MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

Sponsored by CMR Educational Society

(Affiliated to JNTU, Hyderabad, Approved by AICTE - Accredited by NBA & NAAC – 'A' Grade - ISO 9001:2008 Certified)
Maisammaguda, Dhulapally (Post Via Hakimpet), Secunderabad – 500100, Telangana State, India.
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MASTER OF TECHNOLOGY
THERMAL ENGINEERING

DEPARTMENT OF
MECHANICAL ENGINEERING

ACADEMIC REGULATIONS
COURSE STRUCTURE AND SYLLABUS
(Batches admitted from the academic year 2015 - 2016)

Note: The regulations hereunder are subjected to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates (including those already pursuing the program) as may be decided by the Academic Council.

PRELIMINARY DEFINITIONS AND NOMENCLATURES

*"Autonomous Institution /College" means an institution/college designated as autonomous institute / college by University Grants Commission (UGC), as per the UGC Autonomous College Statutes.

*"Academic Autonomy" means freedom to a College in all aspects of conducting its academic programs, granted by the University for promoting excellence.

*"Commission" means University Grants Commission.

*"AICTE" means All India Council for Technical Education.

*"University" means Jawaharlal Nehru Technological University, Hyderabad.

*"College" means Malla Reddy College of Engineering & Technology, Secunderabad unless indicated otherwise by the context.

*"Program" means:

Master of Technology (M.Tech) degree program

PG Degree Program: M.Tech

*"Branch" means specialization in a program like M.Tech degree program in Mechanical Engineering, M.Tech degree program in Aeronautical Engineering etc.

*"Course" or "Subject" means a theory or practical subject, identified by its course – number and course-title, which is normally studied in a semester.

*T–Tutorial, P–Practical, D–Drawing, L-Theory, C-Credits

FOREWORD

The autonomy is conferred on Malla Reddy College of Engineering & Technology (MRCET) by UGC based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like UGC and AICTE. It reflects the confidence of the UGC in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own curriculum, examination system and monitoring mechanism, independent of the affiliating University but under its observance.

Malla Reddy College of Engineering & Technology (MRCET) is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, and also improving upon the values and beliefs for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the College and recommendations of the JNTU Hyderabad to frame the regulations, course structure and syllabi under autonomous status.

The autonomous regulations, course structure and syllabi have been prepared after prolonged and detailed interaction with several experts drawn from academics, industry and research, in accordance with the vision and mission of the college which reflects the mindset of the institution in order to produce quality engineering graduates to the society.

All the faculty, parents and students are requested to go through all the rules and regulations carefully. Any clarifications, if needed, are to be sought at appropriate time and with principal of the college, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The Cooperation of all the stake holders is sought for the successful implementation of the autonomous system in the larger interests of the institution and brighter prospects of engineering graduates.

"A thought beyond the horizons of success committed for educational excellence"

PRINCIPAL

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

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VISION

- To become a model institution in the fields of Engineering Technology and Management.
- To have a perfect synchronization of the ideologies of MRCET with challenging demands of International Pioneering Organizations

MISSION

- To establish a pedestal for the integral innovation, team spirit, originality and competence in the students, expose them to face the global challenges and become pioneers of Indian vision of modern society

QUALITY POLICY

- To implement best practices in Teaching and Learning process for both UG and PG courses meticulously.
- To provide state of art infrastructure and expertise to impart the quality education.
- To groom the students to become intellectually creative and professionally competitive.
- To channelize the activities and tune them in heights of commitment and sincerity, the requisites to claim the never ending ladder of SUCCESS year after year.

For more information: www.mrcet.ac.in

ACADEMIC REGULATIONS R-15 FOR M. TECH. (REGULAR) DEGREE COURSE

Academic Regulations of R-15 are applicable for the students of M. Tech. (Regular) Course from the Academic Year 2015-16 and onwards. The M.Tech Degree of Malla Reddy College of Engineering & Technology (MRCET), Secunderabad shall be conferred on candidates who are admitted to the program and who 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 eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University (or) State Government (or) on the basis of any other order of merit as approved by the University, subject to norms as laid down by the State Govt. 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.
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. COURSE OF STUDY

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

1. Aerospace Engineering
2. Computer Science and Engineering
3. Machine Design
4. System and Signal Processing
5. VLSI and Embedded Systems
6. Thermal Engineering

and any other course as approved by the MRCET from time to time.

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

Aeronautical Engineering	Aerospace Engineering
Computer Science Engineering	Computer Science Engineering
Electronics & Communication Engineering	System & Signal Processing
Electronics & Communication Engineering	VLSI and Embedded Systems
Mechanical Engineering	Machine Design
Mechanical Engineering	Thermal Engineering

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 as determined by the examination branch 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 In order to qualify for the award of the M. Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.

4.8 A student shall not be promoted to the next semester unless he satisfies the minimum academic requirements of the previous semester.

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.

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 Examination Evaluation. The internal evaluation consists of two mid-term examination of 25 marks each covering descriptive paper which consists 5 questions consisting of two parts each (a) and (b), out of which the student has to answer either (a) or (b), not both. Each question carries 5 marks for a total duration of 2 hours. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each candidate.

However, any student scoring internal marks less than 40% will be given a chance to write the internal exam once again after he/she re-registering for the concerned subject and paying stipulated fees as per the norms.

5.1 The end semesters examination will be conducted for 75 marks with 5 questions consisting of two questions each (a) and (b), out of which the student has to answer

either (a) or (b), not both and 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 respectively. 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 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 Examination taken together.

5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to reappear for the End semester Examination in that subject.

5.6 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 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the End Examination in that subject. He shall re-register the subject when next offered.

5.8 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 on a topic approved by the Project Review Committee.

6.1 A Project Review Committee (PRC) shall be constituted with Principal as Chairperson, Heads of all the Departments offering the M. Tech. programs 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, both theory and practical.

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 approval. Only after obtaining the

approval of the Departmental Academic Committee can the student initiate the Project work.

6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Departmental Academic Committee. However, the Departmental Academic Committee shall examine whether or not 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 Supervisor or topic as the case may be.

6.5 A candidate shall submit his 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 at the beginning of the II year and the duration of the project is 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 make an oral presentation before the PRC.

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

6.8 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned 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 decided by the 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 favorable, 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 shall retake the Viva-Voce examination only 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.

7.0 AWARD OF DEGREE AND CLASS

In assessing the performance of the students in examinations, the usual approach is to award marks based on the examinations conducted at various stages (sessional, mid-term, end-semester etc.,) in a semester. As per UGC Autonomous guidelines, the following system

is implemented in awarding the grades and CGPA under the Credit Based Semester System (CBCS).

