JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech in THERMAL ENGINEERING
Effective from Academic Year 2017 - 18 admitted batch

COURSE STRUCTURE AND SYLLABUS

I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-1	Advanced Thermodynamics	25	75	4	0	0	4
PC-2	Advanced Heat Transfer	25	75	4	0	0	4
PC-3	Advanced Fluid Mechanics	25	75	4	0	0	4
PE-1	1. Renewable Energy Sources 2. Fuels &Combustion 3. Advanced Optimization Techniques & Applications	25	75	**3**	0	0	3
PE-2	1. Gas Dynamics 2. Thermal Measurements & Process Control 3. Advanced Materials for Thermal Systems	25	75	**3**	0	0	3
OE-1	***Open Elective - I**	25	75	3	0	0	3
Laboratory I	Advanced Thermal Engineering Lab	25	75	0	0	3	2
Seminar I	Seminar - I	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-4	Refrigeration and Air Conditioning	25	75	4	0	0	4
PC-5	Computational Fluid Dynamics	25	75	4	0	0	4
PC-6	Advanced I.C. Engines	25	75	4	0	0	4
PE-3	1. Alternate Fuels for I.C. Engines 2. Turbo machines & Propulsion Systems 3. Advanced Finite Element Methods	25	75	**3**	0	0	3
PE4	1. Convective Heat Transfer 2. Equipment Design for Thermal Systems 3. Computer Simulation of SI & CI Engine	25	75	**3**	0	0	3
OE-2	***Open Elective - II**	25	75	3	0	0	3
Laboratory II	Computational Methods Lab	25	75	0	0	3	2
Seminar II	Seminar - II	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

III Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review II	100	0	0	0	22	8
Total	**200**	**100**	0	**3**	22	**14**

IV Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review III	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	100	0	0	0	16
Total	**100**	**100**	**0**	**0**	**24**	**24**

***Open Elective subjects must be chosen from the list of open electives offered by OTHER departments.**

 # For Project review I, please refer 7.10 in R17 Academic Regulations.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Thermal Engineering)

REFRIGERATION AND AIR CONDITIONING (Professional Core - 4)

UNIT – I

Vapour Compression Refrigeration: Performance of Complete vapor compression system. **Components of Vapor Compression System:** The condensing unit – Evaporators – Expansion valve – Refrigerants – Properties – ODP & GWP - Load balancing of vapor compression Unit.
Compound Compression: Flash inter-cooling – flash chamber – Multi-evaporator & Multistage systems.

UNIT – II

Production of Low Temperature: Liquefaction system; Cascade System – Applications.– Dry ice system.
Vapor absorption system – Simple and modified aqua – ammonia system – Representation on Enthalpy –Concentration diagram.
Lithium – Bromide system Three fluid system – HCOP.

UNIT – III

Air Refrigeration: Applications – Air Craft Refrigeration -Simple, Bootstrap, Regenerative and Reduced ambient systems – Problems based on different systems.
Steam Jet refrigeration system: Representation on T-s and h-s diagrams – limitations and applications
Unconventional Refrigeration system – Thermo-electric – Vortex tube & Pulse tube – working principles.

UNIT – IV

Air –Conditioning: Psychrometric properties and processes – Construction of Psychrometric chart. Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective Temperature. Summer, Winter, and year round air – conditioning systems.
Cooling load Estimation: Occupants, equipments, infiltration, duet heat gain fan load, Fresh air load.

UNIT – V

Air –Conditioning Systems: All Fresh air, Re-circulated air with and without bypass, with reheat systems – Calculation of Bypass Factor, ADP, RSHF, ESHF and GSHF for different systems. **Components:** Humidification and dehumidification equipment – Systems of Air cleaning – Grills and diffusers – Fans and blowers – Measurement and control of Temperature and Humidity.

