0	3	70	30	100	

Objectives	1. To learn principles and equations of turbo machinery. 2. To know about velocity triangle and power developed by steam turbines. 3. To understand the working principles of Pelton, Francis and Kaplan turbines. 4. To familiarize the working principles of axial flow compressor 5. To understand the working principle of Centrifugal compressor and its performance 6. To learn the power required for Rotary compressors and power developed by Gas turbines
Outcomes	Students will be able to 1. apply gas dynamics equations depending upon applications. 2. estimate the power developed by steam turbines 3. calculate hydraulic efficiency of Impulse and Reaction turbines 4. find efficiency, pressure rise and degree of reaction of axial flow compressor 5. analyze the slip factor and performance of centrifugal compressor 6. understand cycles and improve the cycle efficiency in gas turbines

1	**FUNDAMENTALS OF TURBO MACHINES:**	**Total Hrs**	**7**
Classifications, Applications, Isentropic flow. Energy transfer. Efficiencies, Static and Stagnation conditions, Continuity equations, Euler's flow through variable cross sectional areas.			
2	**STEAM TURBINES:**	**Total Hrs**	**9**
Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure, Design of nozzles. Steam Turbines: Impulse turbines, Work done and Velocity triangle, Efficiencies Compounding.			
3	**HYDRAULIC TURBINES:**	**Total Hrs**	**9**
Introduction, Classification of turbines, Impulse and reaction turbines, construction, working and performance of Pelton, Francis and Kaplan Turbines, Selection of turbines: specific speed, unit quantities			
4	**AXIAL FLOW COMPRESSORS AND CENTRIFUGAL COMRESSORS:**	**Total Hrs**	**9**
Work and velocity triangles, Efficiencies, Stage pressure rise, Degree of reaction, Performance of compressors Types; Velocity triangles and efficiencies; slip factor; performance of compressors			
5	**GAS TURBINES:**	**Total Hrs**	**9**
Principle of working – Classification – Joule's cycle – workdone and efficiency – Brayton Cycle – Optimum Pressure ratio for maximum power and maximum efficiency – P_{max} and η_{max} – Improvement in cycle performance – Intercooling, Reheating and Regeneration (Heat exchanging) – Problems using these principles			
	Total hours to be taught		**43**

Text book (s)	
1	S.M. Yahya, Turbines, Compreessors and Fans, Fourth edition, Tata McGraw-Hill Education Pvt. Ltd., 2010
2	Gopalakrishnan G, Prithvi Raj D, "A treatise on Turbomachines", Scitec Publications, Chennai, 2002
3	Seppo. A. Korpela, Principles of Turbomachinery, John Wiley & sons Inc. Publications, 2011
Reference(s)	
1	R.K.Turton, Principles of Turbomachinery, E & F N Spon Publishers, London & New York.
2	Dennis G. Shepherd, Principles of Turbomachines, Macmillan, 2007

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 203	**FLUID POWER SYSTEMS**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will understand

1. behavior and properties of fluids
2. working principles of hydraulic pumps & motors
3. working principles of hydraulic control valves
4. working principles of various elements associated with hydraulic power
5. characteristics and applications of pneumatics
6. working and operating principles of pneumatic transmission lines

Outcome (s)

A student will be able to

1. understand various types of fluids along with properties used for different applications
2. select motor and pump depending on application
3. analyze the various types of hydraulic valves
4. calculate design nozzles and other elements used for hydraulic purposes such as in pneumatics
5. apply the principles of engineering for linear dynamics
6. Design feedback control of elements

1. HYDRAULIC FLUIDS — **Total Hrs 9**

Advantages and Disadvantages of Fluid control, Types of Hydraulic Fluids, physical, chemical and thermal properties of hydraulic fluids, selection of hydraulic fluid, fluid flow fundamentals

2. HYDRAULIC PUMPS AND CONTROL VALVES — **Total Hrs 9**

Hydraulic Pumps and Motors: Basic Types and constructions, ideal pump and motor analysis, Performance curves and parameters,

Hydraulic Control Valves- Valve configurations, general valve analysis, critical center, open center, three way spool valve analysis and Flapper valve analysis, pressure control valves, single and two stage pressure control valves, flow control valves, introduction to electro hydraulic valves

3. HYDRAULIC POWER ELEMENTS — **Total Hrs 9**

Hydraulic Power Elements: Valve controlled motor, valve controlled piston, three way valve controlled piston, pump controlled motor, pressure transients in power elements

4. PNEUMATICS — **Total Hrs 9**

Characteristics of Pneumatics, Applications of Pneumatics, Basic Pneumatic elements, Steady flow of Ideal gases, orifice and nozzle calculations, capillary flow, flow of real gases, linearised flow equations in Orifices and Nozzles.

Steady state analysis of pneumatic components: Multiple restriction and volume calculations, sensing chambers, valves, Single acting actuators.

5. TRANSIENTS IN ELEMENTARY PNEMATIC SYSTEMS — **Total Hrs 9**

Linear dynamics-linear pneumatic spring rate, linear dynamics of a variable volume of gas, Pneumatic transmission lines, linear dynamics in single acting actuators. Applications in industrial process controls: On-Off pneumatic feedback systems, feedback control of proportional gain, derivative action, integral action, Design of a Pneumatic Pressure Regulator

Total hours to be taught — **45**

Text book (s)

1. Herbert E. Merritt, “Hydraulic Control Systems”, John Wiley & Sons, 1967.
2. W. Anderson, The Analysis and Design of Pneumatic Systems, Wiley, 1967.