Letter Grades and Grade Points:

The UGC recommends a 10-point grading system with the following letter grades as given below:

Grades	Points	Marks secured (%)
O (Outstanding)	10	≥ 85
A+(Excellent)	9	80 – 84
A(Very Good)	8	75 – 79
B+(Good)	7	70 – 74
B(Above Average)	6	65 – 69
C(Average)	5	60 – 64
P(Pass)	4	50 – 59
F(Fail)	0	<50
Ab(Absent)	0	-

A student obtaining Grade F shall be considered failed and will be required to reappear in the examination

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

SGPA (S_i) = $\Sigma(C_i \times G_i) / \Sigma C_i$

where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA = $\Sigma(C_i \times S_i) / \Sigma C_i$

where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

8.0 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the Institute or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will 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.

10. GENERAL

10.1 Wherever the words he, him, his, occur in the regulations, they include she, her, hers .

10.2 The academic regulation should be read as a whole for the purpose of any interpretation.

10.3 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council of the College is final.

10.4 The College may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Academic Council of the College/Affiliating University.

MALPRACTICES RULES
DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S.No	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 marks on 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. 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 shall not be

		allowed to appear for examinations of the remaining subjects of that semester. 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. 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 othe 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. 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.	Using 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 his person or to any of his relations whether by words, either spoken or written or by signs or	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. The

	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.	candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is 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. 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. 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. 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.
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 examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Academic Council of the College (or) affiliating University for further action towards suitable punishment.	

Malpractices identified by squad or special invigilators will entail punishment to the candidates as per the above guidelines..

MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

M.TECH. (THERMAL ENGINEERING)

I Year I Semester (3 Subjects + 2 Core Electives +1 Open Elective +1 Lab)

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C	MAX MARKS	
						INT	EXT
1	R15D2101	Advanced Optimization Techniques and Application	4	-	3	25	75
2	R15D2102	Advanced Thermodynamics	4	-	3	25	75
3	R15D2103	Advanced Heat and Mass Transfer	4	-	3	25	75
4		**Elective I**	4	-	3	25	75
	R15D2104	Cryogenics Engineering					
	R15D2105	Solar Energy Technology					
	R15D2106	Turbomachines					
5		**Elective II**	4	-	3	25	75
	R15D2107	Advanced I.C. Engines					
	R15D2108	Non Conventional Energy Sources					
	R15D2109	Energy and Environmental Engineering					
6		**Open Elective I**	4	-	3	25	75
	R15D2110	Advanced Fluid Mechanics					
	R15D2111	Industrial pollution Prevention					
	R15D2112	Design of Heat Exchangers					
7	R15D2181	Thermal Engineering Lab	-	3	2	25	75
8	R15D2182	Technical Seminar		3	2	100	-
Total			24	6	22	275	525

I Year II Semester (3 Subjects+2 Core Electives+1 Open Elective+ 1 Lab)

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C	MAX MARKS	
						INT	EXT
1	R15D2213	Fuels, Combustion and Environment	4	-	3	25	75
2	R15D2214	Energy Management	4	-	3	25	75
3	R15D2215	Advanced Finite Element Analysis	4	-	3	25	75
4		**Elective III**	4	-	3	25	75
	R15D2216	Computational Fluid Dynamics					
	R15D2217	Equipment Design for Thermal Systems					
	R15D2218	Convective Heat Transfer					
5		**Elective IV**	4	-	3	25	75
	R15D2219	Thermal and Nuclear Power Plants					
	R15D2220	Thermal Measurements and Process Controls					
	R15D2221	Refrigeration and Air-Conditioning					
6		**Open Elective II**	4		3	25	75
	R15D2222	Jet Propulsion and Rocket Engines					
	R15D2223	Mathematical model of IC Engines					
	R15D2224	Industrial Refrigeration Systems					
7	R15D2283	Computational Methods Laboratory	-	3	2	25	75
8	R15D2284	Technical Seminar	-	3	2	100	-
Total			24	6	22	275	525

I Year III Semester

S.No.	Subject Code	SUBJECT	L	T/P/D	C	Max. Marks	
						INT	EXT
1	R15D2185	Project Seminar	-	3	4		
2	R15D2186	Project work			18		
Total				3	22		

II Year IV Semester

S.No.	Subject Code	SUBJECT	L	T/P/D	C	Max. Marks	
						INT	EXT
1	R15D2187	Project work and Viva Voce	-	3	22		
Total				3	22		

MALLAREDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M .Tech I Year–I Sem (Thermal Engineering)

L	T/P/D	C
4	-	3

(R15D2101) ADVANCED OPTIMIZATION TECHNIQUES AND APPLICATIONS

Objectives:

- Develop systematic approach to handle problems to design of electrical circuit etc., with a goal of maximizing the profit and minimizing cost.
- Understand the various optimization techniques such as classified optimization, linear programming. One dimensional minimization methods, unconstrained optimization techniques, constrained optimization techniques and dynamic programming.
- Understand the necessary sufficient conditions for finding the solution of the problems in classical optimization.
- Comprehend the numerical methods for finding approximate solution of complicated problems.
- Apply methods like North West corner rule, least count method etc. to solve the transportation problem

UNIT-I

Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods, Uni-modal function, elimination method, 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 – Sensitivity 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.

Outcomes:

- Design of mechanical systems and interdisciplinary engineering applications and business solutions using suitable optimization technique.
- Apply numerical or iterative techniques in power systems for optimal power flow solutions.
- Optimize the parameters in control systems for desired steady state or transient response.
- Optimize the cost function in deciding economic factors of power systems.

TEXTBOOKS:

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. Optimization in operations research/R.L Rardin.
2. Optimization Techniques/Benugundu & Chandraputla/Person Asia.

MALLAREDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech I Year – I Sem (Thermal Engineering)

L	T/P/D	C
4	0	3

(R15D2102) ADVANCED THERMODYNAMICS

Objectives:

- To understand the nature and operating principles of systems involving energy . flows.
- To describe and apply basic thermodynamic principles to analyze and predict . performance of idealized forms of thermodynamic systems.
- To describe and assess benefits of improvements to thermodynamic systems.
- To relate idealized thermodynamic system models to corresponding real systems.

UNIT-I

Review of Thermodynamic Laws and Corollaries: Transient flow analysis, Second law thermodynamics, Entropy, Availability and unavailability, Thermodynamic potential. Maxwell relations, Specific heat relations, Mayer's relation. Evaluation of thermodynamic properties of working substance.

