R-22 Syllabus for M. TECH (TE), SACET (AUTONOMOUS) w.e.f.2022-2023

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE AND SYLLABUS
For PG –R22
M. TECH – THERMAL ENGINEERING
(Applicable for batches admitted from 2022-2023)

St. ANN'S COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
CHIRALA – 523187, ANDHRA PRADESH, INDIA

(Accredited by NBA, NAAC with 'A' Grade, accredited by IE (I) & Permanently Affiliated to JNTUK)
Recognized by UGC under Section 2(f) & 12(B) of UGC Act,

I SEMESTER

S. No	Category	Course Code	Course Title	Theory/ Lecture (L)	Tutorial (T)	Practical/ Drawing (P)	Self-Study (SS)	Duration in hours/ Week	CIE Marks	SEE Marks	Total Marks	Credits
1	PC	22PTE01	Advanced Thermodynamics	3	--	--	--	3	40	60	100	3
2	PC	22PTE02	Computational Fluid Dynamics	3	--	--	--	3	40	60	100	3
3	PE	22PTE03	Advanced I.C engine ,Electric and Hybrid vehicles	3	--	--	--	3	40	60	100	3
		22PTE04	Advanced Fluid Mechanics									
		22PTE05	Cryogenic Engineering									
		22PTE06	Gas Dynamics									
4	PE	22PTE07	Solar Energy Technology	3	--	--	--	3	40	60	100	3
		22PTE08	Alternative Fuel Technologies									
		22PTE09	Gas Turbines									
		22PTE10	Energy Conservation and Management									
5	CC	22PTE11	Research Methodology and IPR	--	--	--	--	0	40	60	100	2
6	PC	22PTE12	Computational Fluid Dynamics Lab –I	--	--	3	--	3	40	60	100	2
7	PC	22PTE13	Thermal Engineering Lab-I	--	--	3	--	3	40	60	100	2
8	MC	-	Audit Course-1*	2	--	--	--	2	40	60	100	0
Total				14	0	6	0	20	320	480	800	18

HS-Humanities & Sciences, BS-Basic Sciences, ES-Engineering Sciences, MC-Mandatory Course (*Student has to choose any one audit course listed below.), PC-Professional Core, PE-Professional Elective, OE-Open, Elective, PR – Internship / Project

Audit Course 1 & 2:

22PAC01: English for Research Paper Writing
22PAC02: Disaster Management
22PAC03: Sanskrit for Technical Knowledge
22PAC04: Value Education
22PAC05: Constitution of India
22PAC06: Pedagogy Studies
22PAC07: Stress Management by Yoga
22PAC08: Personality Development through Life Enlightenment Skills

II SEMESTER

S. No	Category	Course Code	Course Title	Theory/ Lecture (L)	Tutorial (T)	Practical/ Drawing (P)	Self-Study (SS)	Duration in hours/ Week	CIE Marks	SEE Marks	Total Marks	Credits
1	PC	22PTE15	Advanced Heat and Mass Transfer	3	--	--	--	3	40	60	100	3
2	PC	22PTE16	Advanced Power Plant Engineering	3	--	--	--	3	40	60	100	3
3	PE	22PTE17	Thermal Measurements and Process Controls	3	--	--	--	3	40	60	100	3
		22PTE18	Combustion, Emissions and Environment									
		22PTE19	Advanced Automobile Engg.									
		22PTE20	Thermal and Nuclear Power Plants									
4	PE	22PTE21	Jet Propulsion and Rocket Engineering	3	--	--	--	3	40	60	100	3
		22PTE22	Modeling of I.C engines									
		22PTE23	Renewable Energy Technologies									
		22PTE24	Turbo Machines									
5	PC	22PTE25	Computational Fluid Dynamics Lab –II	--	--	3	--	3	40	60	100	2
6	PC	22PTE26	Thermal Engineering Lab-II	--	--	3	--	3	40	60	100	2
7	PR	22PTE27	Mini Project with Seminar	--	--	4	--	4	100	--	100	2
8	MC	-	Audit Course-2*	2	--	--	--	2	40	60	100	0
Total				14	0	10	0	24	380	420	800	18

HS-Humanities & Sciences, BS-Basic Sciences, ES-Engineering Sciences, MC-Mandatory Course (*Student has to choose any one audit course listed below.), PC-Professional Core, PE-Professional Elective, OE-Open, Elective, PR – Internship / Project

Audit Course 1 & 2:

22PAC01: English for Research Paper Writing

22PAC02: Disaster Management

22PAC03: Sanskrit for Technical Knowledge

22PAC04: Value Education

22PAC05: Constitution of India

22PAC06: Pedagogy Studies

22PAC07: Stress Management by Yoga

22PAC08: Personality Development through Life Enlightenment Skills

III SEMESTER

S. No	Category	Course Code	Course Title	Theory/ Lecture (L)	Tutorial (T)	Practical/ Drawing (P)	Self-Study (SS)	Duration in hours / Week	CIE Marks	SEE Marks	Total Marks	Credits
1	PE	22PTE29	Optimization Techniques and Applications	3	--	--	--	3	40	60	100	3
		22PTE30	Design and Analysis of Experiments									
		22PTE31	Convective Heat Transfer									
		22PTE32	Waste to Energy									
		22PTE33	Advanced finite element methods									
		22PTE34	MOOCs-1 (NPTEL/SWAYAM) 12 Week Program related to the programme which is not listed in the course structure									
2	OE	22PTE35	MOOCs-2 (NPTEL/SWAYAM)-Any 12 Week Course on Engineering/ Management/ Mathematics offered by other than parent department	3	--	--	--	3	40	60	100	3
		--	Course offered by other departments in the college									
3	PR	22PTE37	Dissertation-I/ Industrial Project	--	--	20	--	20	--	100	100	10
Total				6	0	20	0	26	80	220	300	16

HS-Humanities & Sciences, BS-Basic Sciences, ES-Engineering Sciences, MC-Mandatory Course (*Student has to choose any one audit course listed below.), PC-Professional Core, PE-Professional Elective, OE-Open, Elective, PR – Internship / Project
**Students going for Industrial Project/Thesis will complete these courses through MOOCs

OE - Open Electives offered by the Department of CSE

22PCS19: Cloud Computing

22PCS05: Cyber Security

22PCS07: Internet of Things

22PCS13: Machine Learning

IV SEMESTER

S. No	Category	Course Code	Course Title	Theory/ Lecture (L)	Tutorial (T)	Practical/ Drawing (P)	Self-Study (SS)	Duration in hours / Week	CIE Marks	SEE Marks	Total Marks	Credits
1	PR	22PTE38	Dissertation-II	--	--	32	--	32	--	100	100	16
Total				0	0	32	0	32	0	100	100	16

HS-Humanities & Sciences, BS-Basic Sciences, ES-Engineering Sciences, MC-Mandatory Course (*Student has to choose any one audit course listed below.), PC-Professional Core, PE-Professional Elective, OE-Open, Elective, PR – Internship / Project

Total Credits =68

I Year - I Semester	22PTE01	L	T	P	C
		3	0	0	3

Advanced Thermodynamics

UNIT-I AVAILABILITY AND IRREVERSIBILITY: Quality of Energy, available and unavailable energy, availability, surroundings work, reversible work and irreversibility, availability in a closed system, availability in a SSSF process in an open system, second law efficiencies of processes, second law efficiency of cycles and exergy balance equations.

UNIT-II THERMODYNAMIC PROPERTY RELATIONS: Helmholtz and Gibbs Functions, two Mathematical Conditions for Exact Differentials, Maxwell Relations, Clapeyron Equation, Relations for Changes in Enthalpy, Internal Energy and Entropy, Specific Heat Relations, Generalized Relations/Charts for Residual Enthalpy and Entropy, Gibbs Function at zero Pressure: A Mathematical Anomaly, Fugacity, Fugacity Coefficient and Residual Gibbs Function, The Joule, Thomson Coefficient and Inversion Curve, Thermodynamic similarity.

UNIT 3:

NON-REACTING MIXTURES OF GASES AND LIQUIDS: Measures of Composition in Multi Component Systems. Gas Mixtures: Mixtures of ideal Gases, Gas-Vapor Mixtures, Application of First Law to Psychometric Processes, Real Gas Mixtures. Liquid Mixtures/Solutions: Ideal Solutions, Real Solutions. Thermodynamic Relations for Real Mixtures: Partial Properties, Relation for Fugacity and Fugacity Coefficient in Real Gas Mixtures, Relations for Activity and Activity Coefficient in Real Liquid Mixtures/Solutions.

UNIT 4:

PHASE EQUILIBRIUM: VAPOUR LIQUID EQUILIBRIUM OF MIXTURES: Phase Diagrams for Binary Mixtures, Vapor, Liquid Equilibrium in Ideal Solutions, Criteria for Equilibrium, Criterion for phase Equilibrium, Calculation of Standard State Fugacity of Pure Component, Vapor Liquid Equilibrium at Low to Moderate Pressures, Determination of Constants of Activity Coefficient Equations, Enthalpy Calculations.