References:

1. A.B. Goodwin, Fluid Power Systems, Macmillan, 1976.
2. Anthony Esposito, “Fluid power with applications”, Prentice Hall, 7th Edition, 2002.
3. Arthur Akers, Max Gassman, Richard Smith, “Hydraulic Power System Analysis”, Taylor and Francis Group, 2006
4. John Pippenger & Tyler Hicks, “Industrial Hydraulics”, 3rd edition, McGraw Hill, 1980

CBIT	Autonomous Regulation		
Department	Mechanical Engineering	Programme Code & Name	M.E. Thermal Engineering
Semester-I			

Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEE 204	**DESIGN FOR THERMAL SYSTEMS**	3	0	0	3	70	30	100

Objective (s)	Student will understand 1.working principles of various heat exchangers 2.design principles of heat exchangers 3. constructional features and design methods of double pipe heat exchangers 4. constructional features and design principles of shell and tube heat changers 5. operating principles of cooling towers 6. parameters affecting design of cooling towers
Outcome (s)	Student will be able to 1. select heat exchangers depending on application and need 2. design heat exchanges using LMTD & NTU approach 3. understand the importance of double principle & exchanger in industry and its design methods. 4. specify shell and the heat exchanger depending upon application in industry 5. design shell and tube heat exchanger based on importance and specifications 6. know the necessity of cooling towards in industry and its design methodology

1	**INTRODUCTION TO HEAT EXCHANGERS**	**Total Hrs**	**9**
Introduction, Recuperation & regeneration, Tabular heat exchangers, Double pipe, shell & tube heat exchanger, Plate heat Exchangers, Gasketed plate heat exchanger. Spiral plate heat exchanger, Lamella heat exchanger, Extended surface heat exchanger, Plate fin and Tabular fin..			
2	**DESIGN METHODS OF HEAT EXCHANGERS**	**Total Hrs**	**9**
Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient, calculations using LMTD method for heat exchanger analysis: Parallel flow, Counter flow			
3	**DOUBLE PIPE HEAT EXCHANGER**	**Total Hrs**	**9**
Film coefficient for fluids in pipes and tubes, Fluid flowing in annuli: the equivalent diameter, film coefficients, fouling factors, pressure drop in pipes and pipe annuli. The calculation of a Double pipe exchanger. Double pipe exchangers in series-parallel arrangements. The true temperature difference for series- parallel arrangements.			
4	**1-2 SHELL-AND-TUBE EXCHANGER**	**Total Hrs**	**9**
Introduction: Tube layouts, Heat exchanger tubes, Baffles, The calculation of shell and tube heat exchangers: Shell- side film coefficient, Shell-side equivalent diameter, The true temperature difference in a 1-2 exchanger, Shell- side pressure drop, The analysis of performance in an existing 1-2 exchanger. Heat recovery in a 1-2 exchanger.			
5	**DIRECT CONTACT HEAT EXCHANGER**	**Total Hrs**	**9**
Classification of Cooling towers, Relation between the wet- bulb and the dew- point temperatures, The Lewis number, cooling tower internals and role of fill. Analysis of cooling towers requirements			
Total hours to be taught			**45**

Text book (s)

1. Prescribed book: Process Heat Transfer/D.Q.Kern/ TMH
2.Heat Exchanger Design/ A.P.Fraas and M.N.Ozisicj/ John Wiely& sons, New York.
3. Cooling Towers / J.D.Gurney and I.A. Cotter/ Maclaren

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 205	**DESIGN OF GAS TURBINES**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Student will understand
1. To create awareness of the importance of principles of design of gas turbine and methods of improvement of efficiency.
2. the principles of design of rotary compressors and its classification
3. the operating principles of combustion chamber for gas turbine applications
4. to familiarize the design of blades and their cooling systems used in gas turbine
5. the principles of axial flow compressor
6. the design principles of gas turbine blades

Outcome (s)

Student will be able to
1. thermal efficiency of gas turbine cycle and its improvements by different methods
2. various methods used in improving performance of the gas turbine cycle
3. design elements in rotary compressors
4. understand the importance of various types of combustion chambers used in gas turbines
5. design or analyze the forces on blade of gas turbine
6. suggest different cooling methods of gas turbine blades

Unit		
1. THERMODYNAMIC ANALYSIS OF GAS TURBINE CYCLES	**Total Hrs**	**9**
Joule/Brayton. Open and Closed Cycles. Methods of improving cycle efficiency – Inter-cooling. Reheating and Regeneration		
2. DESIGN OF ROTARY COMPRESSORS	**Total Hrs**	**9**
Applications of Turbo Compressors (Centrifugal and axial flow) in Gas turbine power plant. Euler equation of energy transfer in a turbomachine. Design of two stage centrifugal compressor with vaneless and vaned diffusers. Design of multi stage axial flow compressors		
3. COMBUSTION CHAMBERS OF GAS TURBINES	**Total Hrs**	**9**
Types of combustion chambers. Combustion chamber design for modern gas turbines. Can type, annular and tube type of combustors		
4. DESIGN OF AXIAL FLOW TURBINES	**Total Hrs**	**9**
Matching of compressor and turbine for varying load operation. Gas turbine for super charging and cryogenic applications. Small gas turbines for space applications		
5. DESIGN AND CONSTRUCTION OF GAS TURBINE ROTORS AND BLADES	**Total Hrs**	**9**
Blade materials. Blade attachment techniques. Cooling methods of turbine blades. Simple analysis of turbine blade vibrations and balancing of rotors.		
Total hours to be taught		**45**

Text book (s)

1. D.G.Wilson,The Design of High efficiency Turbomachinery and Gas Turbines, The MIT Press, Cambridge, U.K.
2. M.P.Boyce, Gas Turbine Engineering hand book, Gulf Publishing Co., New York.

