SYLLABUS
(With effect from 2014-2015)

ಪಠ್ಯಕ್ರಮ
ಶೈಕ್ಷಣಿಕ ವರ್ಷ ೨೦೧೪-೨೦೧೫ ರಿಂದ

Master of Technology in
THERMAL POWER ENGINEERING

Visvesvaraya Technological University
"Jnana Sangama", Belgaum - 590 018, Karnataka.
ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ
"ಜ್ಞಾನ ಸಂಗಮ", ಬೆಳಗಾವಿ ೫೯೦ ೦೧೮, ಕರ್ನಾಟಕ

Syllabus of I to IV Semesters

(With effect from 2014-2015)

Master of Technology in

THERMAL POWER ENGINEERING

Visvesvaraya Technological University, Belgaum

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Karnataka, INDIA.

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THE MASTER OF TECHNOLOGY COURSE IN ENGINEERING

(Full Time / Part Time)

OM 1 TITLE OF THE COURSE

OM 1.1 The Course shall be called Master of Technology Course, abbreviated as M.Tech. (Subject of Specialization)

OM 2 DURATION OF THE COURSE

OM 2.1 There shall be two categories:
1) Full Time Course and
2) Part Time Course

OM 2.2 Full Time Course:
The course shall extend over a period of four semesters and each semester shall have the following schedule:
First Semester: 23 weeks duration
- 16 weeks course work +7 weeks for (Preparation, Examination and Vacation).

Second Semester: 21 weeks duration
- 16 weeks course work +5 weeks for (Preparation, Examination and Vacation).

Third Semester: 21 weeks duration
- 16 weeks Internship +5 weeks for (Report Submission, Evaluation, Viva-Voce and initiation of Project Phase-II).
- Seminar and Presentation on Internship after 8 weeks from the commencement of III Semester.
- Report on Internship.
- Project Phase- I: Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd semester to the HoD with the approval of the Project Guide.
- Evaluation of Internship report and Viva-Voce, and
- Project Phase- II: Preliminary work on Project Implementation.

Fourth Semester: 24 weeks duration
Course work of 2 subjects +Project Phase-III

OM 2.3 Part Time Course:
(a) The course shall extend over 6 semesters.
(b) Each semester shall be of the duration equivalent to that of the semester for full time students, inclusive of teaching, preparation for examination and vacation.
(c) First, second, third & fourth semester shall comprise of course work and the fifth shall be entirely devoted to Internship

and sixth semester shall be entirely devoted to dissertation work.

(d) During the first semester, the candidate shall register for the subjects of first and third semesters. During the second semester, the candidate shall register for the subjects of second and fourth semesters.

(e) The candidate shall register for a maximum of three subjects per semester.

(f) The candidates shall register for Lab subject in first and second semesters along with the regular three subjects.

OM 2.4 A Full Time candidate shall be allowed a maximum duration of eight semesters from the first semester of admission to become eligible for the award of Master's Degree, failing which he/she may register once again as a fresh candidate.

OM. 2.5 A Part Time candidate shall be allowed a maximum of 12 semesters duration from the first semester of admission to become eligible for the award of Master's Degree, failing which he/she may register once again as a fresh candidate.

OM 2.6 The Calendar of events in respect of the course shall be fixed by the University from time to time.

OM 3 ELIGIBILITY FOR ADMISSION

OM 3.1 Admission to the Master of Technology Course shall be open to all the candidates who have passed B.E. / B. Tech. Examinations (as per the eligibility criteria specified from time to time) of VTU or any other recognized University / Institution. The decision of the Equivalence committee shall be final in establishing the eligibility of candidates for a particular course. For the foreign degrees Equivalence certificate from the Association of Indian Universities is a must.

However, the candidates who have completed their prerequisite degree through the distance mode education are not eligible for admission to M.Tech. Courses under any quota i.e. Govt./ Management.

OM 3.2 AMIE qualification in respective branches shall be equivalent to B.E./ B. Tech. Courses of VTU for admission to M.Tech. However, the candidate seeking admission to M.Tech. courses on the basis of AMIE shall also take the Common Entrance Test.

