ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS
(MR13 Regulations)

For

M.Tech. (THERMAL ENGIEERING)

(Applicable for the batches admitted from academic year 2013-14)

Department of Mechanical Engineering

MALLAREDDY ENGINEERING COLLEGE

(Autonomous)

Maisammaguda, Dulapally (post & via Kompally), Secunderabsd-500 100

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MALLAREDDY ENGINEERING COLLEGE(AUTONOMOUS)

Maisammaguda, Dhulapally (Post via. Kompally), Secunderabad – 500100

ACADEMIC REGULATIONS MR 13 FOR M. TECH. (REGULAR) DEGREE COURSE

(Effective for the students admitted into first year from the academic year 2013-2014)

The M.Tech Degree of MALLAREDDY ENGINEERING COLLEGE, Hyderabad shall be conferred on candidates by the Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad who are admitted to the program and fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to the eligibility, qualifications and Specialization as prescribed by the university/college from time to time.

Admissions shall be made on the basis of merit/rank obtained by the qualifying candidate at an Entrance Test conducted by the University/college or on the basis of any other order of merit approved by the University/college (say **PGECET/GATE)** subject to reservations as laid down by the Government from time to time.

2.0 AWARD OF M. TECH. DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years. However, he is permitted to write the examinations for two more years after four academic years of course work.

2.2 A student, who fails to fulfill all the academic requirements for the award of the degree within four Academic years from the year of his admission, shall forfeit his seat in M. Tech. course.

2.3 The student shall register for all 88 credits and secure all the 88 credits.

2.4 The minimum instruction days in each semester are 90.

3.0 A. COURSES OF STUDY

The following specializations are offered at present for the M. Tech. course of study.

1. Advanced Manufacturing Systems(AMS) - Shift II
2. Computer Science(CS) - Shift I
3. Computer Science and Engineering(CSE) - Shift I & II
4. Control Engineering(CE) - Shift I
5. Control Systems(CS) - Shift I & II
6. Digital Systems and Computer Electronics(DSCE) - Shift I & II
7. Embedded Systems(ES) - Shift I
8. Geotechnical Engineering(GTE) - Shift I
9. Power Electronics and Electrical Drives(PEED) - Shift II
10. Structural Engineering(SE) - Shift I
11. Transportation Engineering(TE) - Shift II
12. Thermal Engineering(THE) - Shift I
13. VLSI System Design(VLSI ED) - Shift I

3.0 B. Departments offering M. Tech. Programmes with specializations are noted below:

Civil Engineering Department.	1. Structural Engineering(SE) 2. Transportation Engineering(TE) 3. Geotechnical Engineering(GTE)
Computer Science & Engineering Department	1. Computer Science(CS) 2. Computer Science and Engineering(CSE)
Electrical & Electronics Engineering Department	1. Control Systems(CS) 2. Control Engineering(CE) 3. Power Electronics and Electrical Drives(PEED)
Electronics & Communication Engineering Department	1.Digital Systems and Computer Electronics(DSCE) 2. VLSI System Design(VLSI SD) 3. Embedded Systems(ES)
Mechanical Engineering Department	1. Thermal Engineering(THE) 2. Advanced Manufacturing Systems(AMS)

4.0 ATTENDANCE

The programs are offered on a unit basis with each subject being considered a unit.

4.1 A student shall be eligible to write University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.

4.3 Shortage of Attendance below 65% in aggregate shall not be condoned.

4.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class and their registration shall stand cancelled.

4.5 A prescribed fee shall be payable towards condonation of shortage of attendance.

4.6 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

4.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirements of the previous semester including the days of attendance in sports, games, NCC and NSS activities.

5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

5.1 For the theory subjects 75 marks shall be awarded based on the performance in the End Semester Examination and 25 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the **average** of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for a total duration of 120 minutes with Part A as one question to be answered out of two questions, which carries 10 marks and Part B with 3 questions to be answered out of 5 questions each question for 5 marks. If any candidate is absent for any subject of a mid -term examination, an additional exam will be conducted in the deserving cases based on the recommendations of the College Academic Committee. End semester examination is conducted for 75 marks with 5 questions to be answered out of 8 questions, each question carries 15 marks.

5.2 For practical subjects, 75 marks shall be awarded based on the performance in the End Semester Examinations and 25 marks shall be awarded based on the day-to-day performance as Internal Marks.

5.3 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

5.4 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is intended to assess the students' understanding of various subjects he has studied during the M. Tech. course of study. The Comprehensive Viva-Voce is evaluated for 100 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce.

5.5 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.5) he has to reappear for the End semester Examination in that subject. A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and so has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled.

5.7 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher and the second examiner shall be another Laboratory Teacher.

6.0 EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation after taking up a topic approved by the Project Review Committee(PRC).

6.1 A Project Review Committee shall be constituted with Principal as chair person, Head of the Department, Coordinator, Supervisor and two other senior faculty members.

6.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects (theory and practical subjects).

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the Departmental Academic Committee for its approval. Only after obtaining the approval of the Departmental Academic Committee can the student initiate the Project work. Departmental Committee(DAC) Consists of Head of the Department as Chairman, along with two Senior Professors and few subject experts too.