References:

1. E. Balje, Turbo machines – A guide to Selection and Theory, John Wiley & Sons, New York
2. J.S. Rao, Rotor Dynamics, Wiley Eastern Publication, New Delhi.

<table>
<tr><td>CBIT</td><td>Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="3">M.E. Thermal Engineering</td></tr>
<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEE 206</td><td rowspan="2">ADVANCED ENERGY SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">Student will understand
1. to create awareness of the importance of the principles of various non- conventional energy resources power and design concepts of wind tunnel
2. the working principles of various collectors used in solar
3. the importance of biogas and its production and the principles of waste heat recovery
4. stress the need for cogeneration systems
5. the design principles of wind rotor blades of wind turbine
6. the principles of waste heat recovery boilers</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">A student will be able to
1. design solar collectors, wind mill as per specifications
2. understand the potential of biogas plants and need for waste heat recovery in the scenario of energy savings
3. understand the need for cogeneration and various methods adopted for it
4. optimize the power plant efficiency
5. optimize power plant efficiency
6. design rotors of wind mill according to consideration of aerodynamics</td></tr>
</table>

1. SOLAR ENERGY	**Total Hrs**	**9**

Solar energy: solar radiation – measurement, collection and storage, design of flat plate and parabolic concentrating collectors. Solar power plants. Photo voltaic power systems. Application of SPV and Solar Thermal Systems

2. WIND ENRGY	**Total Hrs**	**9**

Estimation of wind energy potential. Horizontal and vertical axis wind turbine rotors. Aerodynamic design considerations for wind rotor blades. Wind electric generators-operation and control. Aero generators for battery charging**.**

3. BIO MASS	**Total Hrs**	**9**

Bio mass energy: Sources of biomass. Energy from solid wastes. Biomass for energy production. Methane production. Bio mass energy conversion technologies. Use of Bio-gasifier. Bio mass power generation using agricultural residues. Introduction of Hybrid energy systems

4. WASTE HEAT RECOVERY	**Total Hrs**	**9**

Principles of waste heat recovery and co-generation. Analysis of heat recovery systems. Regenerators and recuperators for waste heat recovery. Advantages of fluidized bed boilers. Atmospheric fluidized bed combustion (AFBC), Pressurized fluidized bed combustion (PFBC and Circulation fluidized bed combustion (CFBC).

5. CO-GENERATION POWER SYSTEMS	**Total Hrs**	**9**

Co-generation power systems, Condensate and back pressure steam turbines. Design of waste heat recovery boilers. Combined cycle power plants based on waste heat recovery. Integrated gasification combined cycle (IGCC) power plants. Optimization of Power plant cycle efficiency. Clean coal technologies

Total hours to be taught		**45**

Text book (s)

1. D.A. Relay, Waste Heat Recovery System.
2. G.C. Drydin, The efficient Use of Energy.

References:

1. J.A. Duffire and W.A. Beckmen, Solar Energy Thermal Processes
2. A.B. Meinel, Applied Solar Energy.
3. V.D. Hunt, Wind Power.
4. N.H Ravindranath and D O Hall, Bio Mass, Energy and Environment, Oxford University Press .V Jadhav, Energy and Environment, Himalaya publishing house, Mumbai

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 207		L	T	P	C	E	I	Total
	FUELS & COMBUSTION	3	0	0	3	70	30	100

Objective (s)

To make student understand

1. conventional energy resources and different types of solid fuels available with their properties
2. various processing methods of solid fuels
3. the principles of refining liquid fuels and their properties, analysis and handling
4. various types of gaseous fuels and their properties, process and cleaning
5. the thermodynamics of combustion and stoichiometric relations.
6. features of different types of burners

Outcome (s)

A student will be able to

1. list different solid fuels for different applications
2. know the various methods of processing solid fuels
3. know the properties handling and storage of liquid fuels
4. understand the production of various methods of gaseous fuels and identify fuels for various applications
5. understand different methods of combustion and estimate the air fuel ratio, adiabatic flame temperature based on the fuel.
6. understand design considerations of burners

1.CONVENTIONAL AND NON-CONVENTIONAL ENERGY RESOURCES	**Total Hrs**	**9**

Introduction: General, Conventional energy resources, Solar energy, Nuclear power, Energy from biomass, Wind power, Tidal power, Geothermal energy, Energy survey for India, Rocket Fuels, Definitions, Units, Measures

2. SOLID FUEL-COAL	**Total Hrs**	**9**

Solid Fuels: General, Biomass, Peat, Lignite or Brown Coal, Sub-bituminous Coal or Black Lignite, Bituminous Coal, Semi-anthracite, Anthracite, Cannel coal and Boghead coal, Natural coke (Jhama)/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: General Coal preparation, Storage of coal, Coal carbonization, Briquetting of solid fuels, Liquefaction of solid fuels

3. LIQUID FUELS	**Total Hrs**	**9**

Liquid Fuels : General, Petroleum, Origin of Petroleum, Petroleum production, Composition of petroleum, Classification of petroleum, Nature of Indian crude's, Petroleum processing, Important petroleum products, Properties and testing of petroleum and petroleum products, Petroleum refining in India, Liquid fuels from sources other than petroleum, Gasification of liquid fuels, Storage and handling of liquid fuels.

4. GASEOUS FUELS	**Total Hrs**	**9**

Gaseous fuels: General, 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

5. COMBUSTION PROCESS	**Total Hrs**	**9**

Combustion Process (Stoichiometry and Thermodynamics): Combustion Stoichiometry : General, Examples, Rapid methods of combustion stoichiometry.