UNIT-II

P.V.T Surface: Equation of state. Real gas behavior, Vander Waal's equation, Generalization compressibility factor. Energy properties of real gases. Vapour pressure, Clausius, Clapeyro equation. Throttling, Joule. Thompson coefficient. Non reactive mixtures of perfect gases. Governing laws, Evaluation of properties, Psychometric mixture properties and psychometric chart, Air conditioning processes, cooling towers. Real gas mixture.

UNIT-III

Combustion: Combustion Reactions, Enthalpy of formation. Entropy of formation, Reference levels of tables. Energy of formation, Heat reaction, Adiabatic flame temperature generated product, Enthalpies, Equilibrium. Chemical equilibrium of ideal gased, Effect of non reacting gases equilibrium in multiple reactions, the vent 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 analysts of cycles. Refrigeration cycles. Thermodynamics off irreversible processes. Introduction, Phenomenological laws, Onsaga Reciprocity relation, Applicability of the Phenomenological relations, Heat flux and entropy production, Thermodynamic phenomena, Thermo electric circuits.

UNIT-V

Direct Energy Conversion Introduction: Fuel cells, Thermo electric energy, Thermo ionic power eneration, Thermodynamic devices magneto hydronamic generations, Photovoltaic cells.

Out Comes:

- Provide in-depth knowledge on fundamental and applied thermodynamics and a firm grasp, clear understanding of basic priciples of work and energy conversion as well as their applications in advanced themodynamic cycles.

TEXT BOOKS:

1. P.K. Nag, "Engineering Thermodynamics", 4 th Edition, Tata McGraw-Hill Education Private Limited, 2010.
2. S.S. Thipse, "Advanced Thermodynamics", Narosa Publishing House, New Delhi, 2013
3. Thermal Engineering by R.K.Rajput, Lakshmi Publications.

REFERENCE BOOKS:

1. Y.A. Cengel and M.A. Boles, "Thermodynamics – An Engineering Approach", 5 th Edition in SI Units, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. C. Borganakke and R.E. Sonntag, "Fundamentals of Thermodynamics", 7 th Edition, Wiley India, Delhi, 2012.
3. Van P. Carey, "Statistical thermodynamics and micro scale thermo physics", Cambridge University Press, 1999

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L	T/P/D	C
4	0	3

(R15D2103) ADVANCED HEAT AND MASS TRANSFER

Objectives:

- To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.
- To analyze the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges**.**
- To achieve an understanding of the basic concepts of phase change processes and mass transfer

UNIT-I

Brief introduction to different modes of heat transfer: Conduction: General heat Conduction equation-initial and boundary conditions.

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

UNIT-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 geometries for laminar and turbulent flows.

Internal flows: Fully developed flow: integral analysis for laminar heat transfer coefficient-types of flow-constant wall temperature and constant heat flux boundary conditions-hydrodynamic *&* thermal entry lengths; use of empirical correlations.

UNIT-IV

Free convection: Approximate analysis on laminar free convective heat transfer-bousisinesq 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 geometries.

UNIT-V

Radiation heat transfer: Radiant heat exchange in grey, non-grey bodies, with transmitting. Reflecting and absorbing media, spherical surfaces, and gas radiation-radiation from flames.

Mass Transfer: Concepts of mass transfer-diffusion & convective mass transfer analogies-significance of non-dimensional numbers.

Outcomes:

- On successful completion of this course the student will be able to apply Various correlations for heat transfer calculations

TEXTBOOKS:

1. Principles of Heat Transfer/Frank Kreith/Cengage Learning
2. Elements of Heat Transfer/E. Radha Krishna/CRC Press/2012
3. Heat Transfer/RK Rajput/S.Chand

REFERENCE BOOKS:

1. Introduction to Heat Transfer/SK Som/PHI
2. Engineering Heat & Mass Transfer/Mahesh Rathore/Lakshmi Publications
3. Heat Transfer / Necati Ozisik / TMH

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(R15D2104) CRYOGENIC ENGINEERING
(ELECTIVE-I)

Objectives:

- To provide an introductory knowledge of Cryogenic Engineering.
- To understand the behavior of materials at low temperatures.
- To develop skills for designing cryogenic systems including refrigeration, storage & . transfer of cryogens, and instrumentation.

UNIT-I

Introduction to Cryogenic Systems: Mechanical Properties at low temperatures. Properties of Cryogenic Fluids.

Gas Liquefaction: Minimum work for liquefaction. Methods to protect 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 in 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 Medium, Solids, Liquids, Gases, Cryogenic fluid storage & transfer, Cryogenic storage systems, Insulation, Fluid transfer mechanisms, Cryostat, CryoCoolers

UNIT-V

Applications: Space technology, In-Flight air separation and collection of LOX, Gas industry, Biology, Medicine, Electronics.

Outcomes:

- Understand the structures of different cryogenic systems and the analytical method. for cryogenic thermodynamic cycle, and cryogenic gases and liquids and their . mixtures.
- Understand the measurement equipment and basic experimental skills, in particular of cryogenic heat transfer, superconducting magnetic levitation, as well as low. power cryocoolers.

TEXTBOOKS:

1. Cryogenic Systems/ R.F.Barren/ Oxford University Press
2. Cryogenic Research and Applications: Marshal Sitting/ Von Nostrand/ Inc. New Jersey
3. Cryogenic Heat Transfer/ R.F.Baron

REFERENCE BOOKS:

1. Experimental Techniques in Low Temperature Physics- O.K. White, Oxford Press, 1968
2. Cryogenic Process Engineering/ K.D. Timmerhaus & TM Flynn/ Plenum Press, 1998
3. Hand Book of Cryogenic Engineering – J.G.Weisend –II, Taylor and Francis,

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(R15D2105) SOLAR ENERGY TECHNOLOGY
(ELECTIVE-I)

Objectives:

- To introduce the basic concepts and novel technologies in solar thermal systems;
- To provide a balance between both frontier technology updates and existing solar thermal energy strategies, in both quantitative and qualitative way.

UNIT-I

Introduction – Solar energy option, specialty and potential – Sun – Earth – Solar radiation, beam and diffuse – measurement – estimation of average solar radiation on horizontal and tilted surfaces – problems – applications.

Capturing solar radiation – physical principles of collection – types – liquid flat plate collectors – construction details – performance analysis – concentrating collection – flat plate collectors with plane reflectors – cylindrical parabolic collectors – Orientation and tracking – Performance Analysis.

UNIT-II

Design of Solar Water Heating System and Layout: Power generation – solar central receiver system – Heliostats and Receiver – Heat transport system – solar distributed receiver system – Power cycles, working fluids and prime movers, concentration ratio.

UNIT-III

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

UNIT-IV

Direct Energy Conversion: solid-state principles – semiconductors – solar cells – performance – modular construction – applications - conversion efficiencies calculations.

