S Y L L A B U S

MASTER OF TECHNOLOGY

TWO YEAR INTERGRATED COURSE

M. Tech. Examination, 2009/2010
Mechanical Engineering- (Thermal Engineering)

JODHPUR NATIONAL UNIVERSITY
JODHPUR

JODHPUR NATIONAL UNIVERSITY

Faculty of Engineering & Technology
M. Tech. Programme

GENERAL INFORMATION FOR STUDENTS

[A] ELIGIBILITY FOR ADMISSION

1. **(a)** Candidates who have passed B.E. in 'Electronics / Electronics & Comm. Engg. / Electronics & Instrumentation Engineering' with at least 55% marks in aggregate from any recognized University or Institute recognized as equivalent may be eligible for admission to "**M.Tech. Programme in Digital Communication**".
   (b) Candidates who have passed B.E. in any of the branches 'Computer Science Engineering / Information Technology' with at least 55% marks in aggregate may be eligible for admission to **"M.Tech. in Computer Science & Engineering."**
   Candidates who have obtained M.Sc. (Computer Science)/MCA degree with at least 60% aggregate marks from any recognized University or Institute recognized as equivalent may be admitted to "M.Tech.in Computer Science & Engineering." Provided the candidates passes the deficiency papers (additional papers offered by the department).
   (c) Candidates who have passed B.E. in 'Civil Engineering/Construction Engineering/Architecture.' with at least 55% marks in aggregate from any recognized University or Institute recognized as equivalent may be eligible for admission to "**M.Tech. Programme in Transportation Engineering / Geotechnical Engineering/Structural Engineering**".
   (d) Candidates who have passed B.E. in 'Mechanical Engineering' with at least 55% marks in aggregate from any recognized University or Institute recognized as equivalent may be eligible for admission to "**M.Tech. Programme in Thermal Engineering**".
   (e) Candidates who have passed B.E. in 'Electrical Engineering' with at least 55% marks in aggregate from any recognized University or Institute recognized as equivalent may be eligible for admission to "**M.Tech. Programme in Electrical Engineering (Power system)**".
   (f) In general, the candidates who have passed B.E. in Computer Science Engineering/Electrical Engineering/ Electronics & Communication Engineering/Information Technology/ Mechanical Engineering/Civil Engineering with at least 55% marks in aggregate from any recognized university or institute recognized as equivalent may be eligible for admission to **M.Tech. Programme in the subject of his B.E./B.Tech.**
2. Candidates who have passed the section 'A' & 'B' examinations of the Institution of Engineers (India) shall be eligible apply for admission to the M.Tech Courses in respective branch of Engineering.
3. On admission, candidate may be required to offer and pass additional courses to make up the deficiency, if any.
4. For the admission to *M.Tech. Programme* candidate shall be screened and/or interviewed by the selection committee constituted under the chairmanship of concerned Head Of the Department.
5. The Faculty reserves the right to admission to any candidate and, the decision of the authorities shall be final in all the cases subject to the approval of Jodhpur National University, Jodhpur.

6. Teachers / Research Scholars / Engineers employed in engineering/scientific organization/self-employed fulfilling the eligibility criteria specified in point 1-4 above may be admitted to the *M.Tech. Programme*.
7. The number of students to be admitted to a particular branch of study shall be decided by the Jodhpur National University in consultation with the Head of the Department concerned.
8. 5% relaxation is provided to candidate belonging to SC/ST category.

[B] DURATION OF THE COURSE

1. The normal duration of *M.Tech. Programme* will be 2 academic years (4 semesters). The maximum period of completion of the programme shall be 5 academic years.
2. In no case a candidate, who has not passed finally after 5 academic years from the date of enrolment, be allowed to continue the course and his/her admission will automatically be cancelled.
    a. Provided that the Vice-Chancellor in consultation with the Head of the Department may waive this limit of 5 years only in the case of candidates who could not complete their M.Tech. programme at one stretch due to genuine reasons. The reasons for granting exemption shall be recorded in writing. Such extension shall not exceed one year.
3. Candidate shall be required to attend regular lecture classes, complete the prescribed course work including the practicals and sessionals.

[C] EXAMINATION & RESULT

1. There shall be an examination at the end of each semester.
2. The examination shall be conducted by means of written papers, practicals including sessionals, viva-voce as per scheme of examination specified in the syllabus
3. A candidate who has undergone regular course of study for the first semester shall be eligible to appear at the First Semester Examination for the M. Tech. Programme.
4. A candidate appearing at the First Semester Examination for the M. Tech. Programme shall be required to show competent knowledge of the subjects mentioned in the teaching and examination scheme for the respective branch of study.
5. A candidate appearing at the Second Semester Examination for the M. Tech. Degree shall be required to show competent knowledge of the subjects mentioned in the teaching and examination scheme of respective branch of study.
6. A candidate appearing at the Third Semester Examination for the M. Tech. Degree shall be required to show competent knowledge of the subjects mentioned in the teaching and examination scheme of respective branch of study.
7. A candidate who fails in any elective subject may be permitted by the Head of the Department to change the elective subject. He shall be required to undergo a regular course of study for the new elective subject.
8. For a pass, candidate should obtain 40 % marks in each theory paper, 50 % marks in each course work (Laboratory) and 50 % marks in Seminar. Both the theory & sessional marks will be considered independent of each other. Aggregate pass percentage will be 50% in each subject.
9. On satisfactory completion of the course and after passing the final examination, a candidate shall be awarded M.Tech. Degree in the respective specialization, in respective branch.

10. The division shall be awarded to the M.Tech. students as follows:
    a. The students who obtain in first attempt 75% or more of the aggregate marks in both theory and sessionals and also if the thesis has been adjudged to merit distinction are awarded **Honours.**

b. The students who obtain 60% or less than 75% of the aggregate marks in all theory papers including thesis and the sessionals are awarded **First Division**.
c. The students who obtain less than 60% of the aggregate marks in all the theory papers and the sessionals but not less than 40% in each theory paper and 50% in the sessionals will be awarded **Second Division.**

11. Examination fees, Re-appear examination fees, Extension of period etc. shall be charged separately as prescribed by the Jodhpur National University, Jodhpur. Separate examination forms are to be submitted with the Jodhpur National University for all the examinations.

[D] SEMINAR / DISSERTATION:

1. Each candidate shall submit for examination a report embodying literature survey along with a critical review of the latest developments / work carried out in a subject related to M.Tech. programme.
2. Four copies of the seminar/dissertation report printed or type written shall be submitted to the Head of the Department along with a certificate or originality of the work recommendation from his/her supervisor.

[E] SCHEME OF STUDY

1. The Medium of instruction and examination shall be **English**
2. Candidate for the M.Tech course shall be instructed & examined as per the Teaching and Examination scheme and course content of respective semester.