REFERENCES:

1. Refrigeration & Air Conditioning /C. P. Arora/TMH
2. Refrigeration & Air Conditioning /Arora & Domkundwar/ Dhanpat Rai
3. Refrigeration and Air Conditioning /Manohar Prasad
4. Refrigeration and Air Conditioning /Stoecker /McGraw Hill
5. Basic Refrigeration & Air Conditioning – P.N. Ananthanarayanan – McGraw Hill
6. Principles of Refrigeration/Dossat /Pearson
7. Refrigeration and Air Conditioning – Dr. S.S. Thipse - Jaico
8. Refrigeration and Air Conditioning /Jordan & Preister /Prentice Hall

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year –II Sem. (Thermal Engineering)

COMPUTATIONAL FLUID DYNAMICS (Professional Core - 5)

UNIT - I:
Introduction to Numerical Methods - Finite Difference, Finite Element and Finite Volume Methods – Classification of Partial Differential Equations – Solution of Linear Algebraic Equations – Direct and Iterative Approaches
Finite difference methods: Taylor's series – FDE formulation for 1D and 2D steady state heat transfer problems – Cartesian, cylindrical and spherical co-ordinate systems – boundary conditions – Un steady state heat conduction – Errors associated with FDE - Explicit Method – Stability criteria – Implicit Method – Crank Nickolson method – 2-D FDE formulation – ADI – ADE

UNIT - II:
Finite Volume Method: Formation of Basic rules for control volume approach using 1D steady heat conduction equation – Interface Thermal Conductivity - Extension of General Nodal Equation to 2D and 3D Steady heat conduction and Unsteady heat conduction

UNIT - III:
FVM to Convection and Diffusion: Concept of Elliptic, Parabolic and Hyperbolic Equations applied to fluid flow – Governing Equations of Flow and Heat transfer – Steady 1D Convection Diffusion – Discretization Schemes and their assessment – Treatment of Boundary Conditions

UNIT - IV:
Calculation of Flow Field: Vorticity & Stream Function Method - Staggered Grid as Remedy for representation of Flow Field - Pressure and Velocity Corrections – Pressure Velocity Coupling - SIMPLE & SIMPLER (revised algorithm) Algorithm.

UNIT - V:
Turbulent Flows: Direct Numerical Simulation, Large Eddy Simulation and RANS Models
Compressible Flows: Introduction - Pressure, Velocity and Density Coupling.

REFERENCES:
1. Numerical heat transfer and fluid flow – S. V. Patankar (Hemisphere Pub. House)
2. An Introduction to Computational Fluid Dynamics – FVM Method – H. K. Versteeg, W. Malalasekhara (PHI)
3. Computational Fluid Flow and Heat Transfer – Muralidharan & Sundarajan (Narosa Pub)
4. Computational Fluid Dynamics – Hoffman and Chiang, Engg Education System
5. Computational Fluid Dynamics – Anderson (TMH)
6. Computational Methods for Fluid Dynamics – Ferziger, Peric (Springer)
7. Computational Fluid Dynamics, T.J. Chung, Cambridge University
8. Computational Fluid Dynamics – A Practical Approach – Tu, Yeoh, Liu (Elsevier)
9. Text Book of Fluid Dynamics, Frank Chorlton, CBS Publishers

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Thermal Engineering)

ADVANCED I. C. ENGINES (Professional Core - 6)

UNIT - I

.Introduction – Historical Review – Engine Types – Design and operating Parameters.
Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles – Real Engine cycles - differences and Factors responsible for – Computer Modeling.

UNIT - II:

Gas Exchange Processes: Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging.
Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

UNIT - III:

Engine Combustion in S.I Engines: Combustion and Speed – Cyclic Variations – Ignition – Abnormal combustion Fuel factors, MPFI, SI engine testing.
Combustion in CI engines: Essential Features – Types off Cycle. Pr. Data – Fuel
Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system.

UNIT - IV:

Pollutant Formation and Control: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.