6.4 If a candidate wishes to change his supervisor or topic of the project he can do so with approval of Departmental Committee. However, the Departmental Committee shall examine whether the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of topic as the case may be.

6.5 Candidate shall submit status report (in a bound-form) in two stages at least with a gap of 3 months between them.

6.6 The work on the project shall be initiated in the beginning of the second year and the duration of the project is for two semesters. A candidate is permitted to submit Project Thesis only after successful completion of theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Principal (through Head of the Department) and shall make an oral presentation/demonstration before the PRC.

6.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/ Institute.

6.8 The thesis shall be adjudicated by one examiner selected by the College. For this, Head of the Department shall submit a panel of 3 examiners to the Chief Controller of Examinations of the College, who are eminent in that field with the help of the concerned guide and Head of the department.

6.9 If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis, in the time frame as described by PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected.

6.10 If the report of the examiner is favourable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work as one of the following:

A. Excellent
B. Good
C. Satisfactory
D. Unsatisfactory

The Head of the Department shall coordinate and make arrangements for the conduct of Viva- Voce examination.

If the report of the viva-voce is unsatisfactory, the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, he will not be eligible for the award of the degree unless he is asked to revise and resubmit by the Board.

7.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	**% of marks to be secured**
First Class with Distinction	70% and above
First Class	Below 70 but not less than 60%
Second Class	Below 60% but not less than 50%
Pass Class	Below 50% but not less than 40%

The marks in internal evaluation and end examination shall be shown separately in the memorandum of marks.

8.0 WITH-HOLDING OF RESULTS

If the candidate has not paid any dues to the university or if any case of in-discipline is pending against him, the result of the candidate will be withheld and he will not be allowed into the next higher semester. The issue of the degree is liable to be withheld in such cases.

9.0 TRANSITORY REGULATIONS

9.1 Discontinued, detained or failed candidates are eligible for admission to two earlier or equivalent subjects at a time as and when offered.
9.2 The candidate who fails in any subject will be given two chances to pass the same subject:otherwise, he has to identify an equivalent subject as per MR13 academic regulations.

10.0 GENERAL

10.1 The academic regulations should be read as a whole for purpose of any interpretation.
10.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.
10.3 The College may change or amend the academic regulations and syllabus at any time and the changes and amendments made shall be applicable to all the students with effect from the date notified by the College.
10.4 Wherever the word he, him or his occur, it will also include she, her and hers.
10.5 Wherever the word 'Subject' occurs in the above regulations, it implies the 'Theory Subject' and 'Practical Subject' or 'Lab'.
10.5 Transfers not allowed among group colleges.

MALPRACTICES RULES
DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any mark son the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shallot be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject tithe academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject

6	Refuses to obey the orders of the Chief Superintendent/Assistant –Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to the person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-incharge,or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police cases registered against them.
7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.

12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action toward suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
   (i) A show cause notice shall be issued to the college.
   (ii) Impose a suitable fine on the college.
   (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

MALLAREDDY ENGINEERING COLLEGE
(Autonomous)
M.Tech (THERMAL ENGINEERING)
COURSE STRUCTURE

I YEAR –I SEMESTER

Code No:	Subject	L	T	P	Credits
MR133101	Advanced Optimization Techniques & Applications	3	1	0	3
MR133102	Advanced Thermodynamics	3	1	0	3
MR133103	Advanced Heat & Mass Transfer	3	1	0	3
MR133104	Advanced Fluid Mechanics	3	1	0	3
MR133105 MR133106 MR133107	**Elective-I** 1.Turbo- Machines 2.Cryogenics Engineering 3.Solar Energy Technology	3	1	0	3
MR133108 MR133109 MR133110	**Elective-II** 1.Advanced I.C Engines 2.Non-Conventional Energy Sources 3.Material Science	3	1	0	3
MR133111	Thermal Engineering Lab	0	0	3	2
MR133112	Seminar	_	3	_	2
	Total	18	9	3	22

I YEAR –II SEMESTER

Code No:	Subject	L	T	P	Credits
MR133113	Fuel Combustion & Environment	3	1	0	3
MR133114	Energy Management	3	1	0	3
MR133115	Advanced Finite Element Analysis	3	1	0	3
MR133116	Computational Fluid Dynamics	3	1	0	3
MR133117 MR133118 MR133119	**Elective-III** 1.Equipment Design for Thermal Systems 2.Convective Heat Transfer 3.Thermal & Nuclear Power plants	3	1	0	3
MR133120 MR133121 MR133122	**Elective-IV** 1.Thermal Measurements and Process Controls 2.Refrigeration & Air Conditioning 3.Jet Propulsion & Rocketry	3	1	0	3
MR133123	Computational Methods Lab	0	0	3	2
MR133124	Seminar	_	3	_	2
	Total	18	9	3	22

II YEAR –I & II SEMESTER

Code No:	Subject	L	T	P	Credits
MR133126	Comprehensive Viva Voce	-	-	-	4
MR133127	Project work & seminar	-	-	-	40
	Total	-	-	-	44

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year I Semester	**3**	**1/-/-**	**3**

ADVANCED OPTIMIZATION TECHNIQUES AND APPLICATIONS

UNIT- I

Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods:- Uni-modal function, elimination methods, ,, Fibonacci method, golden section method, interpolation methods – quadratic & cubic interpolation methods.