Jodhpur National University, Jodhpur

M. Tech. Programme (Thermal Engineering)

Mechanical Engineering

TEACHING/EXAMINATION SCHEME & SYLLABUS

I SEMESTER

Subject Code	Subject	Hrs./ Week				Marks			Exam Hrs
		L	T	P	Total	Theory\ Practical Exam	Internal Assess-ment	Total	
1MME 01	Strategic Management	4	2	-	6	100	50	150	3
1MME 02	Advance Thermodynamics	4	2	-	6	100	50	150	3
1MME 03	Advance Heat Transfer	4	2	-	6	100	50	150	3
1MME 04	Advance Fluid Mechanics	4	2	-	6	100	50	150	3
1MME 05	Thermal Engg. Lab-I	-	-	6	6	50	50	100	3
	Total	**16**	**8**	**6**	**30**	**450**	**250**	**700**	**15**

II SEMESTER

Subject Code	Subject	Hrs./ Week				Marks			Exam Hrs
		L	T	P	Total	Theory\ Practical Exam	Internal Assess-ment	Total	
2MME 01	Gas Turbines And Jet Propulsion	4	2	-	6	100	50	150	3
2MME 02	Combustion Engineering	4	2	-	6	100	50	150	3
2MME 03.1 2MME 03.2 2MME 03.3	Refrigeration Systems Energy Conservation & Management Solar Thermal Processes	4	2	-	6	100	50	150	3
2MME 04.1 2MME 04.2 2MME 04.3	Design Of Heat Transfer Equipments Advance Air Conditioning Alternative Fuels For I. C. Engines	4	2	-	6	100	50	150	4
2MME 05	Thermal Engg. Lab-II	-	-	6	6	50	50	100	3
	Total	**16**	**8**	**6**	**30**	**450**	**250**	**700**	**16**

Jodhpur National University, Jodhpur

M. Tech. Programme (Thermal Engineering)

Mechanical Engineering

TEACHING/EXAMINATION SCHEME & SYLLABUS

III SEMESTER

Subject Code	Subject	Hrs./ Week				Marks			Exam Hrs
		L	T	P	Total	Theory\ Practical Exam	Internal Assess-ment	Total	
	ELECTIVE-III & IV (Any Two)	4	2	-	6	100	50	150	3
		4	2		6	100	50	150	3
3 MME 01.1\02.1	Advance I. C. Engine Technology								
3 MME 01.2\02.2	Non-Conventional Energy System								
3 MME 01.3\02.3	Advance Turbo Machinery								
3 MME 01.4\02.4	Aircraft & Rocket Propulsion								
3 MME 01.5\02.5	Cryogenic systems								
3 MME 01.6\02.6	Advance Power Plants								
3 MME 01.7\02.7	Finite Element Method								
3 MME 01.8\02.8	Cold Preservation of Food								
3 MME 3	SEMINAR (Literature Survey& Presentation)	-	-	-	-	50	50	100	
	Total	**8**	**4**	**-**	**12**	**250**	**150**	**400**	**6**

IV SEMESTER

Subject Code	Subject	Hrs./ Week				Marks		
		L	T	P	Total	Theory Practical Exam/ Viva voce	Internal Assess ment	Total
4 MME 1	Dissertation/Industrial/Training/Project Work	-	-	-	-	200	-	200
	Total	**0**	**0**	**-**	**-**	**200**	**-**	**200**

Total Marks: 700+700+400+200 = 2000

1 MME 01 STRATEGIC MANAGEMENT [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

'Strategic Management' Could Be A Useful Subjects Of 1st Semester Of M-Tech Courses. 'Strategic Management' As Detailed Below Prepares A Young Budding Technocrat To Manage Assets In More Efficient Way And Lead His/Her Team More Effectively.

This Subject Would Cover The Following Issues:-

A) **Managing Change: -** Effective Change Management Is The Need Of The Hour. Situations Change Rather Fast These Days And Has To Prepare Or Mould His / Her Organization To Face Such Changes And Come Out Winningly.

B) **Crisis Management: -** Every Organization Or Every Individual Do Face Crisis Many Times. A Good Management Or A Good Leader Keeps Himself / Herself Always Prepare For Such Eventualities. Training In This Area Has Often Been Neglected.

C) **Innovation And Creativity: -** Human Brain Is Very Creative. Creative Thinking Is A Must For The Fast Changing World. Creative Things Results In Innovation And New Finds. Creativity Could Be Developed In A Positive Sense By Training.

D) **Entrepreneurship: -** Young Budding Technocrats Need Encouragement For Creating Small/Medium Size Organizations. Sessions On This Subject From Industry Leaders Will Help In It.

E) **Work Study And Re-Engineering:-** Re-Engineering Is Term Used These Days In Place Of Old Terms 'Work Study' Re-Engineering Is Needed Not Only For The Product But Also For The Processes As Well As For The 'Organization'.

F) **Managing Intangibles: -** An Organization Have (I) Tangibles Assets Like Machines, Material Etc. And Also (Ii) Intangibles Assets Like Staff, Line Managers Etc. Managing 'People' Or Rather 'Leading' People Needs To Be Taught To Young Engineers.

G) **Communication Skills: -** We Expect Our Managers To Lead Their Terms. For This Communication Skill Is A Must. This Could Be Covered In Class Room Sessions Along With Practice Sessions In Groups Under The Supervision Of A Teacher.

H) **Quality And Customers Care: -** ISO-9000 Has Become A Hallmark For Quality. This Can Cover Pre-Requisites For An Organization And How To Go About For Getting IS0-9000 Certification.

I) **Safety And Ergonomics: -** Safety Is Often Talked About But Not Cared For To That Extent Ergonomics Is Even Less Known. Technocrats Need To Know More About Safety And Ergonomics.

Books Recommended:

TEXT BOOKS:

1.Rehfeld, J.E. Alchemy of a Leader: Combining Western and Japanese Management skills to transform your company, John Whily & Sons, New York.1994

2.Buzzell, R. and Gale, B. The PIMS Principles: Linking Strategy to Performance, Free Press, New York, 1987.

1 MME 02 ADVANCE THERMODYNAMICS [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Review Of Basics: First Law And Second Law Analysis –Unsteady Flow Processes- Concept Of Entropy – Principle Of Increase Of Entropy – Entropy Generation – Availability – Concept Of Exergy, Exergy Balance And Second Law Efficiency– Exergy Analysis Of Combustion Processes.

Helmholtz Function – Gibb'S Function. Thermodynamic Relations, Maxwell'S Relations, T-Ds Equations – Specific Heat Relations-Energy Equations – Joule Thomson Effect – Clausius Claperyon Equation.

Criteria For Equilibrium –Gibb'S Phase Rule – Conditions For Stability. Compressibility Factor, Fugacity and Activity, Computation From The Generalized Charts, Dependence Of Fugacity And Activity On Pressure And Temperature, Chemical – Equilibrium.

Statistical Thermodynamics: Thermodynamics Probability, Maxwell Statistics, Fermi Dirac and Bose–Einstein Statistics, Entropy and Probability, Degeneracy of Energy Levels, Partition Functions.

Kinetic Theory of Gases: Perfect Gas Model, Distribution of Translational Velocities Distribution Function, Molecular Collisions and Mean Free Path, Equipartition of Energy.

Books Recommended:

TEXT BOOKS:

1. Engineering Thermodynamics **-** P.K. Nag, Tata McGraw-Hill Publications.
2. Fundamentals of Classical Thermodynamics **-** G. Van Wylen and R.E. Sonntag, Wiley, 1986.
3. A.S. Michael, 'Thermodynamic for Engineers', Prentice Hall, 1972.
4. J.P. Holman., 'Thermodynamics', 4th Ed., McGraw Hill, 1988.
5. Lee and Sears, 'Statistical Thermodynamics', Addition Wesley, 1976.

RFFERENCE BOOKS:

1. J.Hsieg,' Principles of Thermodynamics', McGraw Hill, 1978.
2. V.Nastrand, S. Glasstne., =Thermodynamics for chemists', 1974
3. M.D. Burghardt,'Engineering Thermodynamics for Engineeris', Harper and Row, NY, 1987
4. K.Wark,' Advanced Thermodynamics for Engineers', McGraw Hill, NY, 1987.
5. K.Smith, H.C. Van Ness, Introduction to Chemical Engineering Thermodynamics McGraw Hill, 1987.

1 MME 03 ADVANCE HEAT TRANSFER [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Conduction: General Heat Conduction Differential Equation in Rectilinear, Cylindrical and Spherical Co-Ordinates, Straight Fins of Rectangular, Triangular and Trapezoidal Sections, Effectiveness Of Fins.