OM 3.3 Admission to M.Tech. Course shall be open to the candidates who have passed the prescribed qualifying examination with not less than 50% of the marks in the aggregate of all the years of the degree examination. However, in the case of candidates belonging to SC/ST and Category I, the aggregate percentage of marks in the qualifying examinations shall not be less than 45%. Rounding off of percentage secured in qualifying examination is not permissible.

OM3.4 There shall be entrance examination for PG Programs from the Karnataka Examination Authority and candidates qualified for the admission through the Entrance examination or qualified for admission under GATE and issued an admission order from KEA are eligible for the admission to M.Tech. Program or through the entrance examination conducted by the University.

For admissions under Management Quota:

The candidates should have appeared for the Entrance Examination conducted by KEA or Qualified under GATE or appeared and qualified through the entrance examination conducted by the University.

Further, there shall be an Admissions Committee for PG Course in each college for each branch of PG studies consisting of the Principal of the College as the Chairman, Head of the concerned Department, one senior staff member of the concerned Department. The Admissions Committee conducts the interview of the candidates for admissions.

For admissions under Sponsored Quota:

The candidates should have appeared for the Entrance Examination conducted by KEA or Qualified under GATE or through the entrance examination conducted by the University.

OM 3.5 The candidates, who have qualified in the GATE Examination for the appropriate branch of engineering, shall be given priority. They shall be exempt from taking Entrance Examination.

OM 3.6 If sufficient number of GATE qualified candidates are not available, such seats shall be filled from amongst the candidates appeared for Entrance Examination in the order of merit.

OM 3.7 The maximum number of seats under various categories (regular, sponsored candidates and SC/ST) shall be as sanctioned by the AICTE, State Government and VTU, from time to time.

OM 3.8 Subject to the provisions of OM 3.1 and OM 3.2, members of the Teaching/Research Staff/Teaching Assistants working in any Engineering College recognized by AICTE either in the State of Karnataka or outside and who have put in a minimum of Three years of teaching experience on full-time basis in Engineering Colleges, Polytechnic institutions / any other institutions imparting Engineering education shall be eligible for admission to PG Courses under sponsored quota, if they are sponsored by the respective Institutions / DTE. Where sufficient number of such candidates is not available, candidates with minimum Three years of teaching experience may be allowed to the course against sponsored quota.

OM 3.9 Subject to the provisions of OM3.1 and OM3.2, members working in the State Government / Central Government / Quasi Government Organizations / Public Sector Industries / Reputed Private Industries, who have put in a minimum of Three years of working experience and are sponsored by the concerned Organizations shall also be eligible to seek admissions to PG Courses against sponsored quota.

OM 3.10 The Engineering graduates other than the graduates of any of the Universities of Karnataka State shall have to obtain Eligibility Certificate from the VTU to seek admission to P.G. course in any of the colleges affiliated to VTU.

OM 3.11 Part time students whose place of working is within radial distance of 40 km from the institution where they seek admission shall take admission for the course under the regulation OM 3.8 or OM3.9.

OM 3.12 Admission to M.Tech. course shall be open under lateral entry scheme for candidates who have completed one year PG Diploma Course of VTU or equivalent course in that branch in which he / she is seeking admission and satisfies all other eligibility criteria for admission to the regular M.Tech. Course.

OM 4 ATTENDANCE REQUIREMENT

OM 4.1 Each course of the semester shall be treated as a separate unit for calculation of the attendance.

OM 4.2 Each semester is considered as a unit and the candidate has to put in a minimum attendance of 85% in each subject with a provision of condonation of 10% of the attendance by the Vice-Chancellor on the specific recommendation of the Principal of the college where the candidate is studying, showing some

reasonable cause such as medical grounds, participation in University level sports, cultural activities, seminars, workshops, paper presentation, etc. The necessary documents such as Medical Certificate, letter of participation in University level activities etc., are to be submitted along with recommendations for condonation.

OM 4.3 A candidate, who does not satisfy the attendance requirement as mentioned above shall not be eligible to appear for the Examination of that semester and shall be required to repeat that semester along with regular students during the subsequent year.

OM 4.4 If a candidate, for any reason, discontinues the course in the middle, he/she may be permitted to register to continue the course along with subsequent batch, subject to the condition that he/she shall complete the class work, laboratory work and seminar including the submission of dissertation within the maximum stipulated period (double the duration of the course). Such candidate shall not be eligible to be considered for the award of rank.