UNIT - V:

Engine Heat Transfer: Importance of heat transfer, heat transfer and engine energy balance, Convective heat transfer, radiation heat transfer, Engine operating characteristics.
Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen.
Modern Trends in IC Engines: Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio – fuels, HCCI and GDI concepts.

REFERENCES:

1. I.C. Engines / V. Ganesan/TMH
2. I.C. Engines/G. K. Pathak & DK Chevan/ Standard Publications
3. I.C. Engines Fundamentals/Heywood/TMH
4. Dual-Fuel Diesel Engines – Ghazi A. Karim – CRC Press
5. I.C. Engines /RK Rajput/Laxmi Publications
6. Internal Combustion Engines – S.S. Thipse - Jaico
7. Computer Simulation of C.I. Engine Process/ V. Ganesan/University Press
8. Fundamentals of IC Engines/HN Gupta/PHI/2nd edition
9. I.C. Engines/Fergnson/Wiley
10. The I.C. Engine in theory and Practice Vol.I / Teylor / IT Prof. And Vol. II
11. Computer Simulation of Spark-Ignition Engine Processes – V. Ganesan – Universities Press

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Thermal Engineering)

ALTERNATIVE FUELS FOR I. C. ENGINES (Professional Elective - 3)

UNIT - I :
Need for alternate fuel : Availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources. Like EV, hybrid, fuel cell and solar cars.

UNIT- II:
Alcohols: Properties as engine fuel, alcohols and gasoline blends, performance in SI engine, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, DME, DEE properties performance analysis, performance in SI & CI Engines.

UNIT- III:
Natural Gas, LPG, Hydrogen and Biogas: Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG using LPG in SI & CI engines, performance and emission of LPG. Hydrogen; storage and handling, performance and safety aspects.

UNIT - IV:
Technical Background of Diesel/Bio-diesel fuels-Oil feed stocks- Transesterification-Bio-diesel production from Vegetable oils and waste cooking oil-High blend levels of bio-diesel-Testing , Bio diesel-Oxidation stability-Performance in Engines, Properties of bio-fuels and their importance in the context of IC Engines. Vegetable Oils: Various vegetable oils for engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics

UNIT - V:
Electric, Hybrid, Fuel Cell And Solar Cars: Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar powered vehicles.

Reference Books:
1. Alternate Fuels - Dr. S. S. Thipse - Jaico Publications
2. Richard. L. Bechfold, Alternative Fuels Guide BooK, SAE International Warrendale - 1997.
3. Maheswar Dayal, Energy Today & tomorrow, -1 & B Horishr India-1982.
4. Nagpal, Power Plant Engineering, Khanna Publishers, 1991.
5. Alcohols as motor fuels progress in technology, Series No. 19 - SAE Publication USE - 1980.
6. SAE paper nos. 840367, 841333, 841334, 841156, Transactions, SAE, USA
7. Alternative Fuels Guidebook - Bechtold R.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Thermal Engineering)

TURBO MACHINES & PROPULSION SYSTEMS (Professional Elective - 3)

UNIT - I:
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
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.

UNIT - II:
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- III:
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
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-IV:
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.

UNIT-V:
Jet Propulsion-Classification-Thermodynamic analysis-Performance parameters-Rocket Propulsion-Classification-Propulsion systems.

REFERENCES:
1. Principles of Turbo Machines/DG Shepherd / Macmillan
2. Turbines, Pumps, Compressors/Yahya/TMH
3. Practice on Turbo Machines/ G. Gopal Krishnan &D. Prithviraj/ Sci Tech Publishers, Chennai
4. Gas Turbines/ Ganesan/TMH
5. Thermal Turbo machines- Singh-Wiley
6. Fundamentals of Turbo machinery/William W Perg/John Wiley & Sons
7. Principles of Jet Propulsion and Gas Turbine/NJ Zucrow/John Wiley & Sons/Newyork
8. Turbo machinery: Design & Theory-Rama S.R.Gorla, AijazA.Khan-CRC Press
9. Turbo machinery: Basic Theory & Applications-Earl Logar Jr-CRC Press

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year –II Sem. (Thermal Engineering)

ADVANCED FINITE ELEMENT METHODS (Professional Elective - 3)

UNIT - I

Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin's Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain- displacement relations.