Two-Dimensional Steady State Conduction: Semi Infinite and Finite Flat Plate, Temperature Field In Infinite And Finite Cylinders, Conduction Through Spherical Shell, Graphical Methods, Numerical Methods,
Unsteady State Conduction, Sudden Changes in Temperature of Infinite Plates, Cylinders, And Other Semi-Infinite Body, Solutions Using Grover's And Heisler's Charts.

Convection: Review Of Continuity And Momentum, Differential Equations For Incompressible Fluids, Differential Equation Of Energy Momentum And Thermal Boundary Layers, Convective Heat Transfer Coefficient, Local And Integrated Values, Nusselt Number And Friction Factor Co–Relation, Heat Transfer In Laminar Flow, Free Convection Between Parallel Plates, Forced Internal Flow Through Circular Tubes Fully Developed Flow, Velocity And Thermal Entry Lengths, Solutions With Constant Wall Temperature And With Constant Heat Flux, Forced External Flow Over Flat Plate, The Two Dimensional Velocity And Temperature Boundary Layer Equations, The Karman-Pohlhanton Approximate Integral Method.

Heat Transfer In Turbulent Flow: Eddy Heat Diffusivity, Reynolds Analogy Between Skin Friction and Heat Transfer, Prandti Taylor, Von Karman, Meritnelii Analogies, Turbulent Flow Through Circular Tubes.

Radiation: Radiation Through Non-Absorbing Media, Hottels Method Of Successive Reflection, Review Of Methods Of Analogous, Electrical Circuits, Radiation Through Absorbing Media, Logarithmic Decrement Of Radiation, Gas Radiation, Apparent Absorptivities Of Simple Shaped Gas Bodies, Net Heat Exchange Between Surfaces Separated By An Absorbing Gas, Radiation Of Luminous Gas Flames.

Books recommended:

TEXT BOOKS:

1. V.S Arpaci – Conduction Heat Transfer
2. E.M Sparrow, R.D Cess – Radiation Heat Transfer
3. J.P. Holman., 'Heat and Mass Transfer', Tata McGraw Hill, 8th Ed., 1989.
4. D.D. Kern, 'Extended Surface Heat Transfer', New Age International Ltd., 1985.

REFERENCE BOOKS:

1. Heat Transfer – A Basic Approach - Ozisik M.N., McGraw-Hill Publications, 1985.
2. Principles of Heat Transfer - Frank Kreith & M. S. Bohn, Thomson Publications, 2001.
3. R.Siegal and J.R Howell-Thermal radiation heat transfer.
4. F.P. Incropera and D. P. Dewit, =Fundamentals of Heat and Mass Transfer', 4th Ed. John.
5. C.P. Kothandaraman., =Fundamentals of Heat and Mass Transfer', 2nd Ed., New Age International, 1997.
6. E.R.D Eckert and R.M. Drake, =Analysis of Heat and Mass Transfer', McGraw Hill, 1980.
7. Kays, W.M. and Crawford W., =Convective Heat and Mass Transfer', McGraw Hill Inc., 1993.
8. Burmister L.C., 'Convective Heat Transfer', John Willey and Sons, 1983

1 MME 04 ADVANCE FLUID MECHANICS [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Fundamental Equations Of The Flow Of Viscous Compressible Fluids: The Equation of continuity-conservation of mass, equation of motion (navier-stokes equation) -conservation of momentum, the energy equation-conservation of energy, the equation of state and perfect gases.

Three Dimensional Inviscid Incompressible Flow: stream function in three dimensional motion, three dimensional axially symmertric flow, uniform flow, radial flow, source and sink doublet, motion of solid bodies in a fluid, superposition of source and rectilinear flow and doublet, three dimensional motion, sphere in uniform stream.

Laminar Flow Viscous Incompressible Fluids: similarity of flow. The reynold's number, viscosity from the point of view of the kinetic theory, flow between parallel flat plates, couetee flow, plane poiseeuille flow in pipes. Flow through a pipe. The heganpoiseuile flow. Flow between two coaxial cylinders, applications of the parallel flow theory. The measure of viscosity, hydrodynamics of bearing lubricant. Unsteady flow around a sphere. Theory of very slow motion, unsteady flow around a sphere. Theory of very slow motion, unsteady motion of a flat plate.

The Laminar Boundary Layer: Properties of navier-stokes equations-boundary layer concept, the boundary layer equation in two dimensional flow, the boundary layer-along a flat plate, the blasius solution, shearing stress and boundary layer thickness, boundary layer on a surface with pressure gradient, momentum-integral theorems for the boundary layer, the von karman-integral relation, von karman-integral relation by momentum law, other forms of the von karman. Integral relation application of momentum, integral equations to boundary layer-von karman-pohlhausen method, separation of boundary layer flow, mathematical criterion, physical example, prediction of boundary layer separation, prevention of boundary layer separation.

Introduction to turbulent flow: the origin of turbulence, reynold's modification of the navier-stoke's equation for turbulent flow, mean values and fluctuations, reynold's equation and reynold's stresses, semi empirical theories of turbulence, prandtl's mixing length theory, von karman similarity hypothesis, universal velocity profile near a wall, turbulent flow in pipe, empirical relation for smooth pipes, flow in rough pipes, turbulent boundary layer over a smooth flat plate, fully boundary layer, boundary layer in the transition range, laminar boundary layer equation in compressible flow, velocity and temperature relation in laminar boundary layers , boundary layer with pressure gradient, boundary layer with zero pressure gradient, integral theorems for the boundary layers, application of momentum integral equation to boundary layers.

Books Recommended:

TEXT BOOKS:

1. Foundations of fluid mechanics - S.W. Yuan, Prentice Hall of India, 1976.
2. Engineering Fluid Mechanics - P.A. Aswatha Narayana & K.N. Seetharamu, Narosa publications, 2005.

REFERENCE BOOKS:

3. Fluid Mechanics - F.M. White, McGraw-Hill publications.
4. Advanced fluid mechanics - K. Muralidhar and G. Biswas, Narosa publications, 1996.
5. Introduction to fluid dynamics - Principles of analysis & design - Stanley Middleman, Wiley, 1997.
1. Currie, LG., *Fundamental Mechanics of Fluids, 3rd* ed., CRC Press, 2002.
2. White, P.M., *Viscous Fluid Flow, 2nd* ed., McGraw-Hill, 1991.
3. Ockendon, H. and Ockendon, J., *Viscous Flow,* Cambridge Uni. Press, 1995.
2. Robertson. *'Hydrodynamics Theory and Application'*, Prentice Hall of India, 1965.
3. M.J Zucrwo and J.D. Hoffman*, 'Gas dynamics'*, Vol. I and II, John Wiley and Sons Inc.1977.

2 MME 01 GAS TURBINES AND JET PROPULSION [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Introduction: Application, Shaft Power Gas Dynamics – Compressibility Effect, Steady One Dimensional Compressible Flow Of A Perfect Gas In A Duct, Isentropic Flow In A Constant Area Duct With Friction, Normal Shock Waves, Oblique Shock Wave, Isentropic Two Dimensional, Supersonic Expansion And Compression.

Centrifugal Fans Blowers And Compressors: Principle Of Operations, Work Done And Pressure Rise, Slip Factor, Diffusers, Compressibility Effects, Non Dimensional Qualities For Plotting Compressor Characteristics.

Gas Power Cycle: Brayton Cycle, Regeneration And Reheating Cycle Analysis; Axial Flow Fans And Compressors: Elementary Theory, Degree Of Reaction, Three Dimensional Flow, Simple Design Methods, Blade Design, Calculation of Stage Performance, Overall Performance, And Compressibility Effects. Performance Characteristics.

Combustion System: Form of Combustion, Important Factors Affecting Combustion Chamber Design, Combustion Processes, Combustion Chamber Performance and Practical Problem.