OM 4.5 Principals of the concerned colleges shall notify regularly, the list of such candidates who fall short of attendance.

OM 4.6 The list of the candidates falling short of attendance shall be sent to the University at least one week prior to the commencement of the examination.

OM 5 INTERNAL ASSESSMENT

OM 5.1 A candidate shall obtain not less than 50% of the maximum marks prescribed for the Internal Assessment (IA) of each subject/Lab, including seminars.

OM 5.2 Internal Assessment Marks shall be based on assignments, tests, oral examination and seminar conducted in respective subjects (minimum of two tests are compulsory).

OM 5.3 Candidates obtaining less than 50% of the Internal Assessment marks in any subject(s)/Lab shall not be eligible to appear for the examination in that subject(s). Only in such cases, the Head of the Department shall arrange for the improvement of Internal Assessment marks in the subject(s)/Lab in subsequent semester.

OM 5.4 The candidates shall write the Internal Assessment Test in Blue Books which shall be maintained by the Principal / Head of the Department for at least three months after the announcement of University results and available for verification

as per the directions of the Registrar (Evaluation).

OM 5.5 Every sheet of the Internal Assessment marks list shall bear the signatures of the concerned Teacher, Head of the Department and the Principal.

OM 5.6 The Internal Assessment marks list shall be displayed on the Notice Board and corrections, if any, shall be incorporated before sending to the University.

OM 5.7 The IA marks shall be sent to the university by the Principals well in advance before the commencement of theory examination. No corrections of the Internal Assessment marks shall be entertained after the submission of marks list to the University.

OM 6 SEMINARS

OM 6.1 All candidates shall present one seminar each in the first and the second semesters on the topics chosen from the relevant fields.

OM 6.2 The Head of the Department shall arrange for conducting such seminars through concerned faculty member of the Department.

OM 6.3 The Internal Assessment marks for the seminar shall be awarded by the concerned faculty member.

OM 7 PAPER SETTING AND EVALUATION OF THEORY ANSWER PAPERS

OM 7.1 Question papers in theory subjects shall be set by the Examiners appointed for that purpose by the University.

OM 7.2 There shall be double valuation of theory papers. The theory Answer booklets shall be valued independently by two examiners appointed by the University.

OM 7.3 If the difference between the marks awarded by the two Examiners is not more than 15 per cent of the maximum marks, the marks awarded to the candidate shall be the average of two evaluations.

OM 7.4 If the difference between the marks awarded by the two Examiners is more than 15 per cent of the maximum marks, the answer booklet shall be evaluated by a third Examiner appointed by the university. The average of the marks of nearest two valuations shall be considered as the marks secured by the candidate. However, if one of the three marks falls exactly midway between the other two, then the highest two marks shall be taken for averaging.

OM 8 INTERNSHIP

OM 8.1 Internship: The student shall undergo Internship for 16 weeks.

OM 8.2 Seminar / Presentation on Internship: The student shall make a midterm presentation of the activities undertaken during the first eight weeks of internship to a panel comprising Internship Guide, a senior faculty from the department and Head of the Department of the college.

OM 8.3 Report on Internship: The College shall facilitate and monitor the student internship program. The internship report of each student shall be submitted to the Head of the Department of the college with the approval of the Guide.

OM 8.4 Evaluation of Internship - To be carried out by the Internal Guide of the college and the respective Head of the Department.

OM 8.5 Viva-Voce on Internship Report- To be conducted internally by the Internship Guide (from the college) and the External Guide under whose supervision the student has carried out the internship.

OM 8.6 Failure to undergo Internship: The student will not be eligible to submit the dissertation

OM 9 DISSERTATION WORK

OM 9.1 The candidate shall submit a soft copy of the dissertation work in the form of CD which should contain the entire Dissertation in monolithic form as a PDF file (not separate chapters)
Guide after checking the report for completeness shall upload the Dissertation along with name, address, mobile number of the candidate, etc. as prescribed in form available on online Dissertation evaluation portal. The guide shall also chose and submit a panel of four expert evaluators.