Combustion Thermodynamics : General Combustion Process (Kinetics): Nature of combustion process, Types of combustion processes, Mechanism of combustion reaction, Spontaneous Ignition Temperature (SIT), Velocity of flame propagation, Limits of inflammability, Structure of flame, Flame stability, Kinetics of liquid fuel combustion, Kinetics of solid fuel combustion.

Combustion Applications: General, Gas burners, Oil burners, Coal burning equipment

Total hours to be taught		**45**

Text book (s)

1. Loftness, R.L.," Energy hand book", New York, Van Nostrand 1998.
2. Wilson, P.J. and J.H. Wells, "Coal, Coke and Coal Chemicals", New York : McGraw-Hill, 1960

References:

1. "Gas Engineers Handbook", New York : Industrial Press, 1966.
2. Williams, D.A. and G. James, "Liquid Fuels", London Pergamon, 1963
3. Minkoff, G.J., and C.F.H. Tipper, "Chemistry of Combustion Reaction", London Butterworths, 1962.
4. Samir Sarkar, "Fuels & Combustion", Orient Long man 1996

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 208	**POWER PLANT CONTROL AND INSTRUMENTATION**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Student will understand

1. the principles of static and dynamic characteristics of instruments
2. working principles of feedback control concepts of electrical parameters
3. To create awareness of the importance of working principles of various measuring instruments and their applications in engineering industry
4. To understand characteristics of instruments
5. To familiarize the principles of data acquisition along influence of electrical parameters on instrumentation
6. To understand the principles of modeling of power systems

Outcome (s)

A student will be able to

1. estimate static and dynamic characteristics of instruments
2. estimate the influence of electrical parameters on measurements
3. understand theory on stability of instruments used for thermal systems
4. model power systems using various numerical methods
5. estimate the role of computers for data acquisition
6. represent various types of process control system

1. STATIC & DYNAMIC CHARACTERISTICS OF INSTRUMENTS	**Total Hrs**	**9**
Static & dynamic characteristics of instruments, sensors, signal processing & data transmission elements, indicating & recording elements**.**		
2. DATA ACQUISITION	**Total Hrs**	**9**
Use of computers for data acquisition & instrumentation for measuring temperature, pressure flow, speed, vibration & noise		
3. ELECTRICAL PARAMETERS	**Total Hrs**	**9**
On-line process instruments. Automatic process control systems Representation. Feedback control concepts. Transient & Frequency response. Types of controllers		
4. STABILITY OF INSTRUMENTS	**Total Hrs**	**9**
Stability, Digital Control System Modern Control theory. Boiler Control, Governing & Control of turbo-machines		
5. COMPUTER AIDED POWER SYSTEMS ANALYSIS	**Total Hrs**	**9**
Modeling of power system, components, Formation of bus admittance and impedance matrices, Power flow solution Gauss-Seidel, Newton Raphson, and fast de-coupled load flow, Short Circuit studies, Static equivalents of power system, Basic concepts of security analysis and state estimation.		
Total hours to be taught		**45**

Text book (s)

Beckwith and Buck, Mechanical Measurements

A.K.Tayal, Instruments and Mechanical Measurements, Galgotia Publication

References:

1. McCloy and Martin H.R., The Control of Fluid Power, Longman Publication, 1973
2. Williams, D.A. and G. James, “Liquid Fuels”, London Pergamon, 1963
3. David Lindsley “Power-Plant Control and Instrumentation “IEE Control Engineering Series 585
4. W.Bolton “Instrumentation and Control Systems”, 1st Edition Elsevier, 2004

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 209	**DESIGN OF PUMPS AND COMPRESSORS**		T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Student will understand

1. the basic concepts of build mechanics & governing laws of fluid flow
2. the various principles involved in maintenance of pumps
3. To create awareness of the importance of working principles of design of rotary pumps and rotary compressors
4. To understand the concepts of selection and design of pumps
5. To familiarize the principles involved in testing and maintenance of pumps
6. To understand the concept of design and selection of drive of rotary compressors along with impellors

Outcome (s)

A student will be able to

1. apply the laws of fluid mechanics to turbo machines
2. install a pumping system & monitor the maintenance of the pumps
3. select pump depending on application
4. do testing of pumping systems
5. to select drive and develop layout of the compressor system
6. to design different types of impellors of centrifugal compressor

1. INTRODUCTION TO PUMPS AND COMPRESSORS	**Total Hrs**	**9**
Characteristics of working fluids, Fluid mechanics concepts and governing laws of fluid flow.		
2. DESIGN OF PUMPS	**Total Hrs**	**9**
Pumps – various components and their functions. Classification of pumping systems – based on the applications and working fluids. Design of pumps – data required for the design of pump and design calculations. Selection of the drive – Types of drives, their behavior and advantages, Selection of the pumps- types of pumps. Selection of piping and other components. Development of a schematic layout of the piping system		
3. OPERATION AND MAINTANANCE OF PUMPS	**Total Hrs**	**9**
Operation and maintenance – installation of pumping system. Testing of the pumping systems – Various methods based on the working fluid, drive and pump etc., Maintenance of the pumps – Prediction and correction methods, Factors affecting the maintenance and their evaluation		
4. ROTARY COMPRESSORS	**Total Hrs**	**9**
Rotary compressor system – various components and their functions. Classification of compressors. Design of compressor – data and analysis. Characteristics of the compressors. Selection of the drive and compressors. Development of the schematic layout of the compressor system.		
5. DESIGN OF IMPELLORS	**Total Hrs**	**9**
Design of impeller, Types of impellers – centrifugal and axial. Design of a diffuser – Vaneless and vaned diffuser. Types of casings, casing design. Performance characteristics of turbo compressors.		
Total hours to be taught		**45**

Text book (s)

1. S.M. Yahya, Turbines, Compressors and Fans, Tata McGraw Hill Publishing Co
2. Val.S. Lobanoff and Robert R. Ross, Centrifugal Pumps – Designs and Application, Jaico book publishing Co

References:

3. Igor J. Karassik and Joseph P. Messina "Pump Handbook 1986
4. Kovats, Andre, Design and performance of centrifugal and axial flow pumps and compressors, Oxford, New York, Pergamon Press, 1964.