Axial Flow Turbines: Elementary Theory, Vortex Theory, Choice of Blade Profile, Pitch and Chord; Estimation of Stage Performance, Heat Exchange in Cooled Turbine. ; Prediction Of Performance Of Simple Gas Turbines: Component Characteristic, Off Design Shaft Gas Turbine, Equilibrium Running Gas Generators, Off Design Of Free Turbine And Jet Engine, Methods of Displacing The Equilibrium, Running Line, Incorporation of Variable Pressure Losses, Methods of Improving Part Load Performance, Matching Procedure For Twin Spool Engines, Behavior of Gas Turbine .Gas Turbine Rotors And Stresses.

Books Recommended:

TEXT BOOKS:

1. Incompressible Flow by S. M. Yahya.
2. Cohen & Rogers, *Gas Turbines.*
3. Turbines Compressors and Fans by S. M. Yahya.

REFERENCE BOOKS:

1. J.E Lee, *Theory and design of stream and gas turbine*.

2 MME 02 COMBUSTION ENGINEERING [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Introduction: Importance of Combustion; Combustion Equipments, Hostile Fire Problems, Pollution Problems Arising From Combustion.

Thermodynamics Of Combustion: Enthalpy Of Formation; Enthalpy Of Reaction; Heating Values; First and Second Laws; Analysis Of Reaction System, Chemical Equilibrium, Equilibrium Composition; Adiabatic and Equilibrium, Flame Temperature.

Kinetics Of Combustion: Law Of Mass Action; Reaction Rate; Simple And Complex Reaction; Reaction Order and Molecularity, Arhenius Laws; Activation Energy; Chain Reaction; Steady Rate and Partial Equilibrium Approximation; Chain Explosion; Explosion Limit And Oxidation Characteristics Of Hydrogen, Carbon Monoxide, Hydrocarbons.

Flames: Remixed Flame Structure and Propagation of Flames in Homogeneous Mixtures; Simplified Rankine Hugoniot Relation, Properties of Hugoniot Curve, Analysis Of Deflagration and Detonation Branches, Properties Of Chapmen Jouguet Wave, Laminar Flame Structure; Theories Of Flame Propagation & Calculation Of Flame Speed Measurements. Stability Limits Of Laminar Flames; Flammability Limits & Quenching Distant, Burner Design, Mechanism Of Flame Stabilization In Laminar & Turbulent Flows, Flame Quenching, Diffusion Flames; Comparison Of Diffusion With Premixed Flame, Combustion Of Gaseous Fuel, Jets Burke & Schumann Development.

Burning Of Condensed Phase: General Mass Burning Considerations, Combustion of Fuels Droplet In A Quiescent And Convective Environment, Introduction To Combustion Of Fuel Sprays.

Ignition: Concept Of Ignition, Chain Ignition, Thermal Spontaneous Ignition, Forced Ignition.

Combustion Generated Pollution & Its Control: Introduction, Nitrogen Oxide, Thermal Fixation of Atmospheric Nitrogen Prompts, NO, Thermal Nox & Control In Combustors. Fuel Nox & Control, Post Combustion Destruction Of Nox, Nitrogen Dioxide, Carbon Monoxide Oxidation-Quenching, Hydrocarbons, Sulphur Oxide.

Books Recommended:

TEXT BOOKS:

1. C.R. Ferguson and A.T. Kirk Patrick, Internal Combustion Engines, John Wiley & Sons Inc. 2001.
2. Stephen R Turns, Introduction to Combustion: Concepts and Applications, McGraw Hill, 2000
3. G.L. Borman and K.N. Ragland, Combustion Engineering, McGraw Hill, 1998.
4. D.Winterbone, Advanced Thermodynamics for Engineers, Elsevier, 1996

REFERENCE BOOKS:

1. Energy. Combustion and Environment - N.A. Chigier, McGraw- Hill, 1981.
2. Introduction to combustion phenomena - A. Murthy Kanury, Gordon and Breach, 1975.
3. Fuels and combustion - S.P. Sharma and Chandra Mohan, Tata McGraw-Hill, 1984.
4. Engineering Thermodynamics - Onkar Singh. New age International Publications.

2 MME 03.1 REFRIGERATION SYSTEMS [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Review Of Thermodynamic Principles Of Refrigeration: Vapour Compression Cycle, Actual Vapour Compression Cycle, Multistage, Multi Evaporator System, Cascade System, Gas Cycle Refrigeration, Aircraft Refrigeration.

Refrigeration Systems: Estimation Of Thermal Load, Selection And Matching Of Components Compressors, Evaporators, Condensers, Expansion Devices, Cyclic Controls Requirements Of Refrigerants, Lubricants In Refrigeration,

Primary Refrigerants, Secondary Refrigerants, Mixed Refrigerants.

Theory Of Mixtures: Enthalpy Composition Diagrams, Absorption System Calculation, Aqua Ammonia Systems, Libr Water System, Three Fluid Absorption Systems, Solar Refrigeration System.

Other Refrigeration Systems: Water Refrigeration, Centrifugal Refrigeration, Steam Jet Refrigeration, Vortex Tube And Pulse Tube Refrigeration Systems, Thermo elective Systems, Production Of Dry Ice(Solid Carbon Dioxide) Cryogenic Systems: Introduction: Insight On Cryogenics, Properties Of Cryogenic Fluids, Material Properties At Cryogenic Temperatures. Carnot Liquefaction Cycle. Yield Of Liquefaction Cycles. Inversion Curve-Joule Thomson Effect. Liquefaction Cycles: Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claudes Cycle, Dual Cycle, Helium Refrigerated Hydrogen Liquefaction Systems. Critical Components In Liquefaction Systems; Cryogenic Refrigerators: J.T.Cryocoolers, Stirling Cycle Refrigerators, G.M.Cryocoolers, Regenerators Used In Cryogenic Refrigerators, Magnetic Refrigerators Applications: Applications Of Cryogenics In Space Programmes, Superconductivity, Cryo Metallurgy, Medical Applications.

Books Recommended:

TEXT BOOKS:

1. C.P.Arora, *A Course in Refrigeration and Air-conditioning,* Tata Mc. Graz-Hill
2. H.F. Stoecker, *A Text Book of Refrigeration and Air-conditioning*, Tata Mc. Graw-Hill.
3. Refrigeration & Air Conditioning - Manohar Prasad., New Age International Publications
4. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration
5. R.J.Dossat, Principle of refrigation, Pearson Education Asia.
6. A Course in refrigeration and Air- Conditioning - Arora and Domkundawar, Danpat Rai & Co Publications
7. Basic Refrigeration and Air Conditioning - P.N. Ananthanarayanan, McGraw-Hill Publications

2 MME 03.2 ENERGY CONSERVATION & MANAGEMENT [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

General Energy Problem, Energy Uses Patterns and Scope of Conservation.

Energy Management Principle: Need, Organizing and Managing an Energy Management Program. **Energy Auditing:** Elements and Concepts, Type of Energy Audits Instruments Used In Energy Auditing.

Economic Analysis: Cash Flows, Time Value Of Money, Formulae Relating Present And Future Cash Flows-Single Amount, Uniform Series.

Financial Appraisal Methods: Pay Back Periods, Net Present Value, Benefit Cost Ratio, Internal Rate of Return And Life Cycle Cost / Benefits.

Thermodynamics of Energy Conservation: Energy Conservation in Boilers and Furnaces, Energy Conservation in Stream and Condensate System.

Cogeneration and Cascading: Concepts, Type of Cogeneration System, Performance Evaluation of a Cogeneration System.

Waste Heat Recovery: Potential, Benefit, Waste Heat Recovery Equipments. Space Heating, Ventilation Air Conditioning (HVAC) And Water Heating Of Building, Transfer Of Heat, Space Heating Methods, Ventilation And Air Conditioning, Heat Pumps, Insulation, Cooling Load, Electric Water Heating Systems, Electric Energy Conversation Methods.