OM 9.2 PLAGIARISM CHECK

Once the Guide uploads the dissertation, The dissertation shall be linked for plagiarism check and the plagiarism index <=25%.
If the report indicates plagiarism index >25% :

- for the first time the candidate has to resubmit the dissertation along with the penal fees of Rs 2000/- (Two thousand only)
- for the second time the candidate has to resubmit the dissertation along with the penal fees of Rs 4000/- (four thousand only)
- If the dissertation is rejected again during second

resubmission, the candidate shall redo the project and submit after a semester's time.

OM 9.3 The date of submission of the dissertation may be extended up to a maximum of four academic years for full-time students and maximum of six academic years for part-time students, from the date of commencement of the first semester in which the candidate has taken admission to the course.

OM 9.4 The dissertation shall be sent through email for evaluation to two examiners - one internal examiner (guide/co-guide) and one external examiner appointed by the University. The evaluation of the dissertation shall be made independently by each examiner.

OM 9.5 The examiners shall independently evaluate and submit the marks through the specified link.

OM 9.6 Average of the marks awarded by the two Examiners shall be the final.

OM 9.7 Examiners shall evaluate the dissertation normally within a period of not more than three weeks from the date of receipt of dissertation through email. The dissertation shall not be accepted for passing if external examiner finds that the dissertation work and the report is not up to the expected standard and the minimum passing marks cannot be awarded. The external examiner can totally reject the dissertation or ask for its modification. The examiner shall give reasons for rejection of the dissertation or requiring its modification and where modification in the dissertation is required, he / she can make suggestion for improvement of the dissertation for resubmission. In cases where modification is recommended after incorporating suggestions, the dissertation report shall be sent to the same external examiner.

OM 9.8 If the examiner does not approve the dissertation on its re-submission, it shall be treated as rejected. After the rejection by the first external examiner, it shall be sent to a second examiner appointed by the University. If the second examiner also does not approve the dissertation, the candidate shall have to carry out the dissertation work once again and shall submit the dissertation within the stipulated time. In such cases of Rejection, the candidate shall redo the entire procedure from the submission of Dissertation in soft copy.

OM 9.9 The candidate may also choose another topic of dissertation under a new guide, if necessary. In such an event, the report shall be submitted within four years in case of full time student and six years in case of part time student respectively from the date of admission to the course.

OM 9.10 If the dissertation report is approved and evaluated by both the examiners and the candidate secured minimum passing marks in the evaluation, the office of the Registrar (Evaluation) will send the link to both the examiners for the conduct of Viva-Voce Exam and submission of marks.

Internal examiner as per the direction of the University to arrive at a mutually convenient date for the conduct of viva-voce examination of the concerned candidate with intimation to the Registrar (Evaluation). In case one of the examiners expresses his inability to attend the viva-voce, the Registrar (Evaluation) shall appoint a substitute examiner in his place.

OM 9.11 The relative weightage for the evaluation of dissertation and the performance at the viva voce shall be as per the scheme of teaching & examination.

OM 9.12 The marks awarded by both the Examiners at the viva voce Examination shall be sent jointly to the University immediately after the examination.

Examination fee as fixed from time to time by the University for evaluation of dissertation report and conduct of viva voce shall be remitted through the Head of the Institution as per the instructions sent by the office of Registrar (Evaluation) from time to time.

OM 9.13 If the dissertation report is approved, as per regulation OM8.11, a viva-voce examination of the candidate shall be conducted by the external examiner and internal examiner / guide. The external examiner, who will be appointed by the University, shall be contacted by the Principal / Head of the Department.

Internal examiner as per the direction of the University shall have to arrive at a mutually convenient date for the conduct of viva-voce examination of the concerned candidate with an intimation to the Registrar (Evaluation). In case one of the examiners expresses his/her inability to attend the viva-voce, the Registrar (Evaluation) shall appoint a substitute examiner in his/her place.

OM 9.14 The relative weightage for the evaluation of dissertation and the performance at the viva voce shall be as per the scheme of teaching & examination.

OM 9.15 The marks awarded by both the Examiners at the viva voce

Examination shall be sent jointly to the University immediately after the examination.