CBIT	Autonomous Regulation	Semester-1			AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name			M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks	
16MEE 210			T	P	C	E	I	Total
	NUMERICAL METHODS	3	0	0	3	70	30	100

Objective (s)

Student will understand

1. the non-linear set of equations in engineering practice
2. linear set of equations applied to engineering applications
3. the importance of working principles of numerical analysis and its applications in engineering
4. understand the various sets of equations used in engineering applications
5. familiarize the concept of various methods of interpolation and its importance in engineering
6. understand various techniques used for solving differential equations used in engineering applications

Outcome (s)

A student will be able to

1. apply different techniques in solving linear and non linear sets of equations
2. apply different methods of interpolation techniques
3. solve numerical differentiation by different methods concerned to engineering practice
4. apply different techniques for numerical differentiation
5. identify various techniques of numerical methods applicable to engineering applications
6. apply different procedures to solve ordinary differential equations

Unit		Hours
1. LINEAR SETS OF EQUATIONS	**Total Hrs**	**9**
Gauss Elimination, LV Decomposition, Matrix Inversion, Scalar Tridiagonal Matrix, Thomas Algorithm, Gauss Seidel Method, Secant Method		
2. **NON-LINEAR SETS OF EQUATIONS**	**Total Hrs**	**9**
Solving nonlinear sets of equations Minimization of function, Newton's Method, Quasi-Newton Method, Steepest Descent Method, Eigen Values & Vectors.		
3. INTERPOLATION	**Total Hrs**	**9**
Interpolation & Polynomial Approximation Least Squares Method, Lagrange Interpolation, Hermite Interpolation, Cubic Spline Interpolation, Chebeshev Polynomials & Series		
4. **NUMERICAL DIFFERENTIATION**	**Total Hrs**	**9**
Numerical Differentiation & Integration Numerical Differentiation, Richardson's Extrapolation, Definite & Indefinite Integrals, Simpson's Rule, Trapezoid Rule, Gaussian Quadrature		
5. **ORDINARY DIFFERNENTIAL EQUATIONS**	**Total Hrs**	**9**
First and Higher Order Taylor Series, First order Runge-kutta Method, Fourth order Runge-kutta Method, Stiff Equations, Errors, Convergence Criteria		
Total hours to be taught		**45**

Text book (s)

1. Cheney E. Ward, Kincaid D.R., Numerical Methods and Applications, 2008, Cengage Learning
2. Gerald C.F., Wheatley P.O., Applied Numerical Analysis, 7th Ed, Pearson Education

References:

1. Burden R.L., Faires J.D., Numerical Analysis: Theory and Applications, 2005, Cengage Learning
2. Chapra S.C., Canale R.P., Numerical Methods for Engineers, 4th Ed,Tata McGraw Hill
3. Mathews J.H., Fink K.D., Numerical Methods using MA TLAB, 4th Ed, Pearson Education
4. Press W.H., Taukolsky S.A., Vetterling W.T., Flannery B.P., Numerical Recipes in C++, 2nd Ed, Cambridge University Press

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CBIT	Autonomous Regulation	Semester-I				A.Y 2016-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEE 211	**ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL**	3	1	0	4	70	30	100

Objective (s)	Student will understand 1. different methods to control air pollution 2. the importance of harmful effects of different types of pollution levels and their effect on human beings and environment 3. different techniques adopted in solid waste management 4. causes and remedies for water pollution 5. other types of pollution like oils, pesticides, noise etc. 6. controlling methods adopted to reduce pollution from their power plants
Outcome (s)	A student will able to 1. Estimate pollution levels in various resources and suggest suitable remedial methods to control them 2. analyze air pollutants and suggest controlling methods 3. suggest a suitable solid waste disposal system 4. suggest suitable remedy to control water pollution 5. suggest suitable remedy to control other pollutants like oils, pesticides, noise etc. 6. Suggest a suitable instrumentation for pollution control

1	**AIR POLLUTION**	**Total Hrs**	**9**

Sources and Effect - Acid Rain - Air Sampling and Measurement - Analysis of Air Pollutants - Air Pollution Control Methods and Equipments - Issues in Air Pollution control.

2	**SOLID WASTE MANAGEMENT**	**Total Hrs**	**9**

Sources and Classification - Characteristics of solid waste-Potential methods of solid waste Disposal – Process and Equipments for Energy Recovery from Municipal Solid Waste and Industrial Solid Waste

3	**WATER POLLUTION**	**Total Hrs**	**9**

Sources and Classification of Water Pollutants - Characteristics - Waste Water Sampling Analysis - Waste Water Treatment - Monitoring compliance with Standards - Treatment, Utilization and Disposal of Sludge

4	**OTHER TYPES OF POLLUTION**	**Total Hrs**	**9**

Noise Pollution and its impact - Oil Pollution - Pesticides - Radioactivity Pollution Prevention and Control

5	**POLLUTION FROM THERMAL POWER PLANTS AND CONTROL METHODS:**	**Total Hrs**	**9**

Instrumentation for pollution control - Water Pollution from Tanneries and other Industries and their control

Total hours to be taught	**45**

Text book (s)

1. G.Masters” Introduction to Environmental Engineering and Science, Prentice -Hall 1998 International Editions.
2. S.Peavy, D.R..Rowe, G.Tchobanoglous “Environmental Engineering” - McGraw- Hill Book Company,NewYork.1985.