UNIT-V

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

Outcomes:

- Outline the technologies that are used to harness the power of solar energy.
- Discuss the aspects of solar energy in relation to natural and human aspects of the . environment.

TEXTBOOKS:

1. Principles of solar engineering/ Kreith and Kerider/Taylor and Franscis/2nd edition.
2. Solar energy thermal processes/ Duffie and Beckman/John Wiley & Sons.
3. Solar energy: Principles of Thermal Collection and Storage/ Sukhatme/TMH/2nd . Edition.

REFERENCE BOOKS:

1. Solar energy/ Garg/TMH.
2. Solar energy/ Magal/Mc Graw Hill.
3. Solar Thermal Engineering Systems / Tiwari and Suneja/Narosa.

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4	0	3

(R15D2106) TURBOMACHINES
(ELECTIVE-I)

Objectives:

- Understand the fundamental concepts of turbo machines.
- Apply concepts of fluid mechanics in turbo machines.
- Understand the thermodynamic analysis of steam nozzles and turbines.
- Understand the different types of compressors and evaluating their performances in the form of velocity triangles.

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.

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

Gas Dynamics: Fundamental thermodynamic concepts, isentropic conditions, mach numbers and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory.

Centrifugal Compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuserand pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach numbers, Pre whirl, Performance.

UNIT-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: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT-V

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.

Outcomes:

- Able to derive the basic equations used for turbo machines.
- Will be able to understand the concept of velocity triangles used for performance .. evaluation of turbines.
- Able to understand the concept of degree of reaction for axial flow compressors.

TEXTBOOKS:

1. Principles of Turbo Machines/DG Shepherd / Macmillan.
2. Fundamentals of Turbo machinery/William W Perg/John Wiley & Sons.
3. Basic Concepts in Turbo machinery by Grant Ingram.

REFERENCE BOOKS:

1. Element of Gas Dynamics/Yahya/TMH.
2. Principles of Jet Propulsion and Gas Turbine/NJ Zucrow/John Wiley.
3. Textbook Of Turbomachines Si Units by MS Govinde Gowda, AM Nagaraja.

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(R15D2107) ADVANCED I.C. ENGINES
(ELECTIVE-II)

Objectives:

- Analyze engine cycles and the factors responsible for making the cycle different from theIdeal cycle.
- Apply principles of thermodynamics, fluid mechanics, and heat transfer to influence . the engine's Performance.
- Understand the delay period and fuel injection system.

UNIT-

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 SI 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, NO_X, 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

Outcomes:

- Analyze engine cycles and the factors responsible for making the cycle different from the Ideal cycle.
- Apply principles of thermodynamics, fluid mechanics, and heat transfer to influence . the engine's performance.
- To demonstrate the delay period and fuel injection system

TEXTBOOKS:

1. I.C. Engines / V.Ganesan/TMH
2. I.C. Engines Fundamentals/Heywood/TMH
3. I.C. Engines/G.K. Pathak & DK Chevan/ Standerd Publications

REFERENCE BOOKS:

1. I.C. Engines /RK Rajput/Laxmi Publications
2. Computer Simulation of C.I. Engine Process/ V.Ganesan/University Pre
3. Advanced I.C Engines by Senthil

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(R15D2108) NON CONVENTIONAL ENERGY SOURCES (ELECTIVE-II)

Objectives:

- To explain the concept of various forms of renewable energy.
- To outline division aspects and utilization of renewable energy sources for both .. domestics and industrial applications.

UNIT-I

Introduction: Energy Scenario, Survey of energy resources. Classification and need for 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 reaction, P-P cycle, Carbon cycle, Deuterium cycle, Condition for controlled fusion, Fuel cells and photovoltaic, Thermionic and Thermoelectric generation and MHD generator.

Hydrogen Gas as Fuel: Production methods, Properties, I.C. Engines applications, Utilization strategy, Performances.

UNIT-IV

Bioenergy: Biomass energy sources. Plant productivity, Biomass wastes, aerobic and anaerobic bioconversion processes, Raw material and properties of bio-gas, Bio-gas plant technology and status, the energetic 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 coefficient, 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.

Outcomes:

- Students get expertise in analyzing the environmental and cost economics of using .. renewable energy sources compared to fossil fuel.

TEXTBOOKS:

1. Non-conventional Energy Sources / GD Rai/Khanna publications
2. Non-Conventional Energy Sources and Utilisation (Energy Engineering)/ R K . Rajput/S.Chand
3. Renewable Energy Sources /Twidell & Weir/Taylor and Francis/ 2nd special Indian . edition

REFERENCE BOOKS:

1. Renewable Energy Resources- Basic Principles and Applications/ G.N.Tiwari and . M.K.Ghosal/ Narosa Publications
2. Renewable Energy Resources/ John Twidell & Tony Weir/Taylor & Francis/2nd . edition.
3. Non Conventional Energy / K.Mittal/ Wheeler.

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(R15D2109) ENERGY AND ENVIRONMENTAL ENGINEERING (ELECTIVE-II)

Objectives:

- Learn the principles of air and water pollution, effect of these pollutants on the . environment and the methods available to control them.
- Familiar with technical and scientific methods for treating, controlling or safely disposing of air and water emissions, which could pose a threat to the environment.

UNIT-I

Introduction to Pollution: Pollution of air, water, and soil; Effect of pollution on living systems

Air Pollution: Sources and classification of air pollutants, Effect of air pollution, Pollution from industries, Chemical reactions in a contaminated atmosphere, urban air pollution, Green house effect, Ozone layer depletion, Acid rain, Photo chemical smog, Meteorological aspects of air pollution.

Air Pollution Sampling and Measurement: Collection of gaseous and particulate pollutants, Analysis of air pollutants – Sulphur dioxide, Nitrogen oxides, Carbon monoxide, Oxidants and Ozone, Hydro carbons and Particulate matter

UNIT–II

Air Pollution Control Methods and Equipment: Cleaning of gaseous effluents, Particulate emission control, Control of specific gaseous pollutants SO2, NOx, Hydrocarbons, CO.

Water Pollution and Control: Types of water pollutants and their effects, Thermal pollution and effects, Water pollution laws and standards, Waste water sampling and analysis, Treatment of waste water (primary, secondary and tertiary treatment processes).

UNIT–III

Waste to Energy Conversion: Sources and classification of wastes, Energy generation from wastes -

Biochemical vs. Thermo-chemical Conversion and their environment benefits, Introduction to Biochemical conversion (anaerobic digestion), Thermo-chemical conversion processes direct combustion, incineration, pyrolysis, gasification and liquefaction, Economics of thermo-chemical conversion, Industrial applications of incinerators and gasifiers, Briquetting; Utilization and advantages of briquetting.