UNIT- II

Multi variable non-linear unconstrained optimization: Direct search method – Univariant method - pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

UNIT- III

Geometric Programming: Polynomials – arithmetic - geometric inequality – unconstrained G.P- constrained G.P

Dynamic Programming: Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory, allocation, scheduling replacement.

UNIT- IV

Linear Programming: Formulation – Sensivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints.

Simulation – Introduction – Types- steps – application – inventory – queuing – thermal system.

UNIT- V

Integer Programming: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

Stochastic Programming: Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co variance, joint probability distribution- stochastic linear, dynamic programming.

TEXT BOOKS:

1. Optimization theory & Applications / S.S.Rao / New Age International.
2. Introductory to operation Research / Kasan & Kumar / Springar
3. Optimization Techniques theory and practice / M.C.Joshi, K.M.Moudgalya/ Narosa Publications

REFERENCE BOOKS:

1) S.D.Sharma / Operations Research
2) Operation Research / H.A.Taha /TMH
3) Optimization in operations research / R.LRardin
4) Optimization Techniques /Benugundu & Chandraputla / Pearson Asia

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

	L	T/P/D	C
M.Tech(Thermal Engineering)			
I Year I Semester	**3**	**1/-/-**	**3**

ADVANCED THERMO DYNAMICS

UNIT - I

Review of Thermo dynamic Laws and Corollaries – Transient Flow Analysis – Second law of thermodynamics – Entropy - Availability and unavailability – Irreversibility – Thermo dynamic Potentials – Maxwell Relations – Specific Heat Relations – Mayer's relation - Evaluation of Thermodynamic properties of working substance.

UNIT - II

P.V.T. surface – Equations of state – Real Gas Behaviour – Vander Waal's equation - eneralised compressibility Factor – Energy properties of Real Gases – Vapour pressure – Clausius – lapeyron Equation – Throttling – Joule – Thompson coefficient.Non-reactive Mixture of perfect Gases – Governing Laws – Evaluation of properties – Pychrometric Mixture properties and psychrometric chart – Air conditioning processes – Cooling Towers – Real Gas Mixture.

UNIT – III

Combustion – Combustion Reactions – Enthalpy of Formation – Entropy of Formation – Reference Levels for Tables – Energy of formation – Heat of Reaction – Aiabatic flame Temperature General product – Enthalpies – Equilibrium. Chemical Equilibrium of Ideal Gases – Effects of Non-reacting Gases Equilibrium in Multiple Reactions. The vant Hoff's Equation. The chemical potential and phase Equilibrium – The Gibbs phase Rule.

UNIT - IV

Power cycles, Review Binary vapour cycle, co-generation and Combined cycles – Second law analysis of cycles – Refrigeration cycles. Thermo Dynamics off irreversible processes – Introduction – phenomenological laws – Onsagar Reciprocity Relation – Applicability of the phenomenological Relations – Heat Flux and Entropy Production – Thermo dynamic phenomena – Thermo electric circuits.

UNIT - V

Direct Energy Conversion Introduction – Fuel Cells - Thermo electric energy – Thermo-ionic power generation - Thermodynamic devices Magneto Hydrodynamic Generations – Photo voltaic cells.

TEXT BOOKS :

1) Basic and Applied Thermodynamics, P.K. Nag, TMH
2) Thermo dynamics / Holman, Mc Graw Hill

REFERENCE BOOKS :

1. Thermo dynamics / Doolittle – Messe
2. Thermo dynamics / Sonnatag & Van Wylen
3. Irreversible Thermo Dynamics / HR De Groff.
4. Engg. Thermo dynamics /PL.Dhar

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

	L	T/P/D	C
M.Tech(Thermal Engineering)			
I Year I Semester	**3**	**1/-/-**	**3**

ADVANCED HEAT AND MASS TRANSFER

UNIT- I

Brief Introduction to different modes of heat transfer; Conduction: General heat conduction equation-Initial and Boundary conditions.

Steady State Heat Transfer: Simplified heat transfer in 1D and 2D – Fins

Transient heat conduction; Lumped system analysis- Heisler charts-semi infinite solid-use of shape factors in conduction - 2D transient heat conduction – product solutions.

UNIT - II

Finite Difference methods for Conduction: 1D & 2D steady state and simple transient heat conduction problems – implicit and explicit methods.

Forced Convection: Equations of Fluid Flow – Concepts of Continuity, momentum equations – Derivation of Energy equation - Methods to determine heat transfer coefficient: Analytical Methods - Dimensional Analysis and concept of exact solution. Approximate Method – Integral analysis.

UNIT - III

External flows: Flow over a flat plate: Integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometrics for Laminar and Turbulent flows.

Internal flows: Fully developed flow: Integral analysis for laminar heat transfer coefficient – Types of flow – Constant Wall Temperature and Constant Heat Flux Boundary Conditions - Hydrodynamic & thermal entry lengths; use of empirical correlations.