References

1. H.Ludwig, W.Evans :” Manual of Environmental Technology in Developing Countries, 1991
2. Environmental Considerations in Energy Development, Asian Development Bank (ADB), Manilla 1991

CBIT	Autonomous Regulation								
Department	Mechanical Engineering	Programme Code & Name					M.E. Thermal Engineering		
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
		L	T	P	C	E	I	Total	
16MEE 212	**REFRIGERATION MACHINERY & COMPONENTS**	3	0	0	3	70	30	100	
Objective (s)	Student will understand 1. different types compressors and their working 2. the importance of design of condensors 3. different types of evaporators 4. different types Refrigerant driers strainers, Receivers, Accumulators 5. other types of pollution like oils, pesticides, noise etc. 6. System Accessories and Controls								
Outcome (s)	A student will able to 1. estimate energy efficiency aspects of Hermetic compressors 2. analyze heat transfer coefficient, Fouling factor, Friction factor 3. design of evaporators 4. evaluate different types Refrigerant driers strainers, Receivers, Accumulators, Low pressure receivers 5. deal with refrigerant pumps, cooling tower fans, 6. teat air conditioners, refrigerators, visicoolers, cold rooms,								

1	**REFRIGERANT COMPRESSORS**	**Total Hrs**	**9**

Hermetic compressors - Reciprocating, Rotary, Scroll Compressors, Open type compressors-Reciprocating, Centrifugal, Screw Compressors. Semi hermetic compressors – Construction , working and Energy Efficiency aspects. Applications of each type.

2	**DESIGN OF CONDENSERS**	**Total Hrs**	**9**

Estimation of heat transfer coefficient, Fouling factor, Friction factor. Design procedures, Wilson plots, Designing different types of condensers, BIS Standards, Optimization studies.

3	**DESIGN OF EVAPORATORS**	**Total Hrs**	**9**

: Different types of evaporators, Design procedure, Selection procedure, Thermal Stress calculations, matching of components, Design of evaporative condensers.

4	**REFRIGERATION SYSTEM COMPONENTS**	**Total Hrs**	**9**

Evaporators and condensers - Different types, capacity control, circuitry, Oil return, Oil separators - Different types Refrigerant driers strainers, Receivers, Accumulators, Low pressure receivers, Air Washers, Spray ponds.

5	**SYSTEM ACCESSORIES AND CONTROLS**	**Total Hrs**	**9**

Refrigerant Pumps, Cooling Tower fans, Compressor Motor protection devices, Oil equalizing in multiple evaporators, Different Defrosting and capacity control methods and their implications -Testing of Air conditioners, Refrigerators, Visicoolers, Cold rooms, Calorimetric tests.

Total hours to be taught	**45**

Text book (s)

1	Chlumsky, "Reciprocating & Rotary compressors", SNTL Publishers for Technical literature, 1965.
2	Hains, J.B, "Automatic Control of Heating & Air conditioning" Mc Graw Hill, 1981.

Reference(s)

1	Althose, A.D. & Turnquist, C.H. "Modern Refrigeration and Air-conditioning" Good Heart -Wilcox Co. Inc., 1985.
2	Recent release of BIS Code for relevant testing practice.
3	ASHRAE Hand book: Equipments, 1998
4	Cooper &Williams, B. "Commercial, Industrial, Institutional Refrigeration, Design, Installation and Trouble Shooting " Eagle Wood Cliffs (NT) Prentice Hall, 1989.

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 213	**ENERGY MANAGEMENT**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To create awareness of the importance of the energy auditing and determination of
2. evaluation methods of engineering projects
3. To understand the principles of energy management for various types of industries
4. To understand the need and necessity of energy auditing and estimate the budget for industry
5. To understand the importance of renewable energies in the scenario of depletion of conventional energy resources

Outcome (s)

A student will be able to

1. grasp the importance of energy auditing
2. estimate the requirement of any proposed industry
3. evaluate the projects and he can act as energy consultant
4. realize the importance of alternative energy techniques in the context of depletion of conventional energy resources
5. evaluation of projects : payback – annualised costs – investor's rate of return – present worth – internal rate of return
6. know importance of alternative energy sources

1. PRINCIPLES OF ENERGY MANAGEMENT	**Total Hrs**	**9**
Managerial Organization – Functional Areas for i. Manufacturing Industry ii. Process Industry iii. Commerce iv. Government. Role of Energy. Manager in each of these organizations initiating.		
2. ENERGY AUDITING	**Total Hrs**	**9**
Energy Audit: Definition and Concepts, Types of Energy Audits – Basic Energy Concepts – Resources for Plant Energy Studies – Data Gathering – Analytical Techniques Energy Conservation: Technologies for Energy Conservation , Design for Conservation of Energy materials – energy flow networks – critical assessment of energy usage– formulation of objectives and constraints – synthesis of alternative options and technical analysis of options – process integration.		
3. ECONOMIC ANALYSIS	**Total Hrs**	**9**
Economic Analysis: Scope, Characterization of an Investment Project – Types of Deprecication – Time Value of money – budget considerations, Risk Analysis		
4. METHODS OF EVALUATION OF PROJECTS	**Total Hrs**	**9**
Methods of Evaluation of Projects : Payback – Annualised Costs – Investor's Rate of return – Present worth – Internal Rate of Return – Pros and Cons of the common methods of analysis – replacement analysis. Energy Consultant: Need of Energy Consultant – Consultant Selection Criteria.		
5. ALTERNATIVE ENERGY SOURCES	**Total Hrs**	**9**
Alternative Energy Sources : Solar Energy – Types of devices for Solar Energy Collection – Thermal Storage System – Control Systems-Wind Energy – Availability – Wind Devices – Wind Characteristics – Performance of Turbines and systems		
Total hours to be taught		**45**