UNIT–IV

Energy Conservation in Industry: Energy Conservation and its Importance, Energy Strategy for the Future, The Energy Conservation Act, 2001 and its Features, Energy conservation in Boilers, Steam Turbines and Cooling Towers.

Waste Heat Recovery: Introduction, Classification and Application, Benefits of Waste Heat Recovery, Development of a Waste Heat Recovery System.

Outcomes:

- Design of mechanical systems and interdisciplinary engineering applications and . business solutions using suitable optimization technique.
- Apply numerical or iterative techniques in power systems for optimal power flow solutions.

TEXT BOOKS:

1. "Environmental pollution control engineering" C. S. Rao/New age International . Pvt.Ltd
2. "Air pollution" M.N.Rao and M.V.N.Rao /Tata Mc Graw Hill
3. G.Masters: Introduction to Environmental Engineering and Science Prentice Hall of India Pvt Ltd, New Delhi -2003.

REFERENCE BOOKS:

1. "Pollution control in process industries" S.P. Mahajan/ Tata Mc Graw Hill
2. "Energy Technology" S.Rao and B.B.Parulekar /Khanna publishers
3. H.S.Peavy, D.R..Rowe, G.Tchobanoglous (1985): Environmental Engineering McGraw- Hill BookCompany, NewYork

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4	0	3

(R15D2110) ADVANCED FLUID MECHANICS
(OPEN ELECTIVE-I)

Objectives:

- To understand the laws of fluid flow for ideal and viscous fluids.
- To represent the real solid shapes by suitable flow patterns and to analyze the same for aerodynamics performances.
- To understand the changes in properties in compressible flow and shock expansion.

UNIT-I

In Viscid 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

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.

Outcomes:

- Apply knowledge of mathematics, science and engineering.
- Derive the governing equations of fluid flow and applying them to simple flow problems.
- Emphasizing the mathematical formulation of various flow problems

TEXT BOOKS

1. Fluid Mechanics and Machines/Modi and Seth/Standard Book House
2. Fluid Mechanics/Cohen and Kundu/Elsevier/5th edition
3. Fluid Mechanics/Potter/Cengage Learning

REFERENCE BOOK:

1. Fluid Mechanics and Machines/CP Kodandaraman/New Age Publications
2. A Text book of Fluid Mechanics/RK Rajput/S. Chand
3. Boundary Layer Theory/ Schlichting H /Springer Publications

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L	T/P/D	C
4	0	3

(R15D2111) INDUSTRIAL POLLUTION PREVENTION (OPEN ELECTIVE-I)

Course Objective:

- The students will learn the essential principles used in industrial pollution abatement and understand important issues in industrial pollution abatement and pertinent environmental legislations.

UNIT-I

Basics of Jurisprudence-Environmental law relation with other disciplines-Criminal law-Common Law-Relevant sections of the code of civil procedure, criminal procedure code - Indian Penal code.

UNIT-II

Fundamental Rights-Directive principles of state policy-Article 48(A) and 51-A (g) Judicial enforceability-Constitution and resources management and pollution control-Indian forest policy (1990) –Indian Environmental policy (1992).

UNIT-III

Administration Regulations-constitution of pollution control Boards Powers, functions, Accounts, Audit etc.-Formal Justice Delivery Mechanism Higher and Lower of judiciary-Constitutional remedies writ jurisdiction Article 32,226,136 special reference to madamus and certiorari for pollution abatement-Equitable remedies for pollution control.

UNIT-IV

Administrative Regulation Under Recent Legislations - Water pollution control, Water (prevention and control of pollution) Act 1974 as Amended by amendment act 1988. Water (prevention of control and pollution) Rules1975 Water (prevention and pollution) Cess Act.1977 as amended by amendment act1991.Air (prevention and control of pollution) Act 1981 as amended by Amendment act 1987 and relevant notifications.

UNIT-V

Relevant Notifications in Connection with Hazardous Wastes - Management and Handling of Biomedical Wastes, Noise pollution, Eco-labeling and EIA.

Course Outcomes:

- Understand the different types of wastes generated in an industry, their effects on living and non-living things.
- Understand environmental regulatory legislations and standards and climate changes.
- Understand the atmospheric dispersion of air pollutants, and operating principles, design calculations of particulate control devices.
- Understand about analysis and quantification of hazardous and nonhazardous solid waste wastes, treatment and disposal.

TEXT BOOKS:

1. Constitution of India Eastern Book Company Lucknow 12th Edition.1997.
2. Pandey, J.N., Constitutional Law of India, (31st Edition) Central Law of Agency, Allahabad, 1997.
3. Pollution Prevention and Control: Part I Human Health and Environmental Quality. Paul Mac Berthouex , Linfield C. Brown.

REFERENCE BOOKS:

1. Kesari, U.P.D, Administrative Law, Universal Book Trade, Delhi, 1998.
2. Tiwari, H.N., Environmental Law, Allahabad Law.Agency 1997.
3. Shyam Divan and Armin Roseneranz “Environmental law and policy in India “Oxford University Press, New Delhi.

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L	T/P/D	C
4	0	3

(R15D2112) DESIGN OF HEAT EXCHANGERS
(OPEN ELECTIVE-I)

Objectives:

- To learn the thermal and stress analysis on various parts of the heat exchangers.
- To analyze the sizing and rating of the heat exchangers for various applications.

UNIT-I

Fundamentals of Heat Exchanger Temperature distribution and its implications types – shell and tube heat exchangers – regenerators and recuperators – analysis of heat exchangers – LMTD and effectiveness method.

UNIT-II

Flow and Stress Analysis: Effect of turbulence – friction factor – pressure loss – stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures.

UNIT-III

Design Aspects: Heat transfer and pressure loss – flow configuration – effect of baffles – effect of deviations from ideality – design of double pipe - finned tube - shell and tube heat exchangers - simulation of heat exchangers.

UNIT–IV

Compact and Plate Heat Exchangers: Types – merits and demerits – design of compact heat exchangers, plate heat exchangers –performance influencing parameters – limitations

UNIT-V

Condensers and Cooling Towers: Design of surface and evaporative condensers – cooling tower – performance characteristics.

Outcomes:

- Able to design the heat exchanger based on the information provided for a particular application and do the cost economic analysis.

TEXT BOOKS:

1. Sadik Kakac and Hongtan Liu, Heat Exchangers Selection, Rating and Thermal Design, CRC Press, 2002.
2. Fundamentals of Heat Exchanger Design by Ramesh K. Shah, Dusan P. Sekulic.
3. Plate Heat Exchangers: Design, Applications and Performance by Bengt Sundén, R. M.Manglik.