UNIT - IV

Free convection: Approximate analysis on laminar free convective heat transfer – Boussinesque Approximation - Different geometries – combined free and forced convection

Boiling and condensation: Boiling curve – Correlations- Nusselt's theory of film condensation on a vertical plate – Assumptions & correlations of film condensation for different geometrics.

UNIT - V

Radiation Heat Transfer: Radiant heat exchange in grey, non-grey bodies, with transmitting, reflecting and absorbing media, specular surfaces, gas radiation – radiation from flames.

Mass Transfer: Concepts of mass transfer – Diffusion & convective mass transfer Analogies – Significance of non-dimensional numbers.

TEXT BOOKS :

1. Heat Transfer – Necati Ozisik (TMH)
2. Heat and Mass Transfer – O P Single (Macmillan India Ltd)
3. Heat Transfer – P.S. Ghoshdastidar (Oxford Press)
4. Engg. Heat & Mass Transfer- Sarit K. Das (Dhanpat Rai)

REFERENCE BOOKS :

1. Fundamentals of Heat & Mass Transfer – Incroera Dewitt
2. Heat Transfer : A basic approach – Yunus Cangel (MH)
3. Heat & Mass Transfer – D.S. Kumar
4. Heat Transfer – P.K. Nag(TMH)
5. Principle of Heat Transfer – Frank Kreith & Mark.Bohn.
6. Convective Heat and Mass Transfer / W.M.Kays & M.E.Crawford(TMH)
7. Radiation Heat Transfer –G.M.Sparrow& R.D.Cess
8. Thermal Radiation heat transfer – R.Siegel & J.R.Howell

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

	L	T/P/D	C
M.Tech(Thermal Engineering)			
I Year I Semester	**3**	**1/-/-**	**3**

ADVANCED FLUID MECHANICS

UNIT- I:

Non – viscous 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 Cartesystems normal and tangential accelerations, Euler's, Bernouli equations in 3D– Continuity and Momentum Equations.

UNIT-II

Principles of 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 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. Schlichting H – Boundary Layer Theory (Springer Publications).
2. Convective Heat and Mass Transfer – Oosthigen, McGrawhill
3. Convective Heat and Mass Transfer – W.M. Kays, M.E. Crawford, McGrawhill
4. Fluid Mechanics and Hydraulic Machines by Rajput.

REFERENCE BOOKS:

1. Yuman S.W – Foundations of Fluid Mechanics.
2. An Introduction to Compressible Flow – Pai.
3. Dynamics & Theory and Dynamics of Compressible Fluid Flow – Shapiro.
4. Fluid Mechanics and Machinery – D. Rama Durgaiah.(New Age Pub.)
5. Fluid Dynamics – William F. Hughes & John A. Brighton (Tata McGraw-Hill Pub

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year I Semester	**-**	**-/3/-**	**2**

THERMAL ENGINEERING LABORATORY

1) Compressibility factor measurement of different real gases.
2) Dryness fraction estimation of steam.
3) Flame propagation analysis of gaseous fuels.
4) Performance test and analysis of exhaust gases of an I.C. Engine.
5) Heat Balance sheet, Volumetric Efficiency and air fuel ratio estimation of an I.C. Engine.
6) COP estimation of vapour compression refrigeration test.
7) Performance analysis of Air conditioning unit.
8) Performance analysis of heat pipe.
9) Solar Flat Plate Collector
10) Evacuative tube concentrator

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

	L	T/P/D	C
M.Tech(Thermal Engineering)			
I Year I Semester	**3**	**1/-/-**	**3**

TURBO MACHINES
(ELECTIVE I)

UNIT – 1

Fundamentals of Turbo machines: Classification, Applications Thermodynamic analysis; Isentropic flow, Energy transfer; Efficiencies; static and Stagnation conditions; continuity equation; Euler's flow through variable cross sectional area; unsteady flow in turbo machines.

UNIT –II

Steam Nozzles: Convergent and Convergent – Divergent nozzles; Energy balance; effect of back – pressure on the analysis; Design of nozzles.

Steam Turbines : Impulse Turbines: Compounding; work done and velocity triangles; Efficiencies; Constant Reaction Blading; Design of blade passages, angles and height; Secondary flow; leakage losses; Thermodynamic analysis of steam turbines.

UNIT –III

Gas Dynamics: Fundamentals thermodynamic concepts; Isentropic conditions; Mach number and Area – Velocity relation; Dynamic pressure; normal shock relations for perfect gas; supersonic flow, oblique shock waves ; normal shock recovery ; detached shocks ; Aerofoil theory.

Centrifugal Compressor: Types; Velocity triangles and efficiencies; Blade passage design; Diffuser and pressure recovery; slip factor; stanitz and stodolas formulae; Effect of inlet mach number; Prewirl; performance.

UNIT –IV

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: Geometry and Terminology; Blade forces, Efficiency; losses; free and forced vortex blades.

UNIT –V

Axial Flow Gas Turbines: Work done; velocity triangles and efficiencies; thermodynamic flow analysis; degree of reaction; Zweifels relation; Design cascade analysis – Soderberg – Hawthrone – ainley-correlations; secondary flow; Free-vortex blades; Blade angles for variable degree of reaction; Actuator disc theory; stresses in blades; Blade assembling; materials and cooling of blades; performance; Matching of compressor and turbine; off-design performance.