Industrial Insulation: Insulation Materials, Insulation Selection, Economical Thickness Of Insulation. Industrial Heating: Heating By Indirect Resistance, Direct Resistance Heating (Salt Bath Furnace), Heat Treatment By Induction Heating In The Electric Furnace Industry.

Energy Conservation In Electric Utility And Industry: Energy Cost And Two-Part Tariff, Energy Conservation In Utility By Improving Load Factor, Load Curve Analysis, Energy Efficient Motors, Energy Conservation In Illuminating System, Importance Of Power Factor In Energy Conservation - Power Factor Improvement Methods, Energy Conservation In Industries.

Books Recommended:

TEXT BOOKS:

1. Energy management handbook - Wayne C. Turner, CRC Press Publications, 2004.

REFERENCE BOOKS:

1. Electrical Energy Utilization and Conservation - S.C. Tripathy, Tata McGraw-Hill, 1991.
2. Industrial Energy Conversation - D.A. Reay, Pergamon Press.
3. Industrial energy conservation Manuals: MIT Press.

2 MME 03.3 SOLAR THERMAL PROCESSES [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Solar Radiations: Solar Angles, Solar Constant, Spartial Distribution of Extraterrestrial Radiations, Beam And Diffuse Radiations.

Measurement Of Solar Radiations: Measuring Instruments Phyrheliometers And Pyranometers, Scale Of Solar Radiations, Estimation Of Average Solar Radiations And Hourly Solar Radiations, Ratio Of Beam And Total Radiations On A Titled Surface To Horizontal Surface, Effect Of Surface Orientation And Motion.

Radiation Characteristics Of Opaque Materials: Electromagnetic Spectrum, Photon Radiations, The Black Body, Planck's, Wiens And Stefan Boltzmann's Laws, Radiation Intensity And Flux, Kirchoff's Law, Absorptance, Emittance And Reflectance And Relation Between Them, Measurement Of The Surface Radiation Properties.

Transmission Of Radiation Through Transparent Media: Reflection, Absorption and Transmission of Solar Radiations in a Transparent Media.

Focusing Collectors: Solar Disc and Theoretical Solar Images Concentrators, Receivers and Orienting Systems, General Characteristics, Optical Losses, Thermal Performance, Heat Capacity Effects, Optimization of Maximum Energy Delivery Materials and Construction of Reflectors.

Energy Storage: Process Loads and Collector Output Energy Storage in Systems, Water Storage, Packed Bed Storage and Phase Change Storage, Capacity of Storage System.

Solar Heating and Cooling: Water Heater Systems, Sizing Of Systems, Auxiliary Energy Flow, Distribution In Collectors, Performance Of Natural Convention Systems, Comfort Solar Heating Systems, Economics Of Heating, Architectural Considerations, Performance And Cost Calculations.

Solar Absorption Cooling and Its Performance: Economics Of Heating And Cooling, Combined Heating And Cooling Systems, Modeling Of Heating And Cooling Systems, Performance And Cost Of A Heating And Cooling System, Collector Storage Well Systems And Collector Radiation Storage Systems, Collector Radiator Heat Pump System, Open Cycle Cooling System, Solar Ponds, Solar Power and Solar Distillation-Introduction.

Books Recommended:

TEXT BOOKS:

1. 1. S.P.Sukhatme, =*Solar Energy Principle of Thermal Collection and Storage'*, Tata McGraw Hill, 1990.
2. G.L. Johnson, *Wind energy systems*, Prentice Hall Inc. New Jersey.
3. J.M.Kriender, =*Principles of Solar Engineering'*, McGraw Hill, 1987.

REFERENCE BOOKS:

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

2 MME 04.1 DESIGN OF HEAT TRANSFER EQUIPMENTS [4-2-0] EXAM HRS: - 4
M.M:- 100+50=150

Reviewof Fundamentals: Overall Coefficients Of Heat Transfer, Controlling, Controlling Film Coefficient, Log-Mean-Tempearture Difference (LMTD) For Counter Flow And Parallel Flow Heat Exchanger, Caloric Or Average Fluid Temperature, Wall Temperature, And Various Types Of Heat Exchangers, Introduction To Heat Exchanger Optimization.

Design Of Double-Pipe Heat Exchangers: Introduction, Film Coefficients For Fluids In Pipes And Tubes, Film Coefficients And Equivalent Diameter For Flow In Annuali, Fouling Factors, Pressure Drop In Pipes And Annuali, Double-Pipe Exchangers In Series-Parallel Arrangements.

Design Of Shell And Tube Heat Exchangers: 1-2 Parallel-Counter Flow Shell And Tube Heat Exchanger, Constructional Features Of Various Types, Layout Of Tubes, Various Types Of Baffles And Expansion Joints, Shell-Side Film Coefficients, Shell-Side Mass Velocity And Shell Equivalent Diameter, True Temperature Difference In 1-2 Exchanger, Shell And Tube Side Pressure Drops, Analysis Of Performance, Exchangers Without Baffles, Flow Arrangements For Increased Heat, Recovery: 2-4 Exchangers And Their Comparison With 1-2 Exchangers, 1-2 Exchangers In Series, 1-1 True Counter Flow Exchangers, Design Calculations**.**

Design of Heat Exchangers With Extended Surfaces: Introduction And Classification, Fin Efficiency, Longitudinal Fins And Double Pipe Exchangers, Extended-Surface-Shell And Tube Exchanger: Cross-Flow LMTD, Film Coefficients and Pressure Drop For Transverse Fins.

Design of Condensors: Drop wise And Film Condensation, Condensing Heat Transfer Coefficients, Horizontal and Vertical Tube Condensors, Brief Introduction to Desuperheater Condensers and Condenser-Sub coolers.

Books Recommended:

TEXT BOOKS:

1. R. K. Shah & D. P. Sekulic, *Fundamentals of Heat Exchanger Design*, John Wiley, 2003.
2. E. M. Smith, *Advances in Thermal Design of Heat Exchangers*, John Wiley, 2005.

REFERENCE BOOKS:

1. E. Hesselgreaves, *Compact Heat Exchangers*, Elsevier, 2001.
2. R.F. Barron, *Cryogenic Systems*, McGraw Hill, 1985.

2MME 04.2 ADVANCE AIR CONDITIONING [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Psychrometry: Simple Psychrometrics Processes, Use of Psychrometrics Chart. Summer Air–Conditioning, Winter Air-Conditioning, Comfort and Industrial Air Conditioning, Use of ASHRAE Data.

Design Conditions, Ventilation Loads, Comfort Air-Conditioning, Physiological Factors. Comfort Index. Load Estimation, Applied Psychrometrics Air Conditioning Systems:

Spray Systems, Chilled Water and DE Coils, Absorption and Adsorption Systems. Humidifiers. Principles of Ventilation. Air Filtration, Air Conveying Fans, Ducts Sizing and Air Diffusion Equipment. Estimation of Air Conditioning Load, Determination of Supply State. Design and Constructional Details of Unitary Air Conditioning Equipment.

Noise Level and Acoustic Control. Automatic Controls in Air Conditioning.

Books Recommended:

TEXT BOOKS:

1. C.P.Arora, *A Course in Refrigeration and Air-conditioning,* Tata Mc. Graz-Hill
2. H.F. Stoecker, *A Text Book of Refrigeration and Air-conditioning*, Tata Mc. Graw-Hill.
3. Refrigeration & Air Conditioning - Manohar Prasad., New Age International Publications
4. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration
5. Basic Refrigeration and Air Conditioning - P.N. Ananthanarayanan, McGraw-Hill Publications

2 MME 04.3 ALTERNATIVE FUELS FOR I. C. ENGINES [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Fuels: Introduction, Structure Of Petroleum, Refining Process, Products Of Refining Process, Fuels For Spark Ignition, Knock Rating Of SI Engine Fuels, Octane Number Requirement, Diesel Fuels.