UNIT - II

1-D Structural Problems: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.
Analysis of Trusses : Plane Trusses and Space Truss elements and problems
Analysis of Beams : Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT - III

2-D Problems: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration.
Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.
3-D Problems: Tetrahedran element – Jacobian matrix – Stiffness matrix.

UNIT - VI

Scalar Field Problems: 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems – Introduction to Torsional problems.

UNIT - V

Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

REFERENCES:

1. Finite Element Method – Dhanraj & Nair – Oxford
2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Applied Finite Element Analysis – Segerlind – Wiley India
4. The Finite Element Methods in Engineering / SS Rao / Pergamon.
5. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
6. Finite Element Modeling and Simulation with ANSYS Workbench – Chen &Lui - CRC
7. Finite Element Method – Zincowitz / McGraw Hill
8. Introduction to Fininte element analysis- S. Md. Jalaludeen, Anuradha Publications, print-2012
9. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
10. Finite Element Analysis – Theory & Programming – Krishna Moorthy / McGraw Hill
11. Finite Element Analysis – Bathe / PHI

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Thermal Engineering)

CONVECTIVE HEAT TRANSFER (Professional Elective - 4)

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

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

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

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

UNIT - V:
Convective Heat Transfer Through Porous Media: Area weighted velocity – Darcy flow model – energy equation – boundary layer solutions for 2-D forced convection – Fully developed duct flow – Natural convection in porous media – filled enclosures – stability of horizontal porous layers.

REFERENCES:
1. Convective Heat Transfer-Oosathuizen, Darin Naylor
2. Introduction to Convective Heat Transfer Analysis/ Patrick H. Oosthuigen & David Naylor /McGraw Hill
3. Convective Heat & Mass Transfer /Kays & Crawford/TMH
4. Fundamentals of Heat & Mass Transfer – Thirumaleshwar – Pearson
5. Heat Transfer – Gregory Nellis& Sanford Klein - Cambridge

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Thermal Engineering)

EQUIPMENT DESIGN FOR THERMAL SYSTEMS (Professional Elective - 4)

UNIT - I:

Classification of Heat Exchangers: Introduction, Recuperation & regeneration, Tabular heat exchangers, Double pipe, shell & tube heat exchanger, Plate heat Exchangers, Gasketed plate heat exchanger. Spiral plate heat exchanger, Lamella heat exchanger, Extended surface heat exchanger, Plate fin and Tabular fin.

Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient, LMTD method for heat exchanger analysis, Parallel flow, Counter flow. Multipass, cross flow heat exchanger design calculations:

UNIT- II:

Double Pipe Heat Exchanger: Film coefficient for fluids in annulus, fouling factors, Calorific temperature, Average fluid temperature, The calculation of double pipe exchanger, Double pipe exchangers in series parallel arrangements.

Shell & Tube Heat Exchangers: Tube layouts for exchangers, Baffle heat exchangers, Calculation of shell and tube heat exchangers, Shell side film coefficients, Shell side equivalent diameter, The true temperature difference in a 1-2 heat exchanger. Influence of approach temperature on correction factor. Shell side pressure drop, Tube side pressure drop, Analysis of performance of 1-2 heat exchanger and design of shell & tube heat exchangers, Flow arrangements for increased heat recovery, the calculation of 2-4 exchangers.

UNIT - III:

Condensation of Single Vapours: Calculation of horizontal condenser, Vertical condenser, De-Super heater condenser, Vertical condenser-sub-Cooler, Horizontal Condenser-Sub cooler, Vertical reflux type condenser. Condensation of steam.