REFERENCE BOOKS:

1. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1988.
2. Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice, McGraw-Hill Book.
3. Hewitt.G.F, Shires.G.L and Bott.T.R, Process Heat Transfer, CRC Press, 1994.

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L	T/P/D	C
0	3	2

(R15D2181) THERMAL ENGINEERING LABORATORY

Course Objectives:

The lab is mainly intended to

- Analyze the performance and exhaust emissions of an IC engine by conducting the performance test on IC Engines.
- Evaluate the performance of the Vapor compression and Air conditioning units.
- Analyze the flame propagation velocity of the gaseous fuels.
- Evaluate the performance of the solar flat plate collector and evacuated tube. concentrator.

LIST OF EXPERIMENTS:

1. Load test on four stroke single cylinder diesel engine using biodiesels
2. Measurement of Burning Velocity of premixed flame.
3. To study V-I characteristics of solar panel
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 vapor compression refrigeration system.
7. To estimate power generation from solar photovoltaic system.
8. Performance analysis of heat pipe.
9. To study the performance of solar flat plate collector.
10. A study on Evacuative tube concentrator.

Course Outcomes:

At the end of the course the learners will be able to

- Analyze the performance and exhaust emissions of an IC engine.
- Evaluate the performance of the Vapor compression and Air conditioning units.
- Analyze the flame propagation velocity of the gaseous fuels.
- Evaluate the performance of the solar flat plate collector and evacuated tube concentrator.

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L	T/P/D	C
0	3	2

(R15D2182) TECHNICAL SEMINAR

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M.Tech I Year – II Sem (Thermal Engineering)

L	T/P/D	C
4	-	3

(R15D2213)FUELS, COMBUSTION AND ENVIRONMENT

Objectives:

- Provide students with knowledge of fuel quantity and engine technology effects on emissions.
- Understand the combustion phenomena.
- Understand the concept of laminar and turbulent flame propagation.

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 liquefaction – 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 analysis – dew point of products– Combustion stoichiometry. Chemical kinetics – Rate of reaction – Reaction order – Molecularity – Zeroth, first, second and third order reactions – complex reactions – chain reactions. Theories of reaction Kinetics – General oxidation 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 – Pulverized 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.

Outcomes:

- Have the knowledge of fuel thermo-chemistry and fuel quality effects on emissions, engine technologies, engine combustion-related emissions and control technologies;
- Extend their knowledge of fuels and engines to different situations of engineering context and professional practice.
- Understand about different methods to reduce air pollution.

TEXTBOOKS:

1. Combustion Fundamentals / Roger A strehlow / Mc Graw Hill
2. Fuels and combustion / Sharma and Chander Mohan/ Tata Mc Graw Hill
3. Combustion Engineering and Fuel Technology / Shaha A.K./ Oxford and IBH.

REFERENCE BOOKS:

1. Combustion / Sarkar / Mc. Graw Hill.
2. An Introduction to Combustion / Stephen R. Turns/ Mc. Graw Hill International . Edition.
3. Combustion Engineering / Gary L. Berman & Kenneth W. Ragland/ Mc. Graw Hill International Edition

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(R15D2214) ENERGY MANAGEMENT

Objectives:

- To understand the principles associated with effective energy management and to apply these principles in the day-to-day life.
- To minimise energy costs / waste without affecting production & quality.
- To minimize environmental effects.
- To gain exposure to energy auditing.

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 organizations. Initiating, Organizing 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 constrains, Synthesis of alternative options and technical analysis of options. Process integration.

UNIT-III

Economic Analysis: Scope, Characterization of an investment project. Types of depreciation, Time value of money. Budget considerations, Risk analysis.

UNIT-IV

Methods of Evaluation of Projects: Payback, Annualized costs, Investor's rate of return, Present worth, Internal rate of return, Pros and cons of the common method of analysis, Replacement analysis.

UNIT-V

Alternative Energy Sources: Solar energy- Types of devices for solar energy collections, Thermal storage system, Control systems. Wind Energy, Availability, Wind Devices, Wind Characteristics, performance of turbines and systems.

Outcomes:

1. Understanding of energy conservation and identification of energy conservation opportunities in various industrial processes
2. Knowledge of various tools and components of energy auditing

TEXTBOOKS:

1. Energy Management Hand Book / W.C. Turner (Ed)
2. Energy Management Principles / CB Smith/ Pergamum Press
3. Energy Audits: A Workbook for Energy Management in Buildings by E-book by Tarik Al-Shemmeri

REFERENCE BOOKS:

1. Energy Management / W.R.Murthy and G.Mc.Kay / BS Publication
2. Management / H.Koontz and Cyrill Donnel / McGraw Hill
3. Energy Management Hand Book, BSR Publications.

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(R15D2215) ADVANCED FINITE ELEMENT ANALYSIS

Objectives:

- Gain a fundamental understanding of the finite element method for solving boundary value problems.
- Learn important concepts of variation form, minimum potential energy principles, and method of weighted residuals.
- Study one dimensional problems such as truss, beam, and frame members, two-dimensional problems such as plain stress and plain strain elasticity problems, torsion problem.

UNIT-I

Introduction to FEM: Basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variation 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 And Dynamic Equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

Outcomes:

- Apply the concepts of minimum potential energy principles to solve structural mechanics problems.
- Compute Eigen values and eigenvectors of simple dynamic systems
- Obtain weak form from strong form and total potential, and recognize similarities . between such solutions, and those obtained by variational principles and principal of . virtual work.

TEXTBOOKS:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.
2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall

REFERENCE BOOKS:

1. Introduction to Fininte element analysis- S.Md.Jalaludeen,Anuradha Publications, . print-. 2012
2. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th . Edition
3. Finite Element Method – Krishna Murthy / TMH

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(R15D2216) COMPUTATIONAL FLUID DYNAMICS (ELECTIVE-III)

Objectives:

- To develop finite difference and finite volume discredited forms of the CFD equations.
- To formulate explicit & implicit algorithms for solving the Euler Equations & Navier Stokes Equations.

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.

Outcomes:

- Derive the basic governing equations applied for fluid flow problems.
- Apply the differential equations to fluid flow problems.
- Understand the concept of discretization.
- Solve simple algorithms for incompressible fluid flow.

TEXTBOOKS:

1. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985
2. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.
3. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications

REFERENCE BOOKS:

1. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
2. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities . Press.
3. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford . University Press/2nd Edition

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(R15D2217) EQUIPMENT DESIGN FOR THERMAL SYSTEMS (ELECTIVE- III)

Objectives:

- Design and analyse the heat exchangers parallel flow, counter flow, multipass and, cross flow heat exchanger.
- Design and analyse the Shell and tube heat exchanger.
- Enable to carry out the preformance of heat exchanger with the extended surfaces.
- Design and analyse the cooling towers.