Text book (s)

1. W.C. Turner "Energy Management Hand book" 5th edition, the Fair Mount Press
2. R.Murphy and G.Mc Kay "Energy Management", Butterworth Publications

References:

1. C.B.Smith "Energy Management Principles" Pergamon Press
2. Stephen W.Fardo, Dile, R.Patric, "Energy conservation Guide Book" Fair Mount Press
3. Frank Krieth, D.Yogi Goswamy "Energy management & conservation hand book" CRC Press 2008

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 214	**CONVECTIVE HEAT TRANSFER**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

objective (s)

1. to create the awareness of the importance of principles of heat transfer by convection and its applications in engineering along with solution
2. to understand the principles, different types of convection heat transfer and their equations to apply for various engineering applications
3. to familiarize the concept of forced convection and its behavior pipes
4. to understand the principles of conjugate heat transfer and its applications in engineering heat transfer

outcome (s)

a student will be able to

1. select the mode of convection heat transfer rate and calculate heat transfer rate depending on the application
2. use this theory in advanced subjects like cfd and various software packages
3. calculate the heat transfer rate in conjugative system like porous media,
4. calculate the rate of heat transfer with the combination of conduction and convection in applications like heat exchangers
5. evaluate forced and free convection
6. analyse flow through the porous media

1. NTRODUCTION TO CONVECTIVE HEAT TRANSFER	**Total Hrs**	**9**

Forced, free & combined convection – convective heat transfer coefficient – Application of dimensional analysis to convection – Physical interpretation of dimensionless numbers. Equations of Convective Heat Transfer: Continuity, Navier-Strokes equation & energy equation for steady state flows – similarity – Equations for turbulent convective heat transfer – Boundary layer equations for laminar, turbulent flows – Boundary layer integral equations

2. FORCED CONVECTION	**Total Hrs**	**9**

External Laminar Forced Convection: Similarity solution for flow over an isothermal plate – integral equation solutions
– Numerical solutions – Viscous dissipation effects on flow over a flat plate. External Turbulent Flows: Analogy solutions for boundary layer flows – Integral equation solutions – Effects of dissipation on flow over a flat plate. Internal Laminar Flows: Fully developed laminar flow in pipe, plane duct & ducts with other cross-sectional shapes – Pipe flow & plane duct flow with developing temperature field – Pipe flows & plane duct flow with developing velocity & temperature fields. Internal Turbulent Flows: Analogy solutions for fully developed pipe flow –Thermally developing pipe & plane duct flow.

3. NATURAL CONVECTION	**Total Hrs**	**9**

Boussineq approximation – Governing equations – Similarity – Boundary layer equations for free convective laminar flows – Numerical solution of boundary layer equations. Free Convective flows through a vertical channel across a rectangular enclosure – Horizontal enclosure – Turbulent natural convection

4. COMBINED CONVECTION	**Total Hrs**	**9**

Governing parameters & equations – laminar boundary layer flow over an isothermal vertical plate – combined convection over a horizontal plate – correlations for mixed convection – effect of boundary forces on turbulent flows – internal flows - internal mixed convective flows – Fully developed mixed convective flow in a vertical plane channel & in a horizontal duct

5. HEAT TRANSFER THROUGH POROUS MEDIA	**Total Hrs**	**9**

Area weighted velocity – Darcy flow model – energy equation – boundary layer solutions for 2-D forced convection – Fully developed duct flow – Natural convection in porous media – filled enclosures – stability of horizontal porous layers

Total hours to be taught		**45**

Text book (s)

1. Patrick H. Oosthuigen & David Naylor “Introduction to Convective Heat Transfer Analysis” (TMH)
2. Kays & Crawford “Convective Heat & Mass Transfer” TMH, 2000

References:

1. Oosthigen, “Convective Heat and Mass Transfer” McGrawhill, 1998
2. Adrian Bejan “Convection Heat Transfer”, 2nd Edition John Wiley,1984

CBIT	Autonomous Regulation	Semester-1	AY - 2006-17
Department	Mechanical Engineering	Programme Code & Name	M.E. Thermal Engineering

Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 215	**THERMAL AND NUCLEAR POWER PLANTS**		T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Student will be able to understand the

1. Performance of steam power plant and to observe the importance of combustion of coal
2. Working principles of steam generators, turbines & condensers
3. Combined cycle effect in gas turbine power plants
4. Compare different nuclear reactors and estimate the economical benefits
5. Calculate the different energy tariffs under various load conditions
6. pressure, temperature and flow parameters of a power plant

Outcome (s)

Students will be able to

1. analyze on combustion of coal and find performance of different power plant cycles.
2. analyze various steam generators, cooling towers, turbines & condensers.
3. analysis on combined cycle, power plants and waste heat recovery systems.
4. design various types of nuclear reactors taking safety precautions and making economically beneficial.
5. calculate the energy rates of power distribution considering the factors affecting the economy.
6. determine the pressure, temperature and flow measurements of steam and water to operate the power plant most efficiently and suggest various remedies to control pollutants.

1. Layout of Power Plants	**Total Hrs**	**9**

Sources of Energy, types of Power Plants, Direct Energy Conversion System, Energy Sources in India, Recent developments in Power Generation. Combustion of Coal, Volumetric Analysis, Gravimetric Analysis, Flue gas Analysis.