OM 9.16 Examination fee as fixed from time to time by the University for evaluation of dissertation report and conduct of viva voce shall be remitted through the Head of the Institution as per the instructions sent by the office of Registrar (Evaluation) from time to time.

OM 10 ELIGIBILITY FOR PASSING

OM 10.1 There shall be University examination at the end of each semester.

OM 10.2 The candidate shall obtain a minimum of 40% of marks in each theory paper in the University examination and a minimum of 50% of marks in each laboratory examination and a minimum of 50% of marks in aggregate including the Internal Assessment marks for pass in each of the theory subject /Lab.

OM 10.3 To pass a candidate shall obtain a minimum of 50% of maximum marks separately both in Seminar and in Dissertation.

OM 10.4 The candidate with a maximum of two backlog subjects of first year shall be eligible for taking admission to second year (III semester).

However for part time course, candidate with one backlog subject shall be eligible for taking admission to odd semester from even semester.

OM 10.5 The full time candidate has to pass in all the subjects of the first two semesters and Internship and the part time candidate has to pass in all the subjects of first four semester and Internship before the submission of dissertation report.

OM 10.6 A candidate may at his/her desire reject his/her latest semester results of University examination in respect to all subjects of that semester. However, in the 4th semester the rejection shall not include the Dissertation result. Rejection shall be permitted only once during the entire course. The Internal Assessment marks of the rejected semester shall be retained.

If the rejection of the University examination results of the semester happens to be of an odd semester, the candidate can take admission to the immediate next even semester. However, if the rejection of the University result is of even semester, the candidate cannot take admission to the next odd semester.

OM 10.7 Application for rejection shall be submitted to the Registrar (Evaluation) through the Principal of the college, within thirty days from the date of announcement of results.

OM 10.8 A candidate, who opts for rejection shall be eligible for the award of class and distinction, but shall not be eligible for the award of rank.

OM 11 AWARD OF CREDITS : A candidate, who satisfactorily completes a subject/lab/seminar/project/ internship shall be awarded the credits prescribed for the subject/lab/seminar/ project/ internship

OM 12 AWARD OF CLASS AND RANK

OM 12.1 Candidates who have complied to the academic requirements for the award of the degree of Master of Technology shall be declared to have passed the course.

OM 12.2 The class shall be awarded at each semester based on the aggregate marks of the semester obtained in the first attempt.

OM 12.3 A candidate who secures 70% or more marks in the aggregate in the first attempt shall be declared to have passed in First class with Distinction.

OM 12.4 A candidate who secures 60% or more marks but less than 70% marks in the aggregate in the first attempt shall be declared to have passed in First Class.

OM 12.5 A candidate who secures 50% or more marks but less than 60% marks in the aggregate in the first attempt shall be declared to have passed in Second Class.

OM 12.6 The class shall be awarded on the aggregate marks obtained in the first attempt in all semesters.

OM 12.7 There shall be three ranks in each PG course, provided the minimum full time strength is 10. The ranks shall be declared only for full time students who have passed every semester in the first attempt, on the basis of the aggregate marks of all the semesters taken together.

OM 12.8 Candidates who have rejected as per the regulation OM9.6 or discontinued the course as per regulation OM4.4 or do not submit the dissertation report within the stipulated period as per OM 2.2 are not eligible for award of ranks.

NOTE: *These regulations governing the Degree of Master of Technology of Visvesvaraya Technological University shall be binding on all and may be modified from time to time.*

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VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
SCHEME OF TEACHING AND EXAMINATION FOR
M.Tech. in Thermal Power Engineering

I Semester **CREDIT BASED**

Subject Code	Name of the Subject	Teaching hours/week		Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Practical / Field Work / Assignment/ Tutorials		I.A.	Exam		
14MDE11	Applied Mathematics	4	2	3	50	100	150	4
14MTP12	Finite Element Method	4	2	3	50	100	150	4
14MTP13	Advanced Fluid Mechanics	4	2	3	50	100	150	4
14MTP14	Thermodynamics & Combustion Engineering	4	2	3	50	100	150	4
14MTP15X	Elective– I	4	2	3	50	100	150	4
14MTP16	Thermal Engineering Measurement Lab- 1	--	3	3	25	50	75	2
14MTP17	SEMINAR	--	3	--	25	--	25	1
	Total	**20**	**16**	**18**	**300**	**550**	**850**	**23**