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.

Outcomes:

- Design and analyse the parallel flow, counter flow, multipass and, cross flow heat exchangers .
- Develope the Shell and tube heat exchanger.
- Optimise the preformance of heat exchanger.
- Design and analyse the cooling towers.

TEXT BOOKS:

1. Process Heat Transfer/D.Q.Kern/ TMH.
2. Heat Exchanger Design/ A.P.Fraas and M.N.Ozisicj/ John Wiely & sons, New York.
3. Design and Optimization of Thermal Systems / Yogesh Jaluria/ Second Edition.

REFERENCE BOOKS:

1. Cooling Towers / J.D.Gurney and I.A. Cotter/ Maclaren.
2. Design analysis of thermal systems/ R. F. Boehm/ Wiley, 1987.
3. Design of Thermal Systems Hardcover by Wilbert F. Stoecker.

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(R15D2218) CONVECTIVE HEAT TRANSFER (ELECTIVE-III)

Objectives:

- To provide a thorough understanding of applications of convective heat transfer in various thermal systems.
- Students learn analytical and numerical solutions for convective heat transfer problems.

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.

Outcome:

- Provide limited design experiences for systems requiring significant consideration to convective heat transfer

TEXT BOOKS:

1. Introduction to Convective Heat Transfer Analysis/ Patrick H. Oosthuigen & David . Naylor /McGraw Hill.
2. Convective Heat & Mass Transfer /Kays & Crawford/TMH.
3. A Heat Transfer Text book by John H. Lienhard IV/ John H. Lienhard V , Phlogiston Press , Third Edition.

REFERENCE BOOKS:

1. Convection Heat Transfer / Adrian Bejan/ Hardcover – Import, 17 May 2013.
2. Convective heat transfer, 3rd edition/ Yaman Yener/CRC press-2013.
3. Momentum, Heat, and Mass Transfer by Leo Lue.

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(R15D2219) THERMAL AND NUCLEAR POWER PLANTS (ELECTIVE-IV)

Objectives:

- Provide awareness about resources of energies available in India for Power Production by Thermal and Nuclear Processes.
- Understand and know the requirements for a Thermal Power Plant and Nuclear Power Plant, from sources to consumption and economics of power plants.
- Study and learn the processes and cycles followed in Thermal Power Plants and nuclear power plants and components used in the power plants.
- Gain the knowledge on steam power plants, steam generators and gas turbine power plants, their analyses on fuel and fluidized bed combustion, ash handling systems.

UNIT–I

Introduction: Sources of energy, Type of Power plants. Direct energy conversion system, Energy sources in India, Recent developments in power generation, Combustion of coal, Volumetric analysis, Gravimetric analysis. Fuel gas analysis.

Steam Power Plant: Introduction. General layout of steam power plant, Modern coal. Fired Steam, Steam power plant. Power plant cycle, Fuel Handling, Combustion equipment, Ash handling, Dust collectors.

Steam Generators: Types, Accessories. Feed water heaters, Performance of boiling, Water treatment, Cooling towers, and Steam turbines. Compounding of turbines, Steam condensers, Jet and surface condensers.

UNIT-II

Gas Turbine Power Plant: Cogeneration. Combined cycle power plant, Analysis, Waste heat recovery, IGCC power plant, Fluidized bed, Combustion, Advantages, and Disadvantages.

UNIT-III

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

UNIT-IV

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

UNIT-V

Power Plant Instrumentations: Classification, Pressure measuring instrument, Temperature measurement and Flow Measurement, Analysis of combustion gases, Pollution types, Methods of control.

Outcomes:

- Gain the knowledge about resources of energies available in India for Power Production by Thermal and Nuclear Processes.
- Analyze the processes and cycles followed in Thermal Power Plants and nuclear power plants and components used in the power plants and identify the losses to get better efficiency.

TEXTBOOKS:

1. Power Plant Engineering / P.K.Nag/ TMH.
2. Power Plant Engineering / R.K.Rajput / Lakshmi Publications.
3. Power Plant Engineering, by Samsher Gautam, First Edition.

REFERENCE BOOKS:

1. Power Plant Engineering / P.C.Sharma / Kotearia Publications.
2. Power Plant Technology / Wakil.
3. Power Plant Engineering by A.K. Raja, Amit Prakash Srivastava,Manish Dwivedi.

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(R15D2220) THERMAL MEASUREMENTS AND PROCESS CONTROLS (ELECTIVE-IV)

Objectives:

- Understand and analyze the behavioral characteristics of instruments
- Make the student learn about calibration procedure of measuring instruments

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 and 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.

Outcomes:

- Making the student conversant with different working principles of various instruments.
- Be able to analyze and design an instrumentation system, dealing with the concepts of Dynamic range, signal noise ratio.

TEXTBOOKS:

1. Measurement System, Application & Design – E.O. Doeblin.
2. Mechanical and Industrial Measurements – R.K. Jain – Khanna Publishers.
3. Applied Thermal Engineering, Design. Processes. Equipment. Economics by T.S. Zhao

REFERENCE BOOKS:

1. Mechanical Measurements – Buck & Beckwith – Pearson.
2. Control Systems, Principles & Design, 2nd Edition – M. Gopal – TMH.
3. Thermal processing quality and Principles by George Awuah, Hosahalli S . Ramaswamy, A Economides

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(R15D2221) REFRIGERATION AND AIR CONDITIONING (ELECTIVE-IV)

Objectives:

- Familiarize students with the terminologies associated with refrigeration & air conditioning
- Cover the basic principles of psychometric and applied psychometrics
- Familiarize students with system analysis
- Familiarize students with load calculations and elementary duct design
- Familiarize students with refrigerants; vapor compression refrigeration and multi-stage vapor compression systems

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: Psychometric properties and processes – Construction of Psychometric 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.

Outcomes:

- Introduce students to HVAC technology, engineering, research, system designs, energy impacts, and overall goals.
- Develop understanding of the principles and practice of thermal comfort .
- Develop understanding of the principles and practice and requirements of ventilation .

TEXTBOOKS:

1. Refrigeration & Air Conditioning /C.P. Arora/TMH.
2. Refrigeration & Air Conditioning /Arora & Domkundwar/ Dhanpat Rai.
3. Refrigeration and Air Conditioning /Manohar Prasad.

REFERENCE BOOKS:

1. Principles of Refrigeration/ Dossat /Pearson.
2. Refrigeration and Air Conditioning /Ananthanarayana /TMH.
3. Refrigeration and Air Conditioning /Jordan& Preister /Prentice Hall.