TEXTBOOKS :

1 Fundamentals of Turbo machines – Shephard
2 Practise on Turbomachines – G. Gopalakrishnan & D. Prithviraj, SciTech Publishers, Chennai.

REFERENCE BOOKS :

1. Theory and practice of steam turbines – Kearton
2. Gas Turbines – Theory and practice – Zucrow
3. Elements of Gas Dynamics – Liepman and Roshkow
4. Elements of Gas Dynamics – Yahya
5. Turbines, Pumps, Compressors – Yahya
6. Axial Flow Compressors – Horlock.
7. Gas Turbines- Cohen, Roger & Sarvanamuttu

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year I Semester	**3**	**1/-/-**	**3**

CRYOGENIC ENGINEERING
(ELECTIVE I)

UNIT – I

Introduction to CRYOGENIC Systems – Mechanical Properties at low temperatures –Properties of cryogenic fluids.

Gas Liquefaction: Minimum work for liquefaction – Methods to produce low temperature – Liquefaction systems for gases other than Neon, Hydrogen and Helium

UNIT – II

Liquefaction systems for Neon, Hydrogen and Helium Components of Liquefaction systems – Heat Exchangers – Compressors and Expanders – expansion valve – Losses for real machines.

UNIT – III

Gas separation and purification systems – Properties of mixtures – Principles of mixtures – Principles of gas separation – Air separation systems.

UNIT –IV

Cryogenic Refrigeration Systems – Working media – Solids, Liquids and gases Cryogenic fluid storage & transfer – Cryogenic storage systems – Insulation – Fluid transfer mechanisms – Cryostat – Cryo Coolers.

UNIT –V

Applications – Space technology – In-flight air seperation and collection of LOX – Gas Industry – Biology – Medicine - Electronics

TEXT BOOKS :

1. Cryogenic Systems – R.F. Barron, Oxford University Press
2. Cryogenic Research and Applications – Marshall Sitting, Von Nostrand Inc, New Jersey

REFERENCE BOOKS:

1. Cryogenics Engineering Edit by B.A.Hands, Academic Press, 1986
2. Cryogenics Engineering – R. B. Scott, Von Nostrand Inc, New Jersey, 1959
3. Experimental Techniques in Low Temperature Physics – G.K. White, Oxford Press, 1968
4. Cryogenics process Engineering – K.D.Timmerhaus & TM Flynn, Plenum press, 1998
5. Cryogenic Heat Transfer - R.F. Baron.
6. Cryogenic Two Phase flow – N.N . Falina and J.G. Weisend –II
7. Cryogenic Regenerative Heat Exchangers – Robort Ackermann, Plenum Press, 1997
8. Cryogenic Engineering – Thomas M. Flynn
9. Safety in Handling of Cryogenic Fluids – Fredrick J. Edeskutty and Watter F. Stewart, Plenum Press, 1996
10. Hand Book of Cryogenic Engineering – J.G.Weisend –II, Taylor and Francis, 1998

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year I Semester	**3**	**1/-/-**	**3**

SOLAR ENERGY TECHNOLOGY
(ELECTIVE I)

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.

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 BOOKS:

1. Principles of solar engineering – Kreith and Kerider
2. Solar energy thermal processes – Duffie and Beckman
3. Solar energy – Sukhatme

REFERENCE BOOKS:

1. Solar energy – Garg
2. Solar energy – Magal
3. Soloar energy – Tiwari and Suneja
4. Power plant technology – El Waki

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

	L	T/P/D	C
M.Tech(Thermal Engineering)			
I Year I Semester	**3**	**1/-/-**	**3**

ADVANCED I.C. ENGINES
(ELECTIVE II)

UNIT - 1:
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

TEXT BOOKS:
1. I.C. Engines Fundamentals/Heywood/Mc Graw Hill
2. The I.C. Engine in theory and Practice Vol.I / Teylor / IT Prof. And Vol.II

REFERENCES BOOKS:
1. I.C. Engines: Obert/Int – Text Book Co.
2. I.C. Engines: Maleev
3. Combustion Engine Processes: Lichty
4. I.C. Engines: Ferguson
5. Scavenging of Two – stroke Cycle Engines – Switzer.
6. I.C.Engines by V.Ganesan

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year I Semester	**3**	**1/-/-**	**3**

NON CONVENTIONAL ENERGY SOURCES
(ELECTIVE II)

UNIT – I

Introduction – Energy Sinario - Survey of Energy Resources – Classification – Need for Non-Conventional Energy Resources. **Solar Energy:** The Sun – 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 – II

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 – III

Direct Energy Conversion: Nuclear Fusion - Fusion – Fusion Reaction- P-P Cycle carbon Cycle, Deuterium cycle – condition for controlled Fusion. Fuel Cells and Photovoltaic –Thermionic and Thermoelectric Generation – MHD Generator.

Hydrogen gas a Fuel – Production methods – Properties – I.C. Engines Applications – Utilization Strategy – Performances.