UNIT-V CHEMICAL REACTIONS AND COMBUSTION: Thermo chemistry, Measures of Composition in Chemical Reactions, Application of First Law of Thermodynamics to chemical Reactions, the Combustion Process-Standard Heat/Enthalpy of Combustion, Reactions at actual Temperatures, adiabatic Flame Temperature, Entropy Change of Reacting Systems, Application of second Law of Thermodynamics to chemical Reactions,chemical equilibrium-Advancement of Chemical Reactions, Equilibrium Criterion in Chemical Reactions, equilibrium Constant and Law of Mass Action, Equilibrium Constant for Gas Phase Reactions in the standard state.

TEXT BOOKS:

1. Basic and Applied Thermodynamics, P.K.Nag, TMH, 2019.

2. Thermodynamics, J.P Holman, Mc Graw Hill, 2017.

3. Thermodynamics ,CP Arora, Mc Graw Hill education (India pvt limited), 2016.

REFERENCES:

1. Engg. Thermodynamics, PL.Dhar, Elsevier, 2008.

2. Thermodynamics, Sonnatag & Van Wylen, John Wiley & Sons, 2004.

3. Thermodynamics for Engineers, Doolittle-Messe, John Wiley & Sons, 2018.

4. Irreversible thermodynamics, HR De Groff, .

5. Thermal Engineering, Soman, PHI, 2011.

6. Thermal Engineering, Rathore, TMH, 2010. 7. Engineering Thermodynamics, Chatopadyaya, 2010.

I Year - I Semester	22PTE02	L	T	P	C
		3	0	0	3

COMPUTATIONAL FLUID DYNAMICS

UNIT – I

INTRODUCTION: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Derivation of finite difference equations.

SOLUTION METHODS: Solution methods of elliptical equations – finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations, explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT – II

HYPERBOLIC EQUATIONS: Explicit schemes and Von Neumann stability analysis, implicit schemes, multi-step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT – III

FORMULATIONS OF INCOMPRESSIBLE VISCOUS FLOWS: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods. **TREATMENT OF COMPRESSIBLE FLOWS:** Potential equation, Eluer equations, Navier -Stokes system of equations, flow-field, dependent variation methods, boundary conditions.

UNIT – IV

FINITE VOLUME METHOD: Finite volume method via finite difference method, formulations for two and three, dimensional problems.

UNIT – V

STANDARD VARIATIONAL METHODS: Linear fluid flow problems, steady state problems, Transient problems.

TEXT BOOKS:

1. Computational fluid dynamics, T. J.Chung, Cambridge University press,2002.

2. Computational Fluid Dynamics by John D. Anderson, McGraw Hill Book Company 2017.

REFERENCE:

1. Text book of fluid dynamics, Frank Chorlton, CBS Publishers &distributors, 1985.

2. Computational Techniques for Fluid Dynamics, Volume 1& 2 By C. A. J. Fletcher, Springer Publication, 2012.

I Year - I Semester	22PTE03	L	T	P	C
		3	0	0	3

ADVANCED I.C ENGINE ELECTRIC ANDHYBRID VECHILES
Program Elective – I

UNIT-I:

GAS EXCHANIGING PROCESSES: Inlet and exhaust processes in the four stroke cycle volumetric efficiency quasi static effects combined quasi static and dynamic effects variation with speed and valve area lift and timing –flow through valves poppet valve geometry and timing flow rate and discharge coefficients, residual gas fraction , exhaust gas flow rate and temperature variation, scavenging in two stroke cyclic engines, scavenging parameters and models actual scavenging processes , flow through ports, super charging and turbo changing – methods of power boosting basic relationships compressors, turbines wave compression devices.

UNIT-II:

CHARGE MOTION WITHIN THE CYLINDER: Intake Jet Flow, Mean velocity and turbulence characteristics definitions application to engine velocity data swirl – swirl measurement, swirl generation during induction swirl modification within the cylinder squish pre chamber engine flows crevice flows and blowby flows generated by piston –cylinder wall interaction.

UNIT-III:

COMBUSTION IN S.I AND C.I ENGINES: Review of normal and abnormal combustion in SI and CI engine cyclic variation in combustion of SI engine, analysis of cylindrical pressure data in SI and CI engine, MPFI in SI engines common rail fuel injection system in CI engines fuel spray behavior in CI engines.

UNIT- IV:

ELECTRIC VEHICLES: Introduction: Limitations of IC Engines as prime mover, History of EVs, EV system, components of EV-DC and AC electric machines: Introduction and basic structure, Electric vehicle drive train, advantages and limitations, Permanent magnet and switched reluctance motors **BATTERIES:** Battery: lead, acid battery, cell discharge and charge operation, construction, advantages of lead, acid battery, Battery parameters: battery capacity, discharge rate, state of charge, state of discharge, depth of discharge, Technical characteristics, Ragone plots.

UNIT- V:

HYBRID VECHILES: Configurations of hybrids, Series and Parallel, advantages and limitations, Hybrid drive trains, sizing of components Initial acceleration, rated vehicle velocity, Maximum velocity and maximum gradeability, Hydrogen: Production, Hydrogen storage systems, reformers.

FUEL CELL VECHILES: Introduction, Fuel cell characteristics, Thermodynamics of fuel cells, Fuel cell types: emphasis on PEM fuel cell.

TEXT BOOKS:

1. J.B. Heywood Internal Combustion Engine Fundamentals, McGraw Hill Co.1988
2. Seth Leitman and Bob Brant Build your own electric vehicle McGraw Hill Co.2009.
    a. F. Barbir PEM Fuel Cells-Theory and Practice Elsevier Academic Press,2005.

REFERENCES:

W.W. Pulkrabek Engineering Fundamentals of IC Engine, PHI Pvt. Ltd 2002

I Year - I Semester	22PTE04	L	T	P	C
		3	0	0	3

ADVANCED FLUID MECHANICS
Program Elective – I

UNIT -I:

INVISCID FLOW OF INCOMPRESSIBLE FLUIDS: Lagrangian and Eulerain Descriptions of fluid motion, Path lines, Stream lines, Streak lines, stream tubes – velocity of a fluid particle, types of flows, Equations of three dimensional continuity equation, Stream and Velocity potential functions. Basic Laws of fluid Flow: Condition for irrationality, circulation & vorticity Accelerations in Carte systems normal and tangential accelerations, Euler's, Bernouli equations in 3D– Continuity and Momentum Equations.

UNIT -II:

Viscous Flow: Derivation of Navier,Stoke's Equations for viscous compressible flow – Exact solutions to certain simple cases: Plain Poisoulle flow, Coutte flow with and without pressure gradient , Hagen Poisoulle flow, Blasius solution.

UNIT -III:

Boundary Layer Concepts : Prandtl's contribution to real fluid flows – Prandtl's boundary layer theory , Boundary layer thickness for flow over a flat plate – Approximate solutions – Creeping motion (Stokes) – Oseen's approximation, Von,Karman momentum integral equation for laminar boundary layer — Expressions for local and mean drag coefficients for different velocity profiles.

UNIT- IV:

Introduction to Turbulent Flow: Fundamental concept of turbulence – Time Averaged Equations – Boundary Layer Equations, Prandtl Mixing Length Model, Universal Velocity Distribution Law: Van Driest Model –Approximate solutions for drag coefficients – More Refined Turbulence Models – k,epsilon model , boundary layer separation and form drag – Karman Vortex Trail, Boundary layer control, lift on circular cylinders. Internal Flow: Smooth and rough boundaries – Equations for Velocity Distribution and frictional Resistance in smooth and rough Pipes – Roughness of Commercial Pipes – Moody's diagram.

UNIT -V:

Compressible Fluid Flow – I: Thermodynamic basics – Equations of continuity, Momentum and Energy , Acoustic Velocity, Derivation of Equation for Mach Number – Flow Regimes – Mach Angle – Mach Cone – Stagnation State. Compressible Fluid Flow – II: Area Variation, Property Relationships in terms of Mach number, Nozzles, Diffusers – Fanno and Releigh Lines, Property Relations – Isothermal Flow in Long Ducts – Normal Compressible Shock, Oblique Shock: Expansion and Compressible Shocks – Supersonic Wave Drag.

TEXT BOOKS:

1. Fluid Mechanics / L.VictorSteeter / TMH

2. Fluid Mechanics / Frank M.White / MGH

REFERENCES:

1. Fluid Mechanics and Machines/Modi and Seth/Standard Book House

2. Fluid Mechanics/Cohen and Kundu/Elsevier/5th edition

3. Fluid Mechanics/Potter/Cengage Learning

4. Fluid Mechanics/William S Janna/CRC Press

5. Fluid Mechanics / Y.A Cengel and J.M Cimbala/MGH

6. Boundary Layer Theory/ Schlichting H /Springer Publications

7. Dynamics & Theory and Dynamics of Compressible Fluid Flow/ Shapiro.

8. Fluid Dynamics/ William F. Hughes & John A. Brighton/TMH

9. Fluid Mechanics / K.L Kumar /S Chand & Co

I Year - I Semester	22PTE04	L	T	P	C
		3	0	0	3

ADVANCED FLUID MECHANICS
Program Elective – I

UNIT -I:

INVISCID FLOW OF INCOMPRESSIBLE FLUIDS: Lagrangian and Eulerain Descriptions of fluid motion, Path lines, Stream lines, Streak lines, stream tubes – velocity of a fluid particle, types of flows, Equations of three dimensional continuity equation, Stream and Velocity potential functions. Basic Laws of fluid Flow: Condition for irrotationality, circulation & vorticity Accelerations in Carte systems normal and tangential accelerations, Euler's, Bernouli equations in 3D– Continuity and Momentum Equations.