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(R15D2222) JET PROPULSION AND ROCKET ENGINES (OPEN ELECTIVE-II)

Objectives:

- Develop an understanding of how air-breathing engines and chemical rockets produce thrust.
- Analyze the overall engine performance.
- Analyze the characteristics of the nozzle.
- Carry out performance analysis rockets.

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 Rocket Engines : 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.

Outcomes:

- The generation of thrust in air-breathing engines and rockets.
- The performance analysis engines.
- The overall performance exhaust nozzles.
- An understanding of axial flow compressors and turbines, and an ability to carry out flow and performance calculations.

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Gas Turbines & Propulsive Systems/Khajuria & Dubey/Dhanpat Rai & Sons.
2. Rocket propulsion/Bevere.
3. Jet propulsion /Nicholas Cumpsty.

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(R15D2223) MATHEMATICAL MODEL OF IC ENGINES
(OPEN ELECTIVE- II)

Objectives:

- To know about modeling, different types of modeling and its application in . Automobile engineering.
- To gain the knowledge in simulation of various systems and components of IC . Engines with various new engine concepts.

UNIT-I

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

UNIT-II

Thermodynamic Combustion Models of CI Engines: Single zone models, premixed and diffusive combustion models, combustion heat release using wiebe function, wall heat transfer correlations, ignition delay, internal energy estimations, two zone model, application of heat release analysis.

UNIT-III

Fuel Spray Behavior: Fuel injection, spray structure, fuel atomization, droplet turbulence interactions, droplet impingement on walls.

Modeling of Charging System: Constant pressure and pulse turbo charging, compressor and turbine maps, charge air cooler.

UNIT -IV

Mathematical Models of SI Engines: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Auto ignition modeling, single zone models, mass burning rate estimation

UNIT-V

SI Engine with Stratified Charge. Friction in pumping, piston assembly, bearings and valve train etc. friction estimation for warm and warm up engines.

Outcomes:

- Conversant with Basic Concept of Modeling
- To develop modeling of IC engines.
- To develop Laminar Flow modeling.
- Understands Simulation of IC Engines and its new concepts.

TEXTBOOKS:

1. Haywood, “I.C. Engines”, Mc Graw Hill.
2. Ramos J(1989) Internal Combustion Engine Modeling. Hemisphere Publishing . Company
3. C. D. Rakopoulos and E. G. Giakoumis, “Diesel Engine Transient

REFERENCE BOOKS:

1. V. Ganeshan, “Internal Combustion Engines”, Tata McGraw Hill, New Delhi, 1996.
2. P.A. Lakshminarayanan and Y. V. Aghav, “ Modelling Diesel Combustion” Springer, 2010
3. Bernard Challen and Rodica Baranescu, “Diesel Engine Reference Book” Butterworth-Heinemann, 1999.

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(R15D2224) INDUSTRIAL REFRIGERATION SYSTEMS (OPEN ELECTIVE- II)

Objectives:

- To provide concepts of Refrigeration systems in residential, commercial and industrial buildings.
- To educate about various system components and accessories of refrigeration systems.
- To learn about cycle analysis pertaining to Refrigeration systems.
- To learn about performance of system components and their balancing in cycles.

UNIT-I

Introduction: Introduction to industrial refrigeration - difference from conventional system - applications – industrial and comfort air - conditioning - conditions for high COP.

UNIT-II

Compressors: Reciprocating and screw compressor: Multistage industrial applications, cylinder arrangement, cooling methods - oil injection and refrigeration injection, capacity regulations - Economizers.

UNIT-III

Evaporators and Condensers: Types of Evaporators, Liquid circulation: Mechanical pumping and gas pumping - advantage and disadvantage of liquid re-circulation - circulation ratio - top feed and bottom feed refrigerant - Net Positive Suction Head (NPSH) - two pumping vessel system - suction risers – design - piping loses. Different Industrial Condensers arrangement, Evaporators-Types and arrangement, liquid circulation, type of feed, refrigerant piping design, functional aspects. Lubricating oil: types - physical properties, types of circulation and oil separator.

UNIT-IV

Vessels in Industrial Refrigeration: High pressure receiver , flash tank , liquid and vapour separator ,separation enhancers , low pressure receivers , surge drum, surge line accumulator , thermosyphon receiver and oil pots.

UNIT-V

Energy Conservation and Design Considerations - Source of losses, energy efficient components, and heat reclaim thermal storage, ice builder and ice harvester.

Insulation: critical thickness, insulation cost and energy cost, vapour barriers, construction methods of refrigerated spaces.

Outcome:

- To enable students to demonstrate and apply knowledge of design, select components for, and prepare design documents for industrial Refrigeration systems.

TEXTBOOKS:

1. Wilbert F.Stoecker, Industrial Refrigeration Hand Book, McGraw-Hill, 1998.
2. ASHRAE Hand Book: Fundamentals, 1997.
3. ASHRAE Hand Book: Refrigeration, 1998.

REFERENCE BOOKS:

1. ASHRAE Hand Book: HVAC Systems and Equipment, 1996.
2. Transport properties of SUVA Refrigerants, Du-Pont Chemicals, 1993.
3. Refrigeration and Air Conditioning Technology by Bill Whitman, Bill Johnson, John Tomczyk &Eugene Silberstein.

MALLAREDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech I Year – II Sem (Thermal Engineering)

L	T/P/D	C
-	3	2

(R15D2283) COMPUTATIONAL METHODS LABORATARY

Objectives:

To make the student understand

- solution of problems of heat conduction using FEM software
- Solving problems involving heat transfer from fins by writing program codes in MAT . lab software

C programming for Problem Solving.

Solving Thermal Engineering problems using available packages such as T K Solver, ANSYS, CFX, STARCD, MATLAB and FLUENT.

Outcomes:

The student will be able to

- Write program source codes to some heat transfer problems and solve them using MAT lab .
- Solve some heat transfer problems using FEM software.

MALLAREDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech I Year – II Sem (Thermal Engineering)

L	T/P/D	C
-	3	2

(R15D2284) TECHNICAL SEMINAR

MALLAREDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech II Year – III Sem (Thermal Engineering)

L	T/P/D	C
-	3	2

(R15D2285) PROJECT SEMINAR

MALLAREDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech II Year – III Sem (Thermal Engineering)

L	T/P/D	C
-	-	18

(R15D2286) PROJECT WORK

MALLAREDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech II Year – IV Sem (Thermal Engineering)

L	T/P/D	C
-	3	22

(R15D2287) PROJECT WORK AND VIVA VOCE