UNIT – IV

Bio – Energy: Biomass Energy Sources – Plant Productivity, Biomass Wastes – Aerobic and Anaerobic bio-conversion processes – Raw Materials and properties of Bio-gas-Bio-gas plant Technology and Status – The Energetics and Economics of Biomass Systems – Biomass gasification.

UNIT – V

Wind Energy: Wind – Beaufort number – characteristics – wind energy conversion systems – types – Betz model – Interference Factor – Power Coefficient – Torque Coefficient and thrust coeff.- Lift machines and drag machines – matching – electricity generation.

Energy from Oceans:

Tidal Energy; Tides – Diurnal and Semi – Diurnal 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 BOOKS:

1. Renewable Energy Resources – Basic Principles and Applications – G.N.Tiwari and M.K.Ghosal, Narosa Pub

REERENCE BOOKS :

1. Renewable Energy Resources / John Twidell & Tony Weir
2. Biological Energy Resources / Malcolm Flescher & Chrris Lawis

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

	L	T/P/D	C
M.Tech(Thermal Engineering)			
I Year I Semester	**3**	**1/-/-**	**3**

MATERIAL SCIENCE
(ELECTIVE II)

UNIT – I:

Atomic And Ionic Arrengements:

Amorphous Materials : Principles and Technological Applications, Lattice, Unit cell, Basis, and Crystal Structures, Points, Directions, and Planes in the unit cell, Crystal Strrutures of Ionic Materials Implementation in the Atomic and Ionic Arrangements:

Points Defects, Dislocations, Significance of Dislocations, Scmid's Law, Surface defects.

UNIT – II:

Mechanical Properties: Fundamentals And Tensile, Hardness, And Impact

TESTING: The Tensile Test: Use of the Stress – Strain Diagram, True Stress and True Strain, The Bend Test for Brittle Materials, Hardness of Materials, Strian Rate effects and Impact Behaviour Heat Treatment of Steels and Cast Irons: Designations and Classification of Steels, Simple Heat treatments, Isothermal Heat treatments, Quench and Temper Heat treatments, Surface treatments, Weldability of Steel.

UNIT – III:

Fracture Mechanics, Fatigue, And Creep Behaviour: Fracture Mechanics, The

Importance of Fracture Mechanics, Microstructural Features of Fracture in Metallic Materials.,Microstructural Features of Fracture in Ceramics, Glasses, and Composites, Fatugue, Result of the Fatigue test, Application of Fatigue test, Creep, Stress Ruptur, and Stress Corrosion, Evaluation of creep Behaviour

UNIT – IV:

Polymers: Classifications of Polymers, Typical Thermoplastics, Structure - Property Relationship in thermoplastics, Effect of Temperature on thermoplastics, Mechanical Properties of thermoplastics, Elastomers (Rubbers), Thermosetting Polymers

Ceramic Materials: Applications of Ceramics, Properties of Ceramics, Characteristics of Sintered ceramics, Glass Ceramics, Refractories.

UNIT – V:

Composites: Teamwork And Synergy In Material: Particulate Composites, Fibre – Reinforced Composites, Characteristics of Fible – Reinforced composites, Manufacturing Fiber and Composites, Fiber Reinforced Systems and Applications, Laminar Composite Materials, Examples

TEXT BOOKS:

1. High temperature materials technology – Campbell E.E. and Sherwood – John Wiley and Sons, 1967
2. High temperature technology – Campbell I.E. – John Wiley

REFERENCE BOOKS:

1. High temperature materials – Hehmann R.F. – Wiley and sons, 1967.
2. Behaviour of high temperature alloys – Proceeding of International conference, 1979.

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year II Semester	**3**	**1/-/-**	**3**

FUELS, COMBUSTION AND ENVIRONMENT

UNIT –I

Fuels – detailed classification – Conventional and Unconventional Solid, Liquid, gaseous fuels and nuclear fuels – Origin of Coal – Analysis of coal.

Coal – Carborisation, Gasification and liquification – Lignite: petroleum based fuels – problems associated with very low calorific value gases: Coal Gas – Blast Furnace Gas Alcohols and Biogas.

UNIT –II

Principles of combustion – Chemical composition – Flue gas anlaysis – 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 behavior of HC's.

UNIT – III

Thermodynamics of combustion – Enthalpy of formation – Heating value of fuel - Adiabatic flame Temperature – Equilibrium composition of gaseous mixtures.

UNIT –IV

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 – Pulverised fuel furnaces – fixed, Entrained and Fluidised Bed Systems.

UNIT – V

Environmental considerations – Air pollution – Effects on Environment, Human Health etc. Principal pollutants – Legislative Measures – Methods of Emission control.

TEXT BOOKS :

1. Combustion Fundamentals by Roger A strehlow – Mc Graw Hill
2. Fuels and combustion by Sharma and Chander Mohan – Tata Mc Graw Hill

REFERENCES BOOKS:

1. Combustion Engineering and Fuel Technology by Shaha A.K. Oxford and IBH.
2. Principles of Combustion by Kanneth K.Kuo, Wiley and Sons.
3. Combustion by Sarkar – Mc. Graw Hill.
4. An Introduction to Combustion – Stephen R. Turns, Mc. Graw Hill International Edition.
5. Combustion Engineering – Gary L. Berman & Kenneth W. Ragland, Mc. Graw Hill International Edition.
6. Combustion- I. Glassman

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

	L	T/P/D	C
M.Tech(Thermal Engineering)			
I Year II Semester	**3**	**1/-/-**	**3**

ENERGY MANAGEMENT

UNIT- I:
Introduction: Principles of Energy Management – Managerial Organization – Functional Areas for i. Manufacturing Industry ii. Process Industry iii. Commerce iv. Government. Role of Energy Manager in each of these organization. Initiating, Organising and Managing Energy Management Programs.