Properties Of Petroleum Products: Specific Gravity, Density, Molecular Weight, Vapour Pressure, Viscosity, Flash Point, Fire Point, Cloud Point, Pour Point, Freezing Point, Smoke Point & Char Value, Aniline Point, Octane Number, Performance Number, Cetane Number, Emulsification, Oxidation Stability, Acid Value/Number, Distillation Range, And Sulphur Content.

Alternative Fuels For I.C. Engines: Need For Alternative Fuels Such As Ethanol, Methanol, LPG, CNG, Hydrogen, Biogas And Producer Gas And Their Methods Of Manufacturing.

Single Fuel Engines: Properties Of Alternative Fuels, Use Of Alternative Fuels In SI Engines, Engine Modifications Required, Performance And Emission Characteristics Of Alternative Fuels In SI Mode Of Operation V/S Gasoline Operation.

Dual Fuel Engine: Need And Advantages, The Working Principle, Combustion In Dual Fuel Engines, Factors Affecting Combustion In Dual Fuel Engine, Use Of Alcohols, LPG, CNG, Hydrogen, Biogas And Producer Gas In CI Engines In Dual Fuel Mode. Engine Modifications Required. Performance And Emission Characteristics Of Alternative Fuels (Mentioned Above) In Dual Fuel Mode Of Operation V/S Diesel Operation.

Bio-Diesels: What Are Bio-Diesels Need Of Bio-Diesels, Properties Of Biodiesels V/S Petro-Diesel, Performance And Emission Characteristics Of Biodiesels V/S Petro Diesel Operation.

Availability: Suitability & Future Prospects Of These Gaseous Fuels In Indian Context.

Environmental Pollution: With Conventional and Alternate Fuels, Pollution Control Methods And Packages.

Books Recommended:

TEXT BOOKS:

1. **A Course in Internal Combustion Engines -** R.P Sharma & M.L. Mathur, Danpat Rai & Sons.
2. **Internal Combustion Engines -** V. Ganesan, Tata McGraw-Hill Publications.
3. John B. Heywood, “IC Engines fundamentals”, McGraw-Hill Publications
4. M. Dayal, "*Energy today & tomorrow* ", I & B Horishr India, 1982.
5. Nagpal, "*Power Plant Engineering* ", Khanna Publishers, 1991.

REFERENCE BOOKS:

1. **Elements of Fuels, Furnaces & Refractories -** O.P. Gupta, Khanna Publishers.
2. **Internal Combustion Engines -** Domkundwar V.M., I Edition, Dhanpat Rai & Sons.
3. **Internal Combustion Engines Fundamentals -** John B. Heywood, McGraw Hill International Edition.
4. **Present and Future Automotive Fuels -** Osamu Hirao & Richard Pefley, Wiley Interscience Publications.

3 MME 01.1\02.1 ADVANCE I. C. ENGINE TECHNOLOGY [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

SI Engine-Introduction-Carburetion- Mixture Requirements-Fuel Supply - Ignition - Stages Of Combustion-Normal And Abnormal Combustion-Factors Affecting Knock -Combustion Chambers. ; CI Engine- Injection Systems-Mechanical And Electronic-Combustion In CI Engines-Stages Of Combustion-Factors Affecting Combustion-Direct And Indirect Injection Systems –Combustion Chambers – Fuel Spray Behavior – Spray Structure, Spray Penetration-And Evaporation – Air Motion – Introduction To Turbo Charging And Supercharging. ; Basic Concepts of Engine Simulation, Governing Equations, Simulation Of Various Engine Processes For SI and CI Engines. Thermodynamic And Fluid Mechanic Based Models. Different Types Of Combustion Chamber ; Engine Instrumentation-Types Of Pollutants-Euro And Bharat Norms-Emission Control Methods In SI And CI Engines-Catalytic Converters-EGR-Modern Evaporative Emission Control System ; Lean Burn Engines – Stratified Charge Engines – Homogeneous Charge Compression Ignition Engines – Plasma Ignition – Zero Emission Vehicles, Engines For Special Applications – Mining, Defence, Off-Highway -Tractor, Bulldozer Etc. Submarines, Race Car Engine Systems, Flexible Fuel Systems. Surface Ignition, Hybrid Car and Electrical Vehicles

Books Recommended:

TEXT BOOKS:

1. **A Course in Internal Combustion Engines -** R.P Sharma & M.L. Mathur, Danpat Rai & Sons.
2. **Internal Combustion Engines -** V. Ganesan, Tata McGraw-Hill Publications.
3. John B. Heywood, “IC Engines fundamentals”, McGraw-Hill Publications.
4. The Internal Combustion Engine In Theory And Practice Volume I & II By Charles Fayette Taylor. The MIT Press.

REFERENCE BOOKS:

1. **Elements of Fuels, Furnaces & Refractories -** O.P. Gupta, Khanna Publishers.
2. **Internal Combustion Engines -** Domkundwar V.M., I Edition, Dhanpat Rai & Sons.
3. **Internal Combustion Engines Fundamentals -** John B. Heywood, McGraw Hill International Edition.
4. **Present and Future Automotive Fuels -** Osamu Hirao & Richard Pefley, Wiley Interscience Publications.

3 MME 01.2\02.2 NON – CONVENTIONAL ENERGY SYSTEMS [4-2-0] EXAM HRS:3
M.M:- 100+50=150

Man and Energy: World's Production and Reserves of Commercial Energy Sources, India's Production and Reserves, Energy Alternatives, Different Forms of Non-Conventional Energy Source, Limitation of Conventional and Non-Conventional Sources of Energy.

Solar Energy: Solar Radiation Geometry, Estimation and Measurement Of Solar Energy. **Photovoltaic Application:** Types And Characteristics (I.V) Of Photovoltaic Cells, Solar Cell Arrays, Balance of System (BOS)

Thermal Application: Water Heating, Drying, Cooking, Desalination, Solar Refrigeration, Solar Ponds (Basic Concepts).

Biomass Energy Sources: Thermo-Chemical And Bio-Chemical Routes To Biomass Utilization.

Wind Energy: Betz Theory For Wind Energy Conversion, Estimation Of Wind Energy Potential, Characteristics Of Wind Turbines (HAWT And VAWT), Aerofoil Blade Structure, Water Pumping And Power Generation Using Wind Turbines.

Wave Energy: Wave Energy Conversion Machine & Recent Advances

Mini And Micro Hydro Power Generation: Basic Concepts, Types Of Turbines, Hydrological Analysis.

Geothermal Energy Conversion: Forms Of Geothermal Energy Sources, Geothermal Electric Power Plants.

OTEC: Principle Of Operation, Open And Closed OTEC Cycles.

Tidal Energy: Single Basin And Double Basin Tidal Systems (Basic Concepts), Nuclear Fusion Energy.

Books Recommended:

TEXT BOOKS:

1. S.P.Sukhatme, =*Solar Energy Principle of Thermal Collection and Storage'*, Tata McGraw Hill, 1990.
2. G.L. Johnson, *Wind energy systems*, Prentice Hall Inc. New Jersey.
3. J.M.Kriender, =*Principles of Solar Engineering'*, McGraw Hill, 1987.