UNIT -II:

Viscous Flow: Derivation of Navier,Stoke's Equations for viscous compressible flow – Exact solutions to certain simple cases: Plain Poisoulle flow, Coutte flow with and without pressure gradient , Hagen Poisoulle flow, Blasius solution.

UNIT -III:

Boundary Layer Concepts : Prandtl's contribution to real fluid flows – Prandtl's boundary layer theory , Boundary layer thickness for flow over a flat plate – Approximate solutions – Creeping motion (Stokes) – Oseen's approximation,Von,Karman momentum integral equation for laminar boundary layer — Expressions for local and mean drag coefficients for different velocity profiles.

UNIT- IV:

Introduction to Turbulent Flow: Fundamental concept of turbulence – Time Averaged Equations – Boundary Layer Equations , Prandtl Mixing Length Model , Universal Velocity Distribution Law: Van Driest Model –Approximate solutions for drag coefficients – More Refined Turbulence Models – k,epsilon model , boundary layer separation and form drag – Karman Vortex Trail, Boundary layer control, lift on circular cylinders. Internal Flow: Smooth and rough boundaries – Equations for Velocity Distribution and frictional Resistance in smooth and rough Pipes – Roughness of Commercial Pipes – Moody's diagram.

UNIT -V:

Compressible Fluid Flow – I: Thermodynamic basics – Equations of continuity, Momentum and Energy , Acoustic Velocity, Derivation of Equation for Mach Number – Flow Regimes – Mach Angle – Mach Cone – Stagnation State. Compressible Fluid Flow – II: Area Variation, Property Relationships in terms of Mach number, Nozzles, Diffusers – Fanno and Releigh Lines, Property Relations – Isothermal Flow in Long Ducts – Normal Compressible Shock, Oblique Shock: Expansion and Compressible Shocks – Supersonic Wave Drag.

TEXT BOOKS:

3. Fluid Mechanics / L.VictorSteeter / TMH
4. Fluid Mechanics / Frank M.White / MGH

REFERENCES:

10. Fluid Mechanics and Machines/Modi and Seth/Standard Book House
11. Fluid Mechanics/Cohen and Kundu/Elsevier/5th edition
12. Fluid Mechanics/Potter/Cengage Learning
13. Fluid Mechanics/William S Janna/CRC Press
14. Fluid Mechanics / Y.A Cengel and J.M Cimbala/MGH
15. Boundary Layer Theory/ Schlichting H /Springer Publications
16. Dynamics & Theory and Dynamics of Compressible Fluid Flow/ Shapiro.
17. Fluid Dynamics/ William F. Hughes & John A. Brighton/TMH
18. Fluid Mechanics / K.L Kumar /S Chand & Co

I Year - I Semester	22PTE05	L	T	P	C
		3	0	0	3

Cryogenic Engineering
Program Elective – I

UNIT-I:

VAPOUR COMPRESSION REFRIGERATION SYSTEMS: Analysis of vapor compression refrigeration cycle, Second law of Thermodynamics, Carnot refrigerator, Vapor Compression Refrigeration Cycle, components, Properties of Refrigerants.

UNIT-II:

MULTIPLE STAGE REFRIGERATION SYSTEM: Introduction, Methods of improving COP of Multi Stage Compression with Intercooling , Multistage evaporator System, Cascade Refrigeration System, Dry ice Manufacturing, Auto Cascade System, Joule-Thomson Coefficient.

UNIT-III:

CRYOGENICS; Liquefaction of air, Linde system, Analysis, Liquefaction of Neon, Hydrogen and Helium.

UNIT-IV:

APPLICATION OF LOWER TEMPERATURES: Effects on the properties of metal strength, Thermal properties, super conductivity, super fluidity. Applications, such as expansion fitting, cryobiology, cryosurgery, space research, computers, and underground power lines.

UNIT-V:

LOW TEMPERATURE INSULATION: Reflective insulation, Evacuated powders, Rigid foams, Super insulation. 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 containers.

TEXT BOOKS:

1. Refrigeration & Air, Conditioning by C.P. Arora, TMH, 2017

2. Cryogenic Systems by R.F Barron, Oxford University Press, 1985.

REFERENCE BOOKS:

1. Refrigeration& Air, Conditioning, StoeckerW.F. Jones, J.W., McGraw Hill, 2014.

2. Refrigeration & Air,Conditioning , Manohar Prasad New Age, 2018 .

3. Refrigeration & Air,Conditioning Domkunduwar, and Arora ,Dhanpatrai & Sons, 2015.

I Year - I Semester	22PTE06	L	T	P	C
		3	0	0	3

Gas Dynamics Program
Elective – I

UNIT-I:

BASIC CONCEPTS : Introduction to compressible flow, A brief review of thermodynamics and fluid mechanics, Integral forms of conservation equations, Differential conservation equations, Continuum Postulates, Acoustic speed and Mach number, Governing equations for compressible flows.

UNIT-II:

ONE-DIMENSIONAL COMPRESSIBLE FLOW: One dimensional flow concept, Isentropic flows, Stagnation/Total conditions, Characteristic speeds of gas dynamics, Dynamic pressure and pressure coefficients, Normal shock waves, Rankine , Hugonoit equations, Rayleigh flow, Fanno flow, Crocco's theorem.

UNIT- III:

TWO-DIMENSIONAL FLOWS: Oblique shock wave and its governing equations, θ,B,M relations, The Hodograph and Shock Polar, Supersonic flow over wedges and cones, Mach line, Attached and Detached shock, Reflections and interaction of oblique shock waves, Expansion waves, Prandtl , Meyer flow and its governing equations, Supersonic flow over convex and concave corners, Approximation of continuous expansion waves by discrete waves.

UNIT IV:

QUASI-ONE DIMENSIONAL FLOWS: Governing equations, Area velocity relations, isentropic flow through variable, area ducts, convergent, divergent (or De Laval) nozzles, over, expanded and under,expanded nozzles, Diffusers.

UNIT V:

UNSTEADY WAVE MOTIONS: Moving normal shock waves, Reflected shock waves, Physical features of wave propagation, Elements of acoustic theory, Incident and reflected waves, Shock tube relations, Piston analogy, Incident and reflected expansion waves, Finite compression waves, Shock tube relations.

INTRODUCTION TO EXPERIMENTAL FACILITIES: Subsonic wind tunnels, Supersonic wind tunnels, Shock tunnels, Free, piston shock tunnel, detonation, driven shock tunnels, and Expansion tubes.

TEXT BOOKS:

1. Gas Dynamics by S.M Yahya, 2017

2. Gas Dynamics by E. Radha Krishnan, Prentice Hall India Learning Private Limited

REFERENCES:

1. Fundamentals of Gas Dynamics by Robert D. Zucker, John Wiley & Sons, INC.

2. Dynamics and Thermodynamics of compressible fluid flow (Vol. I, II) by AscherH.Shapiro.

3. Elements of Gas Dynamics by H.W. Liepmann and A. Roshko, Wiley.

4. Fundamentals of Gas Dynamics by V. Babu, John Wiley & Sons.

5. Modern Compressible Flow by John D. Anderson,Jr./McGraw Hill.

I Year - I Semester	22PTE07	L	T	P	C
		3	0	0	3

Solar Energy Technology
Elective – II

UNIT – I

INTRODUCTION: Solar energy option, specialty and potential – Sun – Earth – Solar radiation, beam and diffuse – measurement – estimation of average solar radiation on horizontal and tilted surfaces – problems – applications. Capturing solar radiation – physical principles of collection – types – liquid flat plate collectors – construction details – performance analysis – concentrating collection – flat plate collectors with plane reflectors– cylindrical parabolic collectors – Orientation and tracking – Performance Analysis.

UNIT -II

DESIGN OF SOLAR WATER HEATING SYSTEM AND LAYOUT: Power generation – solar central receiver system – Heliostats and Receiver – Heat transport system – solar distributed receiver system – Power cycles, working fluids and prime movers, concentration ratio.

UNIT -III

THERMAL ENERGY STORAGE: Introduction – Need for – Methods of sensible heat storage using solids and liquids – Packed bed storage – Latent heat storage – working principle – construction – application and limitations. Other solar devices – stills, air heaters, dryers, Solar Ponds & Solar Refrigeration, active and passive heating systems.

UNIT -IV

DIRECT ENERGY CONVERSION: Solid, state principles – semiconductors – solar cells – performance – modular construction – applications. Conversion efficiencies calculations.