UNIT - IV:

Vaporizers, Evaporators and Reboilers: Vaporizing processes, Forced circulation vaporizing exchanger, Natural circulation vaporizing exchangers, Calculations of a reboiler. Extended Surfaces: Longitudinal fins. Weighted fin efficiency curve, Calculation of a Double pipe fin efficiency curve. Calculation of a double pipe finned exchanger, Calculation of a longitudinal fin shell and tube exchanger.

UNIT - V:

Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb & dew point temperatures, The Lewis number and Classification of cooling towers, Cooling tower internals and the roll of fill, Heat Balance. Heat Transfer by simultaneous diffusion and convection, Analysis of cooling tower requirements, Deign of cooling towers, Determination of the number of diffusion units, Calculation of cooling tower performance.

REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Thermal Engineering)

COMPUTER SIMULATION OF SI & CI ENGINES (Professional Elective - 4)

UNIT - I
Computer Simulation and Thermodynamics of Combustion:
Introduction, Heat of reaction, complete combustion in C/H/O/N Systems, Constant volume adiabatic combustion, constant pressure adiabatic combustion. Calculation of adiabatic flame temperature.

UNIT - II
SI Engine Simulation With Fuel-Air as Working Medium: Deviation between actual and air standard cycles of operation- problems, SI engine simulation with adiabatic constant volume combustion with fuel and air being considered, calculation of temperature drop due to fuel vaporization, calculation of mean effective pressure, torque and thermal efficiency at full throttle, part throttle and supercharged conditions.

UNIT - III
Actual Cycle Simulation in SI Engines: Progressive combustion; gas exchange process, heat transfer process, friction. Procedure of validating computer code with experimental data based on performance parameters and pressure crank angle diagram.

UNIT - IV
Simulation of 2-Stroke SI Engine: Simulation of the process, determination of the pressure-crank angle variation, computation of performance parameters.

UNIT - V
Diesel Engine Simulation: Main difference between SI and CI engine simulation, differences between ideal and actual cycles, mathematical combustion model for diesel engine, heat transfer and gas exchange processes.

REFERENCE BOOKS:

1. Ganesan, V. - Computer Simulation of Spark Ignition Engine Process, Universities Press (I) Ltd, Hyderabad - 1996.
2. Ganesan. V, Computer Simulation of Compression Ignition Engine Process, Universities Press (I) Ltd, Hyderabad-2000.
3. Ashley Campbel , Thermodynamic Analysis of Combustion Engine - John Wiley and Sons, New York - 1986.
4. Benson. R.S., Whitehouse. N.D., - Internal Combustion Engines- Pergamon Press, oxford - 1979.
5. Ramoss. A.L., Modelling of Internal Combusion Engines Processes- McGraw-Hill Publishing Co., -1992.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (Thermal Engineering)

COMPUTATIONAL METHODS LAB

Solving Thermal Engineering problems using available packages such as T K Solver, ANSYS, CFX, STARCD, MATLAB, FLUENT etc…some of the problems are as follows:

1. Simulation of Plane Poiseuille Flow between Two Long Parallel and Stationary Plates
2. Simulation of Couette Flow when the Upper Plate is moving with a velocity
3. Simulation of a Channel Flow(Tube flow) subjected to a Constant wall Temperature/ constant Wall Heat Flux
4. Simulation of Flow Inside a Square Enclosure subjected to Different Temperatures under : a) Natural Convection and b) Natural Convection and Radiation
5. Transient Simulation of Compressible Flow of Air through 2D Convergent Nozzle
6. Simulation of Flow over a Circular Cylinder of size 5cm for different Reynold's number values of Air
7. Simulation of Temperature Contours for a Square Plate of size 0.2m and subjected to different types of Boundary Conditions
8. Simulation of Temperature Contours for a Pin Fin subjected to Natural and Forced Convection conditions