ELECTIVE-I

14MTP151	Non Conventional Energy System	14MTP153	Energy Conservation and Management
14MTP152	Nuclear Energy Conversion	14MTP154	Refrigeration and Air Conditioning

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
SCHEME OF TEACHING AND EXAMINATION FOR
M.Tech. in Thermal Power Engineering

II Semester **CREDIT BASE**

Subject Code	Name of the Subject	Teaching hours/week		Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Practical / Field Work / Assignment/ Tutorials		I.A.	Exam		
14MTP21	Advanced Heat Transfer	4	2	3	50	100	150	4
14MTP22	Steam &Gas Turbines	4	2	3	50	100	150	4
14MTP23	AdvancedPower Plant Cycles	4	2	3	50	100	150	4
14MTP24	Theory of 1C Engines	4	2	3	50	100	150	4
14MTP25X	Elective- II	4	2	3	50	100	150	4
14MTP26	Simulation Laboratory Projects on Thermal Engineering - Lab 2		3	3	25	50	75	2
14MTP27	SEMINAR	--	3	--	25	--	25	1
	Total	**20**	**16**	**18**	**300**	**550**	**850**	**23**

ELECTIVE-II

14MTP 251	Thermal Power Station 1	14MTP 253	Modeling and Simulation of Thermal Systems
14MTP252	Alternate Fuels for 1C Engines	14MTH 254	Computational Methods in Heat Transfer &luid Flow

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
SCHEME OF TEACHING AND EXAMINATION FOR
M.Tech. in Thermal Power Engineering

III Semester: INTERNSHIP **CREDIT BASED**

Course Code	Subject	No. of Hrs./Week		Duration of the Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Practical / Field Work		I.A.	Exam		
14MTP31	Seminar / Presentation on Internship (After 8 weeks from the date of commencement of the semester).	-	-	-	25	-	25	
	Project Phase: I – Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd semester.	-	-	-	-	-	-	
14MTP32	**Evaluation of Internship** - To be carried out by the Internal Guide of the college and the respective Head of the Department.	-	-	-	50		50	
14MTP33	**Viva-Voce on Internship Report** - To be conducted *internally* by the Internship Guide (from the college) and the External Guide under whose supervision the student has carried out the internship.	-	-	-	-	75	75	
	Project Phase: II – Preliminary work on Project Implementation.	-	-	-	-	-	-	
	Total	-	-	-	**75**	**75**	**150**	**20**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
SCHEME OF TEACHING AND EXAMINATION FOR
M.Tech. in Thermal Power Engineering

IV Semester **CREDIT BASED**

Subject Code	Subject	No. of Hrs./Week		Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Field Work / Assignment / Tutorials		I.A.	Exam		
14MTP41	Design of Heat TransferEquipments for ThermalPower Plant	4	2	3	50	100	150	4
14MTP42X	Elective-III	4	2	3	50	100	150	4
14MTP43	Interim Evaluation of Project work (after 10 weeks from the commencement of 4th Semester).	-	-	-	50	-	50	2
14MTP44	Final Evaluation of Project Work and Viva-voce.	–	-	3	-	100+100	200	18
	Total	**8**	**04**	**09**	**150**	**400**	**550**	**28**
						Grand Total (I to IV Sem.) : 2400 Marks; 94 Credits		

ELECTIVE-III

14MTP421	Convective Heat and Mass Transfer	14MTP423	Design & Analysis of Thermal Systems
14MTP422	Engine Flow & Combustion	14MTP 424	Experimental Methods inThermal Power Engineering

NOTE:

III Semester:

- Internship: The student shall undergo Internship for 16 weeks.
- Seminar / Presentation on Internship: The student shall make a midterm presentation of the activities undertaken during the first eight weeks of internship to a panel comprising Internship Guide, a senior faculty from the department and Head of the Department of the college.
- Project Phase: I - Problem formulation and submission of synopsis of Project to the Head of the Department of the college with the approval of the Guide within eight weeks from the commencement of III Semester.
- Report on Internship: The College shall facilitate and monitor the student internship program. The internship report of each student shall be submitted to the Head of the Department of the college with the approval of the Guide.
- Evaluation of Internship - To be carried out by the Internal Guide of the college and the respective Head of the Department.
- Viva-Voce on Internship Report- To be conducted internally by the Internship Guide (from the college) and the External Guide under whose supervision the student has carried out the internship.
- Project Phase : II - Preliminary work on Project Implementation.