UNIT -V

ECONOMICS: Principles of Economic Analysis – Discounted cash flow – Solar system – life cycle costs – Cost benefit analysis and optimization – cost-based analysis of water heating and photo voltaic applications.

TEXT BOOK:

1. Principles of solar engineering/ Kreith and Kerider/Taylor and Franscis/2nd edition

REFERENCES:

1. Solar energy thermal processes/Duffie and Beckman/John Wiley & Sons
2. Solar energy: Principles of Thermal Collection and Storage/Sukhatme/TMH/2nd edition
3. Solar energy/Garg/TMH
4. Solar energy/Magal/McGraw Hill
5. Solar Thermal Engineering Systems /Tiwari and Suneja/Narosa
6. Power plant Technology/ El Wakil/TMH

I Year - I Semester	22PTE08	L	T	P	C
		3	0	0	3

Alternative Fuel Technologies
Elective – II

UNIT I: Fossil fuels and their limitations Engine requirements; Potential alternative liquid and gaseous fuels.

UNIT II: Methods of production; Properties, safety aspects, handling and distribution of various liquid alternative fuels like alcohols, vegetable oils, Di,methyl and Di,ethyl ether etc.

UNIT III: Different ways of using alternative liquid fuels in engines, performance and emission characteristics; Conversion of vegetable oils to their esters and effect on engine performance.

UNIT IV: Use of gaseous fuels like biogas, LPG, hydrogen, natural gas, producer gas etc. in SI/CI engines; Production, storage, distribution and safety aspects of gaseous fuels.

UNIT V: Different approaches like duel fuel combustion and surface ignition to use alternative fuels in engines; Use of additives to improve the performance with alternative fuels; Hybrid power plants and fuel cell.

TEXT BOOK:

1. Alternative Fuels: The Future of Hydrogen, Second Edition, Michael Frank Hordeski, CRC Press

REFERENCES:

1. Alternative Fuels for Transportation, A S Ramadhas, CRC Press

2. Alternative Fuels & Advanced Technology Vehicles: Incentives & Considerations, Thomas Huber,Jack Spera, Nova Science Publishers

I Year - I Semester	22PTE09	L	T	P	C
		3	0	0	3

Gas Turbines
Elective – II

UNIT -I:

INTRODUCTION: Review of the fundamentals, Classification of turbo machines, Applications of gas turbines. GAS TURBINE CYCLES FOR SHAFT POWER: Ideal shaft power cycles and their analysis, Practical shaft power cycles and their analysis.

UNIT -II:

FUNDAMENTALS OF ROTATING MACHINES: Euler's energy equation, Components of energy transfer, Impulse and reaction machines, Degree of reaction, Flow over an airfoil, Lift and drag. CENTRIFUGAL COMPRESSORS: Construction and principle of operation, Factors affecting stage pressure ratio, Compressibility effects, Surging and choking, Performance characteristics.

UNIT- III:

AXIAL FLOW COMPRESSORS: Construction and principle of operation, Factors affecting stage pressure ratio, Degree of reaction, three dimensional flow, Design process, Blade design, Stage performance, Compressibility effects, off, design performance.

UNIT -IV:

GAS TURBINE COMBUSTION SYSTEMS: Operational requirements, Factors affecting combustion chamber design, Combustion process, Flame stabilization, Combustion chamber performance, Practical problems, Gas turbine emissions.

UNIT-V:

AXIAL AND RADIAL FLOW TURBINES: Construction and operation of axial flow turbines, Vortex theory, Estimation of stage performance, Overall turbine performance, Turbine blade cooling, and Radial flow turbines.

TEXT BOOKS:

1. Sarvanamuttoo, H.I.H., Rogers, G. F. C. and Cohen, H., Gas Turbine Theory, 7th Edition, PearsonPrentice Hall, 2017.

2. Ganesan, V., Gas Turbines, 3rd Edition, Tata McGraw Hill, 2017.

REFERENCES

1. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachinery, 7th Edition, Elsevier, 2014.
2. Flack, R.D., Fundamentals of Jet Propulsion with Applications, Cambridge University Press, 2011.

3. Yahya, S. M., Turbines, Compressors and Fans, 4th Edition, Tata McGraw Hill, 2017. Lefebvre, A.H.and Ballal D. R., Gas Turbine Combustion – Alternative Fuels and Emissions, CRC Press, 2010.

I Year - I Semester	22PTE10	L	T	P	C
		3	0	0	3

Energy Conservation and Management
Elective – II

UNIT I:
The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management.

UNIT II:
ENERGY CONSERVATION: Methods of energy conservation and energy efficiency for buildings, air conditioning, heat recovery and thermal energy storage systems Energy conservation in industries, Cogeneration, Combined heating and power systems.

UNIT III:
Energy Management: Principles of Energy Management, Energy demand estimation, Organising and Managing Energy Management Programs, Energy pricing Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries

UNIT IV:
Economic Analysis: Scope, Characterization of an Investment Project

UNIT V:
Relevant international standards and laws.

TEXT BOOK:

1. L.C. Witte, P.S. Schmidt, D.R.Brown, "Industrial Energy Management and Utilization",Hemispherical Publication, 1988.

2. Callaghan "Energy Conservation".

REFERENCES:

1. 1.D.A. Reeg, "Industrial Energy Conservation", Pergamon Press, 1980.
2. T.L. Boyen, "Thermal Energy Recovery" Wiley, 1980
3. L.J. Nagrath, "Systems Modeling and Analysis", Tata McGraw Hill, 1982.
4. W.C. Turner, "Energy Management Handbook ", Wiley, New York, 1982.
5. I.G.C. Dryden, "The Efficient Use of Energy ", Butterworth, London, 1982.
6. R. Loftnen, Van Nostrarid Reinhold C. "Energy Handbook", 1978.
7. TERI Publications. 8. WR Murphy, G McKay "Energy Management"

I Year - I Semester	22PTE11	L	T	P	C
		3	0	0	3

Research Methodology and IPR

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation

Unit 2: Effective literature studies approaches, analysis Plagiarism, and Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 3: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grantsof patents, Patenting under PCT.

Unit 4: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 5: New Developments in IPR: New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students""
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"

Reference Books:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
2. Mayall , "Industrial Design", McGraw Hill, 1992.
3. Niebel , "Product Design", McGraw Hill, 1974.
4. Asimov , "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcomes:

At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today‟s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right tobe promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

I Year - I Semester	22PTE12	L	T	P	C
		3	0	0	3

Computational Fluid Dynamics Lab –I
Elective – II

1. Analysis of Transient state compressible flow through pipes
2. Performance Analysis of Heat Exchanger Device
3. Calibration Performance characteristics of Combustion
4. Estimation of C.O.P for Refrigeration Cycle
5. Analysis of Gas cooled Air-Cooler
6. Performance of Air-Conditioner
7. Thermal Stresses in long cylinder
8. Determination of Insulated Wall Temperature
9. Temperature Gradient across solid Cylinder
10. Radiation Heat Transfer between Concentric Cylinders
11. Solid Liquid Phase Change
12. Thermal Loading on Support structure

I Year - I Semester	22PTE13	L	T	P	C
		3	0	0	3

THERMAL ENGINEERING LAB – I
Elective – II

1. Forced Convection Apparatus: Determination of theoretical, experimental and empirical values of convection heat transfer coefficient for internal forced convection through a circular GI pipe

2. Emissivity Apparatus: Determination of surface emissivity of a given aluminum test plate at a given absolute temperature

3. Heat Pipe Demonstrator: Demonstration of near isothermal characteristic exhibited by a heat pipein comparison to stainless steel and copper pipes

4. Abel's apparatus: Determination of flash and fire points of a given oil sample

5. Redwood Viscometer No. 1: Determination of kinematic and absolute viscosities of an oil sample given

6. Distillation apparatus: Determination of distillation characteristic of a given sample of gasoline

7. Two-Stage Reciprocating Air-Compressor: Determination of volumetric efficiency of thecompressor as a function of receiver pressure

8. Pin-Fin Apparatus: Determination of temperature distribution, efficiency and effectiveness of the fin working in forced convection environment

9. Natural Convection Apparatus: Determination of experimental and empirical values of convection heat transfer coefficient from a Vertical Heated Cylinder losing heat to quiescent air

10. Composite Slab Apparatus: Determination of theoretical end experimental values of equivalent thermal resistance of a composite slab.

I Year - I Semester	22PTE14	L	T	P	C
		2	0	0	2

Research Methodology
Elective – II

UNIT 1:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2:
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 3:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 4:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 5:
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

(1) Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

(2) Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

(3) Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

(4) Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

(5) Mayall, "Industrial Design", McGraw Hill, 1992.

(6) Niebel, "Product Design", McGraw Hill, 1974.

(7) Asimov, "Introduction to Design", Prentice Hall, 1962.

(8) Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016. (9) T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

I Year - II Semester	22PTE15	L	T	P	C
		3	0	0	3

Advanced Heat and Mass Transfer

UNIT 1:

BRIEF INTRODUCTION TO DIFFERENT MODES OF HEAT TRANSFER: Conduction: General heat

Conduction equation, initial and boundary conditions. Transient heat conduction: Lumped system analysis, Heisler charts, semi-infinite solid,use of shape factors in conduction,2D transient heat conduction, product solutions.