REFERENCE BOOKS:

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

3 MME 01.3\02.3 ADVANCE TURBO-MACHINERY [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Introduction, Classification Of Turbo Machinery. Application Of TT – Theorem In Turbo Machinery. Incompressible Fluid In Turbomachines – Effects Of Reynolds Number And Mach Number. Energy Transfer Between A Fluid And A Rotor - Euler Turbine Equation – Components Of Energy Transfer Impulse And Reaction – Efficiencies. ; Radial Flow Pumps And Compressors – Head Capacity Relationship – Axial Flow Pumps And Compressors – Degree Of Reaction Dimensionless Parameters – Efficiency And Utilization Factor In Turbo Machinery. ; Thermodynamics of Turbo Machine Processes – Compression and Expansion Efficiencies – Stage Efficiency – Infinitesimal Stage And Finite Stage Efficiencies. ; Flow Of Fluids In Turbo Machines – Flow And Pressure Distribution Over An Airfoil Section – Effect Of Compressibility Cavitations – Blade Terminology- Cascades Of Blades – Fluid Deviation – Energy Transfer Of Blades – Degree Of Reaction And Blade Spacing – Radial Pressure Gradient – Free Vortex Flow – Losses In Turbo Machines. ; Centrifugal Pumps And Compressors – Inlet Section – Cavitation – Flow In The Impller Channel – Flow In The Discharge Casing Pump And Compressor Characteristic. ; Radial Flow Turbines – Inward Flow Turbines For Compressible Fluids – Inward Flow Hydraulic – Velocity And Flow Coefficients – Gas Turbine Blading – Kaplan Turbine – Pelton Wheels.

Books Recommended:

TEXT BOOKS:

1. Lee, =*Theory and Design of Steam and Gas Turbine'*, McGraw Hill, 1954.
2. Yahya, =*Turbines, Compressions & Fans'*, Tata McGraw Hill, 1983.

REFERENCE BOOKS:

1. Fundamentals of turbomachinery: B.K VENKANNA
2. STRUCTURAL DYNAMICS OF TURBO-MACHINES:A.S RANGWALA.
3. D.G. Stephard, =*Principles of Turbo machines'*, Macmillan Co., 1984.
4. W.J Kerten, =*Steam Turbine Theory and Practice'*, CBS Publisher & Distributors, 1988.
5. C. Rogers, S Muttoo, =*Gas Turbine Theory*', Long man, 1988.
6. W N.Bathe, =*Fundamentals of Gas Turbines'*, Willey & Sons, 1994.

3 MME 01.4\02.4 AIRCRAFT AND ROCKET PROPULSION [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Introduction, Rocket System And Aerodynamics Of Rockets, Fundamentals Of Gas Turbine Engines, Illustration Of Working Principles Of Gas Turbine Engine, Propulsion System And Operating Principle, Thermodynamics Of Propulsion System, Engine Performance Parameters, The Ramjet Cycle, Working Principles Of Ideal Ramjet Cycle, The Turbojet Cycle, Working Principles Of Turbojet Cycle, Non-Ideal Turbojet Cycle, Axial Flow Fans And Compressors, Polytrophic Efficiency Of Compression, Calculation Of Stage Performance And Overall Performance, Working Principles Of Turbofan Cycle, Rocket Performance, Introduction And Working Principles Of Multistage Rocket, Solid Propellant Rockets, Liquid Propellant Rockets ,Thrust Control In Liquid Rockets Cooling In Liquid Rockets, Hybrid Rockets, Limitations Of Hybrid Rockets, Relative Advantages Of Liquid Rockets Over Solid Rockets.

Books Recommended:

TEXT BOOKS:

1. G.C. Oates, *Aerothermodynamics of Aircraft Engine Components*, AIAA Education Series, New York, 1985.
2. W.W. Bathie*, Fundamentals of Gas Turbines*- John Wiley & Sons, 1984.
3. M.L. Mathur, and R.P. Sharma, *Gas Turbine Jet and Rocket Propulsion*, Standard Publishers and Distributors, Delhi, 1988.
4. P.G. Hill, *Mechanics and Thermodynamics of Propulsion*- Addison Wesley, 1970.
5. S.M. Yahya, *Fundamentals of Compressible Flow* - John Wiley, New York, 1982.
6. A.K. Mohanty, *Fluid Mechanics* - Prentice Hall, New Delhi, 2003.

3 MME 01.5\02.5 **CRYOGENIC SYSTEMS [4-2-0]** **EXAM HRS: - 3**
M.M:- 100+50=150

Introduction & Low Temperature Properties of Engineering Materials: Historical Background, Present Area Involving Cryogenics, Mechanical Properties; Thermal Properties; Electrical and Magnetic Properties; Properties Of Cryogenic Fluids.

Gas Liquefaction System: Joule Thompson Effect; Adiabatic Expansion; Simple Linde-Hampson, Precooled Linde- Hampson System; Liquid Dual Pressure System; Cascaded System; Claude System, Kapitza System, Collins Helium Liquefaction System.

Critical Component Of Liquefaction System: Effect Of Heat Exchanger; Effectiveness Of System Performance, Effect Of Compressor And Expander Efficiency On System Performance; Effect Of Heat Transfer To The System.

Cryogenic Refrigeration System: Phillips Refrigerator, Importance Refrigerator, Effectiveness for Phillips Refrigerator, Gifford-Mcmohan Refrigerator.

Measurement System of Low Temperature: Temperature Measurement, Flow Rate Measurement, Liquid Level Measurement.

Cryogenic Storage & Transfer System: Cryogenic Fluid Storage Vessels, Insulation, Cryogenic Transfer System.

Vacuum Technology: Importance Of Vacuum Technology In Cryogenics, Flow Regimes In Vacuum Systems; Conductance In Vacuum Systems, Calculation Of Pump Down Time For A Vacuum System, Components Of Vacuum Systems, Mechanical Vacuum Pumps, Diffusion Pumps, Ion Pumps, Cryopumping, Vacuum Gauges & Valves.

Books Recommended:

TEXT BOOKS:

1. R.Barron, Cryogenic systems, McGraw–Hill Company
2. G.G.Hasseldon. Cryogenic Fundamentals, Academic Press
3. Bailey, Advanced Cryogenics, Plenum Press
4. W.F.Stoecker, Industrial Refrigeration Handbook, McGraw-Hill
5. John A.Corinchock, Technician's Guide to Refrigeration systems, McGraw–Hill
6. P.C.Koelet, Industrial Refrigeration: Principles, Design and Applications, Macmillan
7. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration
8. Graham Walker, Miniature Refrigerators for Cryogenic Sensors and Cold Electronics, Clarendon Press

3 MME 01.6\02.6 ADVANCE POWER PLANT ENGG [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Analysis Of Steam Cycles: Rankine Cycle, Carnot Cycle, Mean Temperature Of Heat Addition, Effect Of Variation Of Steam Condition On Thermal Efficiency Of Steam Power Plant, Reheating Of Steam, Regeneration, Regenerative Feed Water Heating, Feed Water Heaters, Carnotization Of Rankine Cycle, Optimum Degree Of Regeneration, Super Critical Pressure Cycle, Steam Power Plant Appraisal, Deaerator, Typical Layout Of Steam Power Plant, Efficiencies In A Steam Power Plant, Cogeneration Of Power And Process Heat, Numerical Problems.

Combined Cycle Power Generation: Flaws Of Steam As Working Fluid In Power Cycle, Characteristics Of Ideal Working Fluid In Vapor Power Cycle, Binary Vapor Cycles, Coupled Cycles , Combined Cycle Plants, Gas Turbine- Steam Turbine Power Plant, MHD-Steam Power Plant, Thermionic- Steam Power Plant, Numerical Problems.

Fuels And Combustion : Coal, Fuel Oil, Natural And Petroleum Gas, Emulsion Firing, Coal – Oil And Coal – Water Mixtures, Synthetic Fuels, Biomass, Combustion Reactions, Heat Of Combustion And Enthalpy Of Combustion, Theoretical Flame Temperature, Free Energy Of Formation, Equilibrium Constant, Effect Of Dissociation, Numerical Problems.