Steam Power Plants: Introduction – General Layout of Steam Power Plant, Modern Coal-fired Steam Power Plants, Power Plant cycles, Fuel handling, Combustion Equipment, Ash handling, Dust Collectors

2. Combined Cycle Power plant	**Total Hrs**	**9**

Cogeneration, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion – Advantages & Disadvantages

3. Nuclear Power Plant	**Total Hrs**	**9**

Nuclear Physics, Nuclear Reactors, Classification – Types of Reactors, Site Selection, Methods of enriching Uranium, Applications of Nuclear Power Plants.

Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power

4. Economics of Power Plant	**Total Hrs**	**9**

Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic

Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems

5. Power Plant Instrumentation	**Total Hrs**	**9**

Classification, Pressure measuring instruments, Temperature measurement and Flow measurement.

Analysis of Combustion gases, Pollution – Types, Methods to Control.

Total hours to be taught		**45**

Text book (s)

1. EL- Wakil, M.M., “Power Plant Technology “ Mc Graw Hill, New York, 1985
2. Weis Man, J.and Eckert, R, “Modern Power Plant Engineering”, PHI, New Delhi, 1983

References:

1. Arora and Domkundwar, “A course in Power Plant Engineering”, Dhanpat Rai & sons 2002
2. P.K. Nag, “Power Plant Engineering,” TMH, 2003
3. P.C.Sharma, “Power Plant Engineering” Kotaria Publications. 2007

CBIT	Autonomous Regulation							
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Semester-I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEC 2062	**THERMAL SYSTEMS LABORATORY (Lab-1)**	0	0	3	2		50	50
Objective(s)	1. To evaluate the performance of computerized I.C Engine 2. To determine heat transfer coefficient in two phase heat transfer 3. To determine effectiveness of cross flow heat exchanger 4. To evaluate the performance of heat pipe 5. To evaluate the thermal properties of fluids 6. To conduct performance test on solar collectors							
Outcome(s)	A student will be able to 1. estimate the thermal efficiency of IC engine 2. prove that value of convection heat transfer coefficient is very high with two phase heat transfer 3. estimate the effectiveness of cross flow heat exchanger and prove that it is very high compared with other configurations 4. calculate heat of condensation and vaporization pipe 5. estimate the efficiency of solar collector 6. find out properties of fluids such as coefficient of thermal expansion, enthalpy of fusion							

List of Experiments:

1. Performance Evaluation on single cylinder 4-stroke SI Engine with alternate fuels with computer interfacing.
2. Performance Evaluation on single cylinder 4 stroke CI Engine with alternate fuels with computer interfacing
3. Determination of heat transfer coefficient in Film wise and Drop wise condensation
4. Cross flow Heat Exchanger.
5. Heat Pipe Demonstration
6. Performance text on Axial flow compressor
7. Performance test on solar collector
8. Determination of coefficient of thermal expansion of Solids, Liquids and Gases
9. Determination of thermal capacity of Solids
10. Determination of isentropic coefficient of air by Clement-Desormes method
11. Measure of enthalpy of fusion and solidification
12. Measurement of Temperature Distribution in the interior and external Surface of an electric water heater with thermometers and thermo-camera

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 207	**COMPUTATIONAL FLUID DEYNAMCS LABORATORY (Lab-II)**	L	T	P	C	E	I	Total
		0	0	3	2		50	50

Objective(s)

Student to understand the

1. Concept of fluid mechanics
2. Basic steps in a CFD simulation: ANSYS Workbench design modular and meshing
3. Simulation of steady and unsteady problems
4. Physics setup involves boundary conditions
5. Solution of Thermal related problems
6. Post processor of workbench tool for various problems

Outcome(s):

A student will be to

1. analyze laminar flow problems in plates and pipes
2. solve steady and unsteady flows
3. perform analysis free and forced convection
4. evaluate thermal flow in hot and cold fluid
5. simulate NACA aerofoil blades
6. analyze problems related to combustion

The following simulations will be performed using ANSYS workbench tools

List of Experiments:

1. Laminar Flow over Flat plate
2. Laminar Pipe Flow.
3. Steady Flow past a Cylinder
4. Unsteady Flow past a Cylinder
5. Two Dimensional Steady Free Convection
6. Forced Convection for pipe cross section.
7. Study of Hot & Cold Fluid Mix
8. Flow analysis of Airfoil.
9. Compressible Flow in a Nozzle
10. Partially Premixed Combustion
11. Supersonic Flow Over Wedge
12. Bifurcating Artery

16MEC210

MINIPROJECT GUIDELINES

Instruction	2 Hrs / week
Sessional	50 Marks
Credits	01

Objectives:

First year ME students will each do a 14-week mini project, each generally comprising about one week of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment (see assessment information below). Each student will be allotted to a Faculty supervisor for mentoring.

Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original. Mini projects should have inter disciplinary/ industry relevance. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling. All the investigations are clearly stated and documented with the reasons/explanations. All the projects should contain A clear statement of the research objectives, background of work, Literature review, techniques used, prospective deliverables, benefit from this [line of] research, Detailed discussion on results, Conclusions and references.

Outcomes:

Students are able to
1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained and write the documentation in standard format

Assessment:

1. 50 % of marks for a scientific report on the project.
   Regarding the formatting and structure, the report should be written as a journal article using the style file of a journal appropriate for the field of the research (which journal format is most appropriate should be agreed between student and supervisor). If the journal you selected has a page limit, it can be ignored but the report should not exceed 8000 words (common sense should be used if there are a lot of equations).

   Regarding content, the report should be understandable by your fellow students, so the introduction and literature review could be a bit more detailed than in a research paper. The results and discussions are in elaborate form and at end conclusions and include references.

2. 50 % of marks for an oral presentation which will take place at the end of the semester and evaluation by a committee consist of Supervisor, one senior faculty and Head of the department or his nominee.