UNIT 2:

FINITE DIFFERENCE METHODS FOR CONDUCTION: ID & 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, ntegral analysis.

UNIT 3:

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 geometries 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.

UNIT 4:

FREE CONVECTION: Approximate analysis on laminar free convective heat transfer, boussinesque approximation, different geometries, and combined free and forced convection. BOILING AND CONDENSATION: Boiling curve, correlations, Nusselts theory of film condensation on a vertical plate, assumptions & correlations of film condensation for different geometries. HEAT EXCHANGERS Types of Heat Exchangers, LMTD and NTU methods

UNIT 5:

RADIATION HEAT TRANSFER: Radiant heat exchange in grey, non, grey bodies, with transmitting, Reflecting and absorbing media, specular surfaces, gas radiation, from flames. MASS TRANSFER: Concepts of mass transfer, diffusion & convective mass transfer analogies, significance of non- dimensional numbers.

TEXT BOOKS:

1. Principles of Heat Transfer / Frank Kreith / Cengage Learning
2. Heat Transfer / Necati Ozisik / TMH

REFERENCES:

1. Fundamentals of Heat and Mass Transfer,5 th Ed. / Frank P. Incropera/John Wiley

2. Elements of Heat Transfer/E. Radha Krishna/CRC Press/2012
3. Introduction to Heat Transfer/SK Som/PHI
4. Heat Transfer / Nellis& Klein / Cambridge University Press / 2012.
5. Heat Transfer/ P.S. Ghoshdastidar/ Oxford Press
6. Engg. Heat & Mass Transfer/ Sarat K. Das/DhanpatRai
7. Heat Transfer/ P.K.Nag /TMH 8. Heat Transfer / J.P Holman/MGH

I Year - II Semester	22PTE16	L	T	P	C
		3	0	0	3

Advanced Power Plant Engineering

UNIT 1:

Introduction to the sources of energy – resources and development of power in India. STEAM POWER PLANT: Plant layout, working of different circuits, fuel handling equipment's, types of coals, coal handling, and choice of handling equipment, coal storage, and ash handling systems. Combustion: properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT 2:

GAS TURBINE PLANT: Introduction – classification, construction – layout with auxiliaries, combined cycle power plants and comparison. Cogeneration of Power and Process heat. Waste heat recovery systems. HYDRO PROJECTS AND PLANT: Classification – typical layouts – plant auxiliaries – plant operation pumped storage plants.

UNIT 3:

NUCLEAR POWER STATION: Nuclear fuel – breeding and fertile materials – nuclear reactor – reactor operation. TYPES OF REACTORS: Pressurized water reactor, boiling water reactor, sodium,graphite reactor, fast breeder reactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding – radioactive waste disposal.

UNIT 4:

COMBINED OPERATIONS OF DIFFERENT POWER PLANTS: Introduction, advantages of combined working, load division between power stations, storage type hydroelectric plant in combination with steam plant, run,of,river plant in combination with steam plant, pump storage plant in combination with steam or nuclear power plant, coordination of hydroelectric and gas turbine stations, coordination of hydroelectric and nuclear power stations, coordination of different types of power plants. POWER PLANT INSTRUMENTATION AND CONTROL: Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O2 and CO2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit, nuclear measurements.

UNIT 4:

POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS: Capital cost, investment of

fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – methods of pollution control.

TEXT BOOKS:

1. A course in Power Plant Engineering /Arora and Domkundwar/Dhanpatrai & Co.

2. Power Plant Engineering /P.C.Sharma / S.K.Kataria Pub

REFERENCES:

1. Power Plant Engineering: P.K.Nag/ II Edition /TMH.

2. Power station Engineering – ElWakil / McGrawHill.

3. An Introduction to Power Plant Technology / G.D. Rai/Khanna Publishers

I Year - II Semester	22PTE17	L	T	P	C
		3	0	0	3

THERMAL MEASUREMENTS AND PROCESS CONTROLS

UNIT 1:

GENERAL CONCEPTS: Fundamental elements of a measuring instruments. Static and dynamic characteristics – errors in instruments – Different methods of measurement and their analysis – Sensing elements and transducers. Measurement of pressure – principles of pressure measurement, static and dynamic pressure, vacuum and high pressure measurement – Measurement of low pressure, Manometers, Calibration methods, Dynamic characteristics, design principles.

UNIT 2:

MEASUREMENT OF FLOW: Obstruction meters, variable area meters, Pressure probes, compressible fluid flow measurement, Thermal anemometers, calibration of flow measuring instruments. Introduction to design of flow measuring instruments.

UNIT 3:

TEMPERATURE MEASUREMENT: Different principles of Temperature Measurement, use of bimetallic thermometers – Mercury thermometers, Vapor Pressure thermometers, Thermo positive elements, thermocouples in series & parallel, pyrometry, measurement of heat flux, calibration of temperature measuring instruments. Design of temperature measuring instruments. MEASURMENT OF: Velocity, moisture content, humidity and thermal conductivity.

UNIT 4:

VOLTAGE INDICATING, RECORDING AND DATA ACQUISITION SYSTEMS:
Standards and calibration, analog volt meters and potentiometers. Electrical instruments. Digital Voltmeters and multimeters. Signal generation. Electro mechanical servo type XT and XY recorders. Thermal array recorders and data acquisition systems. Analog and digital CROs. Displays and liquid crystals flat panel displays. Displays. Virtual instruments. Magnetic tape and disk recorders/reproducers. Fiber optic sensors.

UNIT 5:

PROCESS CONTROL: Introduction and need for process control principles, transfer functions, block diagrams, signal flow graphs, open and closed loop control systems – Analysis of First & Second order systems with examples of mechanical and thermal systems. Control System Evaluation –Stability, steady state regulations, and transient regulations.

TEXT BOOK:

1. Measurement System, Application & Design – E.O. Doeblin, MGH

REFERENCES:

1. Mechanical and Industrial Measurements – R.K. Jain – Khanna Publishers.
2. Mechanical Measurements – Buck & Beckwith – Pearson.

I Year - II Semester	22PTE18	L	T	P	C
		3	0	0	3

Combustion, Emissions and Environment

UNIT 1:

PRINCIPLES OF COMBUSTION: Chemical composition, Flue gas analysis, dew point of products, Combustion stoichiometry, Chemical kinetics, Rate of reaction, Reaction order, Molecularity, Zeroth, first, second and third order reactions, complex reactions, chain reactions, Theories of reaction Kinetics, General oxidation behaviour of HCs.

UNIT 2:

THERMODYNAMICS OF COMBUSTION: Enthalpy of formation, heating value of fuel, Adiabatic flameTemperature, Equilibrium composition of gaseous mixtures.

UNIT 3:

LAMINAR AND TURBULENT FLAMES PROPAGATION AND STRUCTURE: Flame stability, burning velocity of fuels, Measurement of burning velocity, factors affecting the Burning velocity. Combustion of fuel droplets and sprays, Combustion systems, Pulverized fuel furnaces- fixed, entrained and fluidized bed systems.

UNIT 4:

POLLUTION FORMATION MEASUREMENT AND CONTROL: Causes for Formation of NOx, SOx, COx, Smoke and UBHC. Different methods of measurement of pollutants. Methods of controlling the formation of pollutants, BHARAT and EURO standards of emissions.

UNIT 5:

ENVIRONMENTAL CONSIDERATIONS: Air pollution, effects on environment, human health etc.Principal pollutants, Legislative measures, methods of emission control.

TEXT BOOK:

1. Fuels and combustion, Sharma and Chandra Mohan, Tata McGraw Hill, 1984..

REFERENCES:

1. Combustion Fundamentals , Roger A strehlow , McGraw Hill.

2. Combustion Engineering and Fuel Technology , Shaha A.K., Oxford and IBH.

3. Principles of Combustion , KannethK.Kuo, Wiley and Sons.

4. Combustion , Samir Sarkar , Mc. Graw Hill, 2009.

5. An Introduction to Combustion , Stephen R. Turns, Mc. Graw Hill International Edition.

6. Combustion Engineering , Gary L. Berman & Kenneth W. Ragland, Mc. Graw Hill InternationalEdition 2009

I Year - II Semester	22PTE19	L	T	P	C
		3	0	0	3

Advanced Automobile Engg.
Program Elective – III

UNIT 1:

INTRODUCTION: Overview of the course, Examination and Evaluation patterns, History of Automobiles, Classification of Automobiles. POWER PLANT: Classification, Engine Terminology, Types of Cycles, working principle of and IC engine, advanced classification of Engines, Multi cylinder engines, Engine balance, firing order.

UNIT 2:

FUEL SYSTEM, IGNITION SYSTEM AND ELECTRICAL SYSTEM: spark Ignition engines, Fuel tank, fuel filter, fuel pump, air cleaner/filter, carburetor, direct injection of petrol engines. Compression Ignition engines, Fuel Injection System, air & solid injection system, Pressure charging of engines, super charging and turbo charging, Components of Ignition systems, battery ignition system, magneto ignition system, electronic ignition and ignition timing. Main electrical circuits, generating& stating circuit, lighting system, indicating devices, warning lights, speedometer.