Combustion Mechanisms : Kinetics Of Combustion, Mechanisms Of Solid Fuel Combustion, Kinetic And Diffusion Control, Pulverized Coal Firing System, Fuel-Bed Combustion, Fluidized Bed Combustion, Coal Gassifiers, Combustion Of Fuel Oil, Combustion Of Gas, Combined Gas Fuel Oil Burners, Numerical Problems.

Steam Generators: Basic Type of Steam Generators, Fire Tube Boilers, Water Tube Boilers. Economizers, Superheaters, Reheaters, Steam Generator Control, Air Preheater, Fluidized Bed Boilers, Electrostatic Precipitator, Fabric Filters And Bag Houses, Ash Handling System, Feed Water Treatment, Deaeration, Evaporation, Internal Treatment, Boiler Blow Down, Steam Purity, Numerical Problems.

Condenser, Feed Water And Circulating Water Systems: Need Of Condenser, Direct Contact Condensers, Feed Water Heaters, Circulating Water System, Cooling Towers, Calculations, Numerical Problems.

Nuclear Power Plants: Chemical And Nuclear Reactions, Nuclear Stability And Binding Energy, Radioactive Decay And Half Life, Nuclear Fission, Chain Reaction, Neutron Energies. Neutron Flux And Reaction Rates, Moderating Power And Moderating Ratio, Variation Of Neutron Cross Sections With Neutron Energy, Neutron Life Cycle. Reflectors, Types Of Reactor, PWR, BWR, Gas Cooled Reactors. Liquid Metal Fast Breeder Reactor, Heavy Water Reactors, Fusion Power Reactors, Numerical Problems.

Hydro Electric Power Plant: Introduction, Advantages And Disadvantages Of Water Power, Optimization Of Hydro – Thermal Mix, Hydrological Cycles, Storage And Pondage, Essential Elements Of Hydro Electric Power Plant, Classification, Hydraulic Turbines – Pelton Wheel, Francis Turbine, Propeller And Kaplan Turbines, Deriaz Turbine, Bulb Turbine, Comparisons Of Turbines, Selection Of Turbines, Numerical Problems.

Books Recommended:

TEXT BOOKS:

1. **Power Plant Engineering -** P.K. Nag, Tata McGraw-Hill Publications.
2. **Power Plant Engineering -** M.M. EI-Wakil, McGraw- Hill Publications.

3 MME 01.7\02.7 **FINITE ELEMENT METHODS [4-2-0]** **EXAM HRS: - 3**
M.M:- 100+50=150

Introduction: Importance of Stress Analysis, Heat Transfer and Fluid Flow, Conservation Laws For Mass, Omentum And Energy; Fourier Equation, N-S Equations; Energy Principles In Stress Analysis; Basic Equations In Elasticity; Boundary Conditions. Some Basic Discrete Systems: Discrete Systems As Basis For FEM Analysis; Examples Of Discrete Systems In Stress Analysis, Heat Transfer And Fluid Flow. 1-D Finite Elements: Introduction; Elements and Shape Functions – One Dimensional Linear Element (Bar Element), One Dimensional Quadratic Element.

2-D Finite Elements: Two Dimensional Linear Triangular Elements, Local And Global Coordinate Systems, Quadratic Triangular Elements, Two Dimensional Quadrilateral Elements, Iso-Parametric Elements, Three Dimensional Elements, Beam, Plate And Shell Elements, Composite Materials.

Formulation: Introduction; Variational Approach; Methods of Weighted Residuals for Heat Transfer Problems, Principle Of Virtual Work For Stress Analysis Problems; Mixed Formulation; Penalty Formulation For Fluid Flow Problems. Primitive Variables Formulation for Flow Problems.

Heat Conduction Problems: FEM Analysis Of Steady State Heat Conduction In One Dimension Using Linear And Quadratic Elements; Steady State Heat Conduction In Two Dimensions Using Triangular And Rectangular Elements; Three Dimensions Problems, Axi-Symmetric Problems.

Transient And Phase Change Problems: Transient Heat Conduction In One And Multi Dimensional Problems; Time Stepping Scheme Using Finite Difference And Finite Element Methods; Phase Change Problems – Solidification And Melting; Inverse Heat Conduction Problems.

Stress Analysis Problems: Introduction; Stress Analysis In One, Two (Plane Stress And Plane Strain) And Three Dimensions; Axi-Symmetric Problems; Beam And Plate Bending Problems; Thermal Stress Development; Shrinkage Stress Development; Prediction Of Distortions In Manufactured Products; Introduction To Simple Dynamic Problems.

Convective Heat Transfer Problems: Introduction; Galerkin Method Of Steady, Convection-Diffusion Problems; Upwind Finite Element In One Dimension - Petro-Galerkin Formulation, Artificial Diffusion; Upwind Method Extended To Multi-Dimension; Transient Convection - Diffusion Problems - FEM Solutions, Extension To Multi Dimensions; Primitive Variables Approach (U, V, W, P, T Formulation); Characteristic - Based Split Scheme (CBS); Artificial Compressibility Scheme; Calculation Of Nusselt Number, Drag And Stream Function; Mesh Convergence; Introduction To Convection In Porous Media; Laminar And Turbulent Flows.

Books Recommended:

TEXT BOOKS:

1. The finite element method in heat transfer and fluid dynamics - J.N. Reddy and Gartling D.K., CRC publications, 2000.
2. The finite element method volume 3: fluid dynamics - O.C. Zienkiewicz and R.L. Taylor, John Wiley & Sons, 2001.
3. The finite element and for solid and structural mechanics - O.C. Zienkiewicz and R.L. Taylor, Elsevier Publishers, 2005.
4. Introduction to Finite Elements in Engineering - Tirupathi R. Chandrupatla, Ashok D. Belegundu, Prentice-Hall Ltd., 2002.
5. Finite Element Analysis - S.S. Bavikatti, New Age International, 2005.

REFERENCE BOOKS:

1. FINITE ELEMENT METHODS FOR ENGINEERS – U.S.Dixit

3 MME 01.8\02.8 COLD PRESERVATION OF FOOD [4-2-0] EXAM HRS: - 3
M.M:- 100+50=150

Introduction: Necessity of Food Preservation; General Techniques; Cold Preservation of Food. **Biological Aspects:** Live and Dead Foods; Biology of Food Products Such As Fruits, Vegetables, Milk, Meat and Fish; Effect of Temperature on Food Ingredients; Respiration Rates of Food Products; Controlled Atmospheric Storage; Disease and Deterioration of Foods.

Cold Preservation Of Food: Short And Long Term Preservation; Methods Of Chilling; Freezing And Freeze-Drying; Heat And Mass Transfer Analysis Of Cooling And Freezing.

Cold Storages: Necessity And Present Status In The Country; Site Selection; Building Constructional Features, Load Calculation, Equipment, Selection, Safety Consideration, Insurance And Management Of Cold Storages; Storages Of Some Important Food Products; Modern Trends In Cold Storage Practices.

Refrigerated Food Handling: Preparation For Cooling/Freezing; Packaging Of Foods; Modes Of Transportation- Land, Sea And Air; Their Thermal Load And Equipment; Marketing Of Refrigerated Food.

Books Recommended:

TEXT BOOKS:

1. STOCKING UP: THE THIRD EDITION OF THE CLASSIC PRESERVING GUIDE BY CAROL HUPPING 1990
2. THE BIG BOOK OF PRESERVING THE HARVEST- CAROL W COSTENBADEN PAMELA LAPPIES-1997
3. THE BUSY PERSON'S GUIDE TO PRESON'S GUIDE TO PRESERVING FOOD-JANET BACHAND CHADWICK-1995