UNIT- II:
Energy Audit: Definition and Concepts, Types of Energy Audits – Basic Energy Concepts – Resources for Plant Energy Studies – Data Gathering – Analytical Techniques.
Energy Conservation: Technologies for Energy Conservation , Design for Conservation of Energy materials – energy flow networks – critical assessment of energy usage – formulation of objectives and constraints – synthesis of alternative options and technical analysis of options – process integration.

UNIT- III:
Economic Analysis: Scope, Characterization of an Investment Project – Types of Deprecication – Time Value of money – budget considerations, Risk Analysis.

UNIT- IV:
Methods of Evaluation of Projects : Payback – Annualised Costs – Investor's Rate of return – Present worth – Internal Rate of Return – Pros and Cons of the common methods of analysis – replacement analysis.

UNIT- V:
Alternative Energy Sources: Solar Energy – Types of devices for Solar Energy Collection – Thermal Storage System – Control Systems-
Wind Energy – Availability – Wind Devices – Wind Characteristics – Performance of Turbines and systems.

TEXT BOOKS :
1. Energy Management Hand book by W.C. Turner (Ed)
2. Management by H.Koontz and Cyrill O Donnell

REFERENCES BOOKS:
1. Financial Management by S.C. Kuchhal
2. Energy Management by W.R.Murthy and G.Mc Kay
3. Energy Management Principles by CB Smith.

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year II Semester	**3**	**1/-/-**	**3**

ADVANCED FINITE ELEMENT ANALYSIS

UNIT -I

Introduction to FEM: basic concepts, historical back ground, application of FEM, general description, comparison of fem with other methods, variational approach, Galerkin 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 function. Analysis of Trusses – Plane Truss and Space Truss elements. Analysis of beams – Hermite shape functions – stiffness matrix – Load vector – Problems – analysis.

UNIT -III

2-D problems –CST, force terms, Stiffness matrix and load vector, boundary conditions, Isoparametric element – quadrilateral element, Shape functions – Numerical Integration. Finite Element modeling of axisymmetric solids subjected to axi symmetric loading with triangular elements. 3-D problems – Tetrahedran element – Jacobian matrix – Stiffness matrix

UNIT -IV

Scalar field problems - 1-D Heat conduction – 1-D fin element – 2-D heat conduction problems – Torsion.

UNIT -V

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

TEXT BOOKS:

1. Introduction to finite elements in engineering – Tirupathi K. Chandrupatla and Ashok D. Belagundu.
2. The finite element methods in Engineering – S.S. Rao _ Pergamon, New York

REFERENCES BOOKS:

1. An Introduction to Finite Element Methods – J. N. Reddy – Mc Grawhill
2. The Finite element method in engineering science – O.C. Aienkowitz, Mc Grawhill.
3. Concepts and applications of finite element analysis – Robert Cook
4. Finite Element Procedures in Engineering analysis – K.J Bathe
5. Introduction to Finite Element Analysis-S.Md.Jalaludeen,Anuradha Publications

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year II Semester	**3**	**1/-/-**	**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, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

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 Flow and Heat Transfer – Muralidharan & Sundarajan (Narosa Pub)
2. Numerical heat transfer and fluid flow – S.V. Patankar (Hemisphere Pub. House)

REFERENCE BOOKS:

1. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press,2002.
2. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
3. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
4. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford University
5. Press/2nd EditionAn Introduction to Computational Fluid Dynamics – FVM Method – H.K. Versteeg, W. Malalasekhara (PHI)
6. Computational Fluid Dynamics – Anderson (TMH)
7. Computational Methods for Fluid Dynamics – Ferziger, Peric (Springer)
8. Computational Fluid Dynamics – A Practical Approach – Tu, Yeoh, Liu (Elsevier)
9. Text Book of Fluid Dynamics, Frank Chorlton, CBS Publishers

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year II Semester	**-**	**-/3/-**	**2**

COMPUTATIONAL METHODS LABORATARY

C programming for problem solving.

Solving Thermal Engineering problems using available packages such as T K Solver,

ANSYS, CFX, STARCD, MATLAB, FLUENT etc…

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

	L	T/P/D	C
M.Tech(Thermal Engineering)			
I Year II Semester	**3**	**1/-/-**	**3**

EQUIPMENT DESIGN FOR THERMAL SYSTEMS
(ELECTIVE III)

UNIT -I

Classification of heat exchangers: Introduction, Recuperation & Regeneration – Tubular 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 Tubular 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 calculation of shell & tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers.

UNIT -III

Condensation of single vapors: Calculation of a horizontal condenser, vertical condenser, De-super heater condenser, vertical condenser – sub-cooler, horizontal condenser – subcooler, vertical reflux type condenser, condensation of steam.