UNIT 3:

LUBRICATING SYSTEMS AND COOLING SYSTEMS: Functions & properties of lubricants, methods of lubrication, splash type, pressure type, dry sump, and wet sump & mist lubrication. Oil filters, oil pumps, oil coolers. Characteristics of an effective cooling system, types of cooling system, radiator, thermostat, air cooling & water cooling.

TRANSMISSION, AXLES, CLUTCHES, PROPELLER SHAFTS AND DIFFERENTIAL: Types of gear boxes, functions and types of front and rear axles, types and functions, components of the clutches, fluid couplings, design considerations of Hotchkiss drive torque tube drive, function and parts of differential and traction control.

UNIT 4:

STEERING SYSTEM: Functions of steering mechanism, steering gear box types, and wheel geometry. Braking and suspension system: Functions and types of brakes, operation and principle of brakes, constructional and operational classification and parking brake. Types of springs shock observers, objectives and types of suspension system, rear axle's suspension, electronic control and proactive suspension system.

WHEELS AND TYRES: Wheel quality, assembly, types of wheels, wheel rims, construction of tyres and tyre specifications.

UNIT 5: AUTOMATION IN AUTOMOBILES: Sensors and actuators, electronic fuel injection system, electronic management system, automatic transmission, electronic transmission control, Antilock Braking System (ABS).

TEXT BOOKS:

1. Joseph Heitner, Automotive Mechanics, CBS publications,2017.
2. Srinivasan. S, Automotive Mechanics, 2nd Edition, Tata McGraw,Hill, 2003

REFERENCES:

1. Crouse and Anglin, Automotive Mechanism, 9th Edition. Tata McGraw,Hill, 2003.
2.Jack Erjavec, A Systems Approach to Automotive Technology, Cengage Learning Pub.2009

I Year - II Semester	22PTE20	L	T	P	C
		3	0	0	3

Thermal and Nuclear Power Plants
Program Elective – III

UNIT 1:

INTRODUCTION: Sources of energy, Type of Power plants. Direct energy conversion system, Energy sources in India, Recent developments in power generation, Combustion of coal, Volumetric analysis, Gravimetric analysis, Fuel gas analysis. Steam power plant: Introduction. General layout of steam power plant, Modern coal fired Steam power plant. Power plant cycle, Fuel Handling, Combustion equipment, Ash handling, Dust collectors.

UNIT 2:

GAS TURBINE POWER PLANT: Cogeneration. Combined cycle power plant, Analysis, Waste heat recovery, IGCC power plant, Fluidized bed, Combustion, Advantages, Disadvantages

UNIT 3:

NUCLEAR POWER PLANT: Nuclear physics, Nuclear Reactor, Classification, Types of reactors, Site selection. Method of enriching uranium. Application of nuclear power plant. Nuclear Power Plant Safety: Bi-Product of nuclear power generation, Economics of nuclear power plant, Nuclear power plant in India, Future of nuclear power.

UNIT 4:

ECONOMICS OF POWER GENERATION: Factors affecting the economics, Loading factors, Utilization factor, Performance and operating characteristics of power plant, Point economic load sharing, Depreciation. Energy rate, Criteria for optimum loading. Specific economic energy problem

UNIT 5:

POWER PLANT INSTRUMENTATIONS: Classification, Pressure measuring instrument, Temperature measurement and Flow Measurement, Analysis of combustion gases, Pollution, types, Methods of control.

TEXT BOOKS:

1. Nuclear Power Plant Engineering/ James H. Rust/Haralson Publishing Company.
2. Powr Plant Technology / Mohamed Mohamed El-Wakil /Tata McGraw Hill
3. Thermal Engineering in Power Systems/R.S Amano, B. Sunden/WIT Press

REFERENCES:

1. Power Plant Engineering / P.K.Nag / TMH
2. Power Plant Engineering / R.K.Rajput/ Lakshmi Publications.
3. Power Plant Engineering / P.C.Sharma/ Kotearia Publications.
4. Power Plant Technology / Wakil.

I Year - II Semester	22PTE21	L	T	P	C
		3	0	0	3

Jet Propulsion and Rocket Engineering
Program Elective – IV

UNIT 1:

TURBO JET PROPULSION SYSTEMS: Gas turbine cycle analysis, layout of turbo jet engine. Turbo machinery, compressors and turbines, combustor, blade aerodynamics, engine off design performance analysis. Flight Performance: Forces acting on vehicle, Basic relations of motion, multi stage vehicles.

UNIT 2:

PRINCIPLES OF JET PROPULSION AND ROCKETRY: Fundamentals of jet propulsion, Rockets and air breathing jet engines, Classification, turbo jet , turbo fan, turbo prop, rocket (Solid and Liquid propellant rockets) and Ramjet engines. Nozzle Theory and Characteristics Parameters: Theory of one dimensional convergent, divergent nozzles, aerodynamic choking of nozzles and mass flow through a nozzle, nozzle exhaust velocity, thrust, thrust coefficient, Ac / At of a nozzle, Supersonic nozzle shape, non, adapted nozzles, Summerfield criteria, departure from simple analysis, characteristic parameters,1) characteristic velocity, 2) specific impulse 3) total impulse 4) relationship between the characteristic parameters 5) nozzle efficiency, combustion efficiency and overall efficiency.

UNIT 3:

AERO THERMO CHEMISTRY OF THE COMBUSTION PRODUCTS: Review of properties of mixture of gases, Gibbs, Dalton laws, Equivalent ratio, enthalpy changes in reactions, heat of reaction and heat of formation, calculation of adiabatic flame temperature and specific impulse, frozen and equilibrium flows. Solid Propulsion System: Solid propellants, classification, homogeneous and heterogeneous propellants, double base propellant compositions and manufacturing methods. Composite propellant oxidizers and binders. Effect of binder on propellant properties. Burning rate and burning rate laws, factors influencing the burning rate, methods of determining burning rates.

UNIT 4:

SOLID PROPELLANT ROCKET ENGINE: Internal ballistics, equilibrium motor operation and equilibrium pressure to various parameters. Transient and pseudo equilibrium operation, end burning and burning grains, grain design. Rocket motor hard ware design. Heat transfer considerations in solid rocket motor design. Ignition system, simple pyro devices.

Liquid Rocket Propulsion System: Liquid propellants, classification, Mono and Bi propellants, Cryogenic and storage propellants, ignition delay of hypergolic propellants, physical and chemical characteristics of liquid propellant. Liquid propellant rocket engine, system layout, pump and pressure feed systems, feed system components. Design of combustion chamber, characteristic length, constructional features, and chamber wall stresses. Heat transfer and cooling aspects. Uncooled engines, injectors, various types, injection patterns, injector characteristics, and atomization and drop size distribution, propellant tank design.

UNIT 5:

RAMJET AND INTEGRAL ROCKET RAMJET PROPULSION SYSTEM: Fuel rich solid propellants, gross thrust, gross thrust coefficient, combustion efficiency of ramjet engine, air intakes and their classification, critical, super critical and sub, critical operation of air intakes, engine intake matching, classification and comparison of Integral Rocket Ramjet (IRR) propulsion systems.

TEXT BOOKS:

1. Mechanics and Dynamics of Propulsion/ Hill and Peterson/John Wiley & Sons
2. Rocket propulsion elements/Sutton/John Wiley & Sons/8th Edition

REFERENCES:

1. Gas Turbines/Ganesan /TMH
2. Gas Turbines & Propulsive Systems / Khajuria & Dubey / Dhanpat Rai& Sons
3. Rocket propulsion/Bevere/ 4. Jet propulsion /Nicholas Cumpsty/University of Cambridge

I Year - II Semester	22PTE22	L	T	P	C
		3	0	0	3

Modeling of I.C engines
Program Elective – IV

UNIT 1:

FUNDAMENTALS: Governing equations, Equilibrium charts of combustion chemistry, chemical reaction rates, and approaches of modeling, model building and integration methods, gas exchange through valves, engine and porting geometry, exhaust gas recirculation, valve lift curves.

UNIT 2:

THERMODYNAMIC COMBUSTION MODELS OF CI ENGINES: Single zone models, premixed and diffusive combustion models, combustion heat release using wiebe function, wall heat transfer correlations, ignition delay, internal energy estimations, two zone model, application of heat release analysis.

UNIT 3:

FUEL SPRAY BEHAVIOR: Fuel injection, spray structure, fuel atomization, droplet turbulence interactions, droplet impingement on walls. UNIT - IV: MODELING OF CHARGING SYSTEM: Constant pressure and pulse turbo charging, compressor and turbine maps, charge air cooler.

UNIT 4:

MATHEMATICAL MODELS OF SI ENGINES: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Autoignition modeling, single zone models, mass burning rate estimation, SI Engine with stratified charge. Friction in pumping, piston assembly, bearings and valve train etc. friction estimation for warm and warm up engines

REFERENCES:

1. Haywood, "I.C. Engines", Mc Graw Hill.
2. Ramos J (1989) Internal Combustion Engine Modeling. Hemisphere Publishing Company
3. C. D. Rakopoulos and E. G. Giakoumis, "Diesel Engine Transient
4. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill, New Delhi, 1996.
5. P.A. Lakshminarayanan and Y. V. Aghav, " Modelling Diesel Combustion" Springer, 2010
6. Bernard Challen and Rodica Baranescu, "Diesel Engine Reference Book" Butterworth Heinemann,1999.

I Year - II Semester	22PTE23	L	T	P	C
		3	0	0	3

Renewable Energy Technologies
Program Elective – IV

UNIT 1:

INTRODUCTION: Energy Scenario, Survey of energy resources. Classification and need for conventional energy resources. SOLAR ENERGY: Sun, Earth relationship, Basic matter to waste heat energy circuit, Solar Radiation, Attention, Radiation measuring instruments. SOLAR ENERGY APPLICATIONS: Solar water heating. Space heating, Active and passive heating. Energy storage. Selective surface. Solar stills and ponds, solar refrigeration, Photovoltaic generation.

UNIT 2:

GEOTHERMAL ENERGY: Structure of earth, Geothermal Regions, Hot springs. Hot Rocks, Hot Aquifers. Analytical methods to estimate thermal potential. Harnessing techniques, Electricity generating systems.

UNIT 3:

DIRECT ENERGY CONVERSION: Nuclear Fusion, Fusion, Fusion reaction, P,P cycle, Carbon cycle, Deuterium cycle, Condition for controlled fusion, Fuel cells and photovoltaic. Thermionic & thermoelectric generation, MHD generator. HYDROGEN GAS AS FUEL: Production methods, Properties, I.C. Engine applications, Utilization strategy, Performance.

UNIT 4:

BIO, ENERGY: Biomass energy sources. Plant productivity, Biomass wastes, aerobic and anaerobic bioconversion processes, Raw material and properties of biogas, Biogas plant technology and status, the energetic and economics of biomass systems, Biomass gasification

UNIT 5:

WIND ENERGY: Wind, Beaufort number, Characteristics, Wind energy conversion systems, Types, Betz model. Interference factor. Power coefficient, Torque coefficient and Thrust coefficient, Lift machines and Drag machines. Matching, Electricity generation. ENERGY FROM OCEANS: Tidal energy, Tides, Diurnal and semidiurnal nature, Power from tides, Wave Energy, Waves, Theoretical energy available. Calculation of period and phase velocity of waves, Wave power systems, submerged devices. Ocean thermal Energy, Principles, Heat exchangers, Pumping requirements, Practical considerations.

TEXT BOOK:

1. Renewable Energy Resources/ John Twidell& Tony Weir/Taylor & Francis/2nd edition

REFERENCES:

1. Renewable Energy Resources, Basic Principles and Applications/ G.N.Tiwari and M.K.Ghosal/Narosa Publications
2. Biological Energy Resources/ Malcolm Fleischer & Chris Lawis/ E&FN Spon 3. Renewable EnergySources / G.D Rai /Khanna Publishers

I Year - II Semester	22PTE24	L	T	P	C
		3	0	0	3

Turbo Machines
Program Elective – IV

UNIT 1:

FUNDAMENTALS OF TURBO MACHINES: Classifications, Applications, Thermodynamic analysis, isentropic flow. Energy transfer. Efficiencies, Static and Stagnation conditions, Continuity equations, Euler's flow through variable cross sectional areas, unsteady flow in turbo machines

UNIT 2:

STEAM NOZZLES: Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure of analysis. Designs of nozzles. Steam Turbines: Impulse turbines, Compounding, Work done and Velocity triangle, Efficiencies, Constant reactions, Blading, Design of blade passages, Angle and height, Secondary flow. Leakage losses, Thermodynamic analysis of steam turbines.

UNIT 3:

GAS DYNAMICS: Fundamental thermodynamic concepts, isentropic conditions, mach numbers and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory. Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuserand pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach numbers, Pre whirl, Performance

UNIT 4:

AXIAL FLOW COMPRESSORS: Flow Analysis, Work and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance Cascade Analysis: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT 5:

AXIAL FLOW GAS TURBINES: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

TEXTBOOK:

1. Principles of Turbo Machines/DG Shepherd / Macmillan

REFERENCES:

1. Fundamentals of Turbomachinery/William W Perg/John Wiley & Sons
2. Element of Gas Dynamics/Yahya/TMH

3. Principles of Jet Propulsion and Gas Turbine/NJ Zucrow/John Wiley & Sons/Newyork
4. Turbines, Pumps, Compressors/Yahya/TMH
5. Theory and practice of Steam Turbines/ WJ Kearton/ELBS Pitman/London
6. Element of Gas Dynamics/Liepeman and Roshkow/ Dover Publications

I Year - II Semester	22PTE25	L	T	P	C
		0	0	3	2

Computational Fluid Dynamics Lab –II
Program Elective – IV

1. Static Structural Analysis of a Rectangular Plate with Circular hole
2. Steady State Analysis of a Composite Slab
3. Analysis of Laminar flow in a 3D Circular Pipe
4. Analysis of Pressure and Velocity in a Convergent Divergent Nozzle
5. Study of Variation of various losses in a Sudden contraction in pipes
6. External flow analysis of a Cylinder
7. 3 D analysis of a Rectangular Duct
8. Internal Flow 3D analysis
9. Study of Variation of various parameters in a Rotor
10. Study of Variation of various parameters in a Rotary Compressor
11. Transient State Analysis of a Sphere 12. Analysis of Orifice in a Cylinder

I Year - II Semester	22PTE26	L	T	P	C
		0	0	3	2

THERMAL ENGINEERING LAB – II

1. Single-Cylinder Kirloskar CI Diesel Engine: Constant Speed Performance Test on Single-CylinderKirloskar CI Diesel Engine.
2. Single-Cylinder Kirloskar CI Diesel Engine: Motoring Test on Single-Cylinder Kirloskar CI DieselEngine.
3. Single-Cylinder Kirloskar CI Diesel Engine: Retardation Test on Single-Cylinder Kirloskar CI DieselEngine.
4. Lister and Textool IC Engines: Valve and Port Timing Diagrams on 4-stroke and 2- stroke ICEngines.
5. Hindustan Petrol Engine: Morse Test on 4-Cylinder Hindustan Petrol Engine.
6. Perkins CI Diesel Engine: Morse Test on 4-Cylnder Perkins CI Diesel Engine.
7. MPFI Petrol Engine: Performance Test on MPFI Petrol Engine.
8. Bio Gas-Diesel operated Twin-Cylinder Kirloskar CI Diesel Engine: Performance Test on Bio Gas-Diesel operated Twin-Cylinder Kirloskar CI Diesel Engine.
9. Axial Flow Fan: Constant Speed Performance Test on Axial Flow Fan.
10. Centrifugal Blower: Constant Speed Performance Test on a Centrifugal Blower.
11. Solar Energy Simulator: Perform tests on solar energy simulator
12. PV Cell: Conduct test to findout efficiency and to find VI characteristics when conned in series and Parallel.

I Year - II Semester	22PTE27	L	T	P	C
		2	0	0	2

Mini Project with Seminar

II Year –I Sem	22PTE29	L	T	P	C
		3	0	0	3

OPTMIZATION TECHNIQUES & APPLICATIONS

UNIT-I

SINGLE VARIABLE NON, LINEAR UNCONSTRAINED OPTIMIZATION: One dimensionalOptimizationmethods:,Uni,modalfunction,eliminationmethods,Fibonaccimethod,goldensectionmethod,interpolation methods,quadratic&cubicinterpolationmethods.

UNIT-II

MULTIVARIABLE NON, LINEAR UNCONSTRAINED OPTIMIZATION: Directsearch method, Univariant method , pattern search methods,Powell's, Hook ,Jeeves, Rosenbrock searchmethods,gradientmethods,gradientoffunction,steepestdecentmethod,FletcherReevesmethod,variable metric method.

UNIT-III

LINEAR PROGRAMMING: Formulation, Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Duality, importance of duality, solution of primal from dual.

UNIT-IV

NON TRADITIONAL OPTIMIZATION ALGORITHMS: Genetics Algorithm, Working Principles, Similarities and Differences between Genetic Algorithm &Traditional Methods. Simulated Annealing, Working Principle, Simple Problems.

UNIT-V

APPLICATIONS TO THERMAL SYSTEMS: Optimal design of heat exchangers, condensers, evaporator and IC Engines.

TEXTBOOKS:

1. Optimizationtheory&Applications/S.S.Rao/NewAge International.
2. OptimizationforEngineeringDesign,KalyanmoyDeb,PHI

REFERENCEBOOKS:

1. S.D.Sharma/OperationsResearch
2. OptimizationTechniques/Benugundu&Chandraputla/PearsonAsia.
3. DesignofThermalSystems/W.FStoecker/Mc GrawHillEducation

II Year –I Sem	22PTE30	L	T	P	C
		3	0	0	3

DESIGN AND ANALYSIS OF EXPERIMENTS

UNIT-I

STRATEGY OF EXPERIMENTATION: Guidelines for designing experiments, sampling andsampling distributions, hypothesis testing, choice of sample size. Experiments with single factor**:**Analysis of variance, analysis of the fixed effects model, model adequacy checking, samplecomputeroutput, regression approach to theanalysisof variance.

UNIT-II

FACTORIALDESIGNS: Principles, advantage of factorials,two-factorfactorialdesign,general factorial design, fitting response curves and surfaces.2^k factorial design: 2^2 design, 2^3design,General 2^kdesign, singlereplicate of2^kdesign.

UNIT-III

TWO-LEVEL FRACTIONAL FACTORIAL DESIGNS: one-half fraction of 2^K design, one-quarter fraction of 2^K design, blocking replicated 2^K factorial design, confounding in 2^K factorialdesign. Three-level and mixed-level factorial design: 3^K factorial design, confounding in 3^Kfactorialdesign,fractionalreplication of3^K factorial design,factorialswithmixedlevels.

UNIT-IV

REGRESSION MODELS: Linear regression models, estimation of the parameters, hypothesistesting in multiple regression, confidence intervals in multiple regression, prediction of newresponseobservations, regression model diagnostics.

UNIT-V

RESPONSESURFACEMETHODS: Introduction,methodofsteepestascent,analysisofsecond-orderresponse surface,experimental designs forfittingresponse surfaces.

TEXTBOOK:

1.D.C.Montgomery,"DesignandAnalysisofExperiments",5thedition,JohnWileyandsons,2009.

REFERENCES:

1. D.C.Montgomery,"IntroductiontoStatisticalQualityControl",4thedition,JohnWileyandsons, 2001.
2. AngelaDeanandDanielVoss,"Designand AnalysisofExperiments",Springer,1999

II Year –I Sem	22PTE31	L	T	P	C
		3	0	0	3

CONVECTIVE HEAT TRANSFER

UNIT-I:

Introduction to free, forced combined convection,convective heat transfer coefficient,Applicationofdimensionalanalysis toconvection,Physicalinterpretation ofdimensionlessnumbers.

EquationsofConvectiveHeatTransfer: Continuity,Navier,Strokesequation&energyequationforsteadystate flows,similarity,Equationsforturbulentconvectiveheattransfer,Boundarylayerequationsforlaminar,turbulent flows,Boundarylayerintegralequations.

UNIT-II:

EXTERNAL LAMINAR FORCED CONVECTION: Similarity solution for flow over anisothermal plate,integral equation solutions,Numerical solutions,Viscous dissipation effects onflowover a flat plate.

ExternalTurbulentFlows: Analogysolutionsforboundarylayerflows,Integralequationsolutions,Effectsof dissipation on flowover a flatplate.

Internal Laminar Flows: Fully developed laminar flow in pipe, plane duct & ducts with othercross,sectional shapes,Pipe flow & plane duct flow with developing temperature field,Pipe flows&planeduct flow with developing velocity &temperaturefields.

InternalTurbulentFlows: Analogysolutionsforfullydevelopedpipeflow– Thermallydevelopingpipe & plane duct flow.

UNIT-III:

NATURALCONVECTION: Boussineqapproximation,Governingequations,Similarity,Boundarylayerequ ationsforfreeconvectivelaminarflows,Numericalsolutionofboundarylayerequations.FreeConvectiveflowsth roughaverticalchannelacrossarectangularenclosure,Horizontalenclosure,Turbulent natural convection.

UNIT-IV:

COMBINEDCONVECTION: Governingparameters&equations,laminarboundarylayerflow over an isothermal vertical plate,combined convection over a horizontal plate,correlationsfor mixed convection,effect of boundary forces on turbulent flows,internal flows , internal mixedconvective flows,Fully developed mixed convective flow in a vertical plane channel & in ahorizontalduct.

UNIT-V:

CONVECTIVEHEATTRANSFERTHROUGHPOROUSMEDIA: Areaweighted velocity,Darcyflowmodel,energyequation,boundarylayersolutionsfor2,Dforcedconvection,Fullydeveloped ductflow,Naturalconvectioninporousmedia,filledenclosures,stabilityof horizontal porous layers.

TEXTBOOK:

1.ConvectiveHeat&MassTransfer/Kays&Crawford/TMH

REFERENCES:

1. IntroductiontoConvectiveHeatTransferAnalysis/PatrickH.Oosthuigen&DavidNaylor,MGH.
2. ConvectionHeatTransfer/AdrianBejan/Wiley
3. PrinciplesofConvectiveHeatTransfer/Kaviany,Massoud/Springer

II Year –I Sem	22PTE32	L	T	P	C
		3	0	0	3

WASTE TO ENERGY

UNIT-I

INTRODUCTIONTOENERGYFROMWASTE: Classificationofwasteasfuel,Agrobased,Foret residue,Industrialwaste,MSW,Conversiondevices,Incinerators,gasifiers,digestors

UNIT-II

BIOMASSPYROLYSIS:

Pyrolysis,Types,slowfast,Manufactureofcharcoal,MethodsYieldsandapplication,Manufactureofpyr olyticoilsand gases,yieldsandapplications.

UNIT-III

BIOMASS GASIFICATION: Gasifiers, Fixed bed system, Downdraft and updraft gasifier–Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement forthermalheating,gasifierenginearrangementandelectricalpowerEquilibriumandkineticconsiderationin gasifieroperation.

UNIT-IV

BIOMASS COMBUSTION: Biomass stoves, Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design,constructionand operation,Operation ofall theabovebiomass combustors.

UNIT-V

BIOGAS: Properties of biogas (Calorific value and composition) , Biogas plant technology andstatus , Bio energy system , Design and constructional features , Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion,Direct combustion ,biomass gasification,pyrolysisandliquefaction,biochemicalconversion,anaerobicdigestion ,TypesofbiogasPlants,Applications,Alcoholproductionfrombiomass, Biodieselproduction ,Urbanwastetoenergyconversion,Biomassenergyprogrammedin India.

TEXTBOOKS:

1. BiogasTechnology,APracticalHandBook,Khandelwal,K.C.andMahdi,S.S.,Vol.I&II,Tata McGraw Hill Publishing Co. Ltd., 1983.
2. BiomassConversionandTechnology,C.Y.WereKo-BrobbyandE.B.Hagan,JohnWiley&Sons, 1996.

REFERENCES:

1. NonConventionalEnergy, Desai,AshokV.,WileyEastern Ltd.,1990.
2. Food,FeedandFuelfromBiomass, Challal,D.S.,IBHPublishing Co.Pvt.Ltd.,1991.

II Year –I Sem	22PTE33	L	T	P	C
		3	0	0	3

ADVANCED FINITE ELEMENTS METHODS

UNIT– I

FORMULATION TECHNIQUES: Methodology, Engineering problems and governingdifferential equations, finite elements., Variational methods-potential energy method, RaleighRitz method, strong and weak forms, Galerkin and weighted residual methods, calculus ofvariations,Essential andnatural boundaryconditions.

UNIT– II

ONE-DIMENSIONALELEMENTS: Bar,trusses,beamsandframes,displacements,stressesandtemperatureeffects.

UNIT– III

TWO DIMENSIONAL PROBLEMS: CST, LST, four nodded and eight nodded rectangularelements,Lagrangebasisfortrianglesandrectangles, serendipityinterpolationfunctions.
AxisymmetricProblems:Axisymmetricformulations,Elementmatrices,boundaryconditions.
Heat Transfer problems: Conduction and convection, examples: - two-dimensionalfin.

UNIT– IV

ISOPARAMETRICFORMULATION: Concepts,subparametric,superparametricelements,numericalintegration,Requirements forconvergence,h-refinementandp-refinement, completeandincompleteinterpolationfunctions,Pascal'striangle,Patchtest.

UNIT– V

FINITE ELEMENTS IN STRUCTURAL ANALYSIS: Static and dynamic analysis, eigenvalueproblems, andtheirsolutionmethods,casestudiesusingcommercialfiniteelementpackages.

TEXTBOOK:

1.Finiteelementmethods byChandrubatla&Belagondu.

REFERENCES:

1. J.N.Reddy,FiniteelementmethodinHeattransferandfluiddynamics,CRCpress,1994
2. ZienckiwiczO.C. &R. L.Taylor, FiniteElement Method,McGraw-Hill,1983.
3. K.J.Bathe,Finiteelementprocedures,Prentice-Hall,1996

II Year –I Sem		L	T	P	C
		3	0	0	3
OPENELECTIVE					

Students are advised to opt for an open elective course of their choice being offered by other departments of institute

(OR)

MOOCS/NPTEL Certification courses duly approved by the department

M. Tech –III Sem	22PTE37	L	T	P	C
		0	0	20	10
DESRTATION PHASE– I					
M. Tech –IV Sem	22PTE38	L	T	P	C
		0	0	32	16
DESRTATION PHASE–II					