IV Semester:

- Interim Evaluation of Project : Comprising Evaluation of Project Phase – I and Project Phase – II – By Internal Guide after Ten weeks from the commencement of Fourth Semester.
- Project Phase-III : Finalization of Project work, dissertation report writing and submission of dissertation report.
- Evaluation of Dissertation / Final Project:
- Final evaluation of project to be carried out after 24 weeks from the date of commencement of 4th semester.
- The Internal Examiner (the project guide with a teaching experience of at least three years) and External Examiner shall be appointed by the University for the final evaluation of Project.
- Internal Examiner shall carry out the evaluation for 100 Marks, and
- External Examiner, shall carry out the evaluation for 100 Marks.
- The average of the marks allotted by the Internal Examiner and the External examiner shall be the final marks of the Project Evaluation.
- Viva – Voce : The Viva-Voce shall be conducted jointly by Internal Examiner and External Examiner for 100 Marks.

APPLIED MATHEMATICS
(Common to MDE, MMD, MEA, CAE, MCM, MAR, IAE, MTP, MTH, MST, MTE, MTR)

Sub Code	:	**14MDE11**	**IA Marks**	:	**50**
Hrs/ Week	:	**04**	**Exam Hours**	:	**03**
Total Hrs.	:	**50**	**Exam Marks**	:	**100**

Course Objectives:

The main objectives of the course are to enhance the knowledge of various methods in finding the roots of an algebraic, transcendental or simultaneous system of equations and also to evaluate integrals numerically and differentiation of complex functions with a greater accuracy. These concepts occur frequently in their subjects like finite element method and other design application oriented subjects.

Course Content:

1. Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modeling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering.

06 Hours

2. Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton- Raphson method, Secant Method. Multiple roots, Simple fixed point iteration.

Roots of polynomial-Polynomials in Engineering and Science, Muller's method, Bairstow's Method Graeffe's Roots Squaring Method.

12 Hours

3. Numerical Differentiation and Numerical Integration: Newton –Cotes and Guass Quadrature Integration formulae, Integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae

06 Hours

4. System of Linear Algebraic Equations And Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, Iteration Methods.

Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method.

14 Hours

5. Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engineering

Orthogonality and Least Squares: Inner product, length and orthogonality, orthogonal sets, Orthogonal projections, The Gram-schmidt process, Least Square problems, Inner product spaces.

12 Hours

TEXT BOOKS:

1. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
2. Steven C. Chapra, Raymond P.Canale, Numerical Methods for Engineers, Tata Mcgraw Hill, 4th Ed, 2002.
3. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.

REFERENCE BOOKS:

1. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge, 2010.
2. David. C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002.

Course Outcomes:

The Student will be able to

1. Model some simple mathematical models of physical Applications.
2. Find the roots of polynomials in Science and Engineering problems.
3. Differentiate and integrate a function for a given set of tabulated data, for Engineering Applications

FINITE ELEMENT METHOD
(Common to MTP,MTH,MCS)

Sub Code	**:**	**14MTP12**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objectives :

1. Introduce the various aspects of FEM as applied to engineering problems.
2. Apply the fundamental concepts of mathematical methods solve Heat Conduction, Transient and Phase Change ,Convective Heat Transfer problems.

Course Content:

1. Introduction: Importance of stress analysis, heat transfer and fluid flow, conservation laws for mass, momentum and energy; Fourier equation, N-S equations; energy principles in stress analysis; Basic equations in elasticity; Boundary conditions. Some Basic Discrete Systems: Discrete systems as basis for FEM analysis; Examples of discrete systems in stress analysis, heat transfer and fluid flow.

1-D Finite Elements: Introduction; Elements and shape functions - one dimensional linear element (bar element), one dimensional quadratic element.

10 Hours

2. 2-D Finite Elements: two dimensional linear triangular elements, Local and Global coordinate systems, quadratic triangular elements, two dimensional quadrilateral elements, iso-parametric elements, three dimensional elements, beam, plate and shell elements, composite materials.

6 Hours

Formulation: Introduction; Variational approach; methods of weighted residuals for heat transfer problems, principle of virtual work for stress analysis problems; mixed formulation; penalty formulation for fluid flow problems. Primitive variables formulation for flow problems.

12 Hours

3. Heat conduction problems: FEM analysis of steady state heat conduction in one dimension using linear and quadratic elements; steady state heat conduction in two dimensions using triangular and rectangular elements; three

dimensions problems, Axi-symmetric problems.

6 Hours

4. Transient and Phase change problems: Transient heat conduction in one and multi dimensional problems; time stepping scheme using finite difference and finite element methods; phase change problems - solidification and melting; Inverse heat conduction problems.

6 Hours

5. Stress Analysis Problems: Introduction; stress analysis in one, two (plane stress and plane strain) and three dimensions; Axi-symmetric problems; beam and plate bending problems; thermal stress development; shrinkage stress development; prediction of distortions in manufactured products; Introduction to simple dynamic problems.

10 Hours

6. Convective Heat Transfer Problems: Introduction; Galerkin method of Steady, convection-diffusion problems; upwind finite element in one dimension - Petro-Galerkin formulation, artificial diffusion; upwind method extended to multi-dimension; transient convection - diffusion problems - FEM solutions, extension to multi dimensions; primitive variables approach (u, v, w, p, t formulation); characteristic - based split scheme (CBS); artificial compressibility scheme; calculation of Nusselt number, drag and stream function; mesh convergence; Introduction to convection in Porous media; Laminar and turbulent flows.

8 Hours

TEXT BOOKS:

1. Fundamentals of the finite element method for heat and fluid flow - R.W. Lewis, P. Nithiarasu and K. N. Seetharamu, , John Wiley and Sons, 2004.
2. The finite element method in heat transfer analysis - R.W. Lewis, K Morgan, H.R. Thomas, K.N. Seetharamu, John Wiley and Sons, 1996.

REFERENCE BOOKS:

1. The finite element method in heat transfer and fluid dynamics -J.N. Reddy and Gartling D.K., CRC publications, 2000.
2. The finite element method volume 3: fluid dynamics - O.C. Zienkiewicz and R.L. Taylor, John Wiley & Sons, 2001.
3. The finite element and for solid and structural mechanics - O.C. Zienkiewicz and R.L. Taylor, Elsevier Publishers , 2005.

4. Introduction to Finite Elements in Engineering - Tirupathi R. Chandrupatla, Ashok D. Belegundu, Prentice-Hall Ltd., 2002.
5. Finite Element Analysis - S.S. Bavikatti, New Age International, 2005.

Course Outcome:

Students will be able to

1. Define the element properties such as shape function and stiffness matrix for the various elements.
2. Formulate element properties for 1D and 2D elements.
3. Develop skill to solve simple Heat Transfer problems using the steps of FEM

ADVANCED FLUID MECHANICS
(Common to MTP,MTH)

Sub Code	**:**	**14MTP13**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:
To understand the kinematics of fluids, their governing equations, Mechanics of laminar and turbulent flow, NS Equations and Experimental Techniques.

Course Content:

1. Introduction and Kinematics of Fluids: Concepts of continuum rarefied gas dynamics, magneto fluid mechanics regimes in mechanics of fluids; fluid properties. Kinematics of Fluids- Methods of describing fluid motion - Lagrangian method, Eulerian method; translation, rotation and rate of deformation; stream lines, path lines and streak line; material derivative and acceleration; vorticity.

Governing Equations for Fluid Flow: Nature of stress; transformation of stresses - nature of strains; transformation of the rate of strain; relation between stress and rate of strain; Conservation equations for mass, momentum and energy - differential and integral forms; Euler's equations of motion, integration along the stream line; integration of steady irrotational motion; integration for two dimensional unsteady flow.

12 Hours

2. Mechanics of Laminar Flow: Introduction; Laminar and turbulent flows; viscous flow at different Reynolds number - wake frequency; laminar