UNIT –IV

Vaporizers, Evaporators and Reboilers: Vaporizing processes, forced circulation vaporizing exchangers, 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, Design of cooling towers, Determination of the number of diffusion units, calculation of cooling tower performance.

TEXT BOOKS :

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

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year II Semester	**3**	**1/-/-**	**3**

CONVECTIVE HEAT TRANSFER
(ELECTIVE III)

UNIT-I

Introduction: 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.

TEXT BOOKS:

1. Introduction to Convective Heat Transfer Analysis – Patrick H. Oosthuigen & David Naylor (MCH)
2. Convective Heat & Mass Transfer – Kays & Crawford (TMH)

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year II Semester	**3**	**1/-/-**	**3**

THERMAL AND NUCLEAR POWER PLANTS
(ELECTIVE III)

UNIT -I

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

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

Steam Generators: Types, Accessories, Feed water heaters, Performance of Boilers, Water Treatment, Cooling Towers, Steam Turbines, Compounding of Turbines, Steam Condensers, Jet & Surface Condensers.

UNIT -II

Gas Turbine Power Plant: Cogeneration, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion – Advantages & Disadvantages.

UNIT -III

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

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

UNIT -IV

Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems.

UNIT - V

Power Plant Instrumentation: Classification, Pressure measuring instruments, Temperature measurement and Flow measurement. Analysis of Combustion gases, Pollution – Types, Methods to Control.

TEXT BOOKS:

1. Power Plant Engineering / P.K. Nag / TMH.
2. Power Plant Engineering / R.K. Rajput / Lakshmi Publications.

REFERENCE BOOKS:

3. Power Plant Engineering / P.C.Sharma / Kotaria Publications.
4. Power Plant Technology / Wakil.

MALLAREDDY ENGINEERING COLLEGE
(AUTONOMOUS)

M.Tech(Thermal Engineering)	**L**	**T/P/D**	**C**
I Year II Semester	**3**	**1/-/-**	**3**

THERMAL MEASUREMENTS AND PROCESSCONTROLS
(ELECTIVE IV)

UNIT-I

General concepts – fundamental elements of a measuring instrument. 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 measuring – Measurement of low pressure, Manometers, Calibration methods, Dynamic characteristics-design principles.

UNIT-II

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-III

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.

UNIT-IV

Level Measurement: Direct & indirect methods, manometric methods, float level meters, electrical conductivity, Capacitive, Ultrasonic, and Nucleonic Methods.

Measurement of density – Hydrometer, continuous weight method, Gamma rays, Gas impulse wheel.

Velocity Measurement – Coefficient of viscosity, Ostesld method, free fall of piston under gravity, torque method.

Measurement of moisture content and humidity.

Measurement of thermal conductivity of solids, liquids and gases.

UNIT-V:

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, transient regulations.

TEXT BOOKS:

1. Measurement System, Application & Design – E.O. Doeblin.
2. Control Systems, Principles & Design, 2nd Edition – M. Gopal – TMH.

REFERENCE BOOKS:

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

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REFRIGERATION AND AIR CONDITIONING
(ELECTIVE IV)

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.

TEXT BOOKS :

1. Refrigeration & Air Conditioning – C.P. Arora(TMH)
2. Refrigeration & Air Conditioning – Arora & Domkundwar – Dhanpat Rai

REFERENCE BOOKS :

1) Refrigeration and Air Conditioning :Manohar Prasad
2) Refrigeration and Air Conditioning : Stoecker – Mc Graw Hill
3) Principles of Refrigeration – Dossat (Pearson)
4) Refrigeration and Air Conditioning : Ananthanarayana (TMH)
5) Refrigeration and Air Conditioning : Jordan and – Prentice Hall, Preister
6) Refrigeration and Air Conditioning : Dossat – Mc Graw Hill
7) Thermal Environmental Engg. : Threlkeld – Van Nostrand
8) Refrigeration and Air Conditioning : Ballany – Khanna
9) Refrigeration and Air Conditioning : Arora – Tata Mc Graw Hill
10) Refrigeration and Air Conditioning : Domkundwar – Dhanpatrai
11) Refrigeration and Air Conditioning : SC Jain S.Chand and Co.
12) Ashrae Hand Book : 2 Vols.

MALLAREDDY ENGINEERING COLLEGE
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M.Tech(Thermal Engineering)			
I Year II Semester	**3**	**1/-/-**	**3**

JET PROPULSION AND ROCKETRY
(ELECTIVE IV)

UNIT - I

Turbo Jet Propulsion System: 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 - II

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, A_c / A_t of a nozzle, Supersonic nozzle shape, non-adapted nozzles, summer field 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 - III

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 -IV

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 - V

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 IIRR propulsion systems.

TEXT BOOKS:

1. Mechanics and Dynamics of Propulsion – Hill and Peterson
2. Rocket propulsion elements – Sutton

REFERENCES BOOKS:

1. Gas Turbines – Ganesan (TMH)
2. Gas Turbines & Propulsive Systems – Khajuria & Dubey (Dhanpatrai)
3. Rocket propulsion – Bevere
4. Jet propulsion – Nicholas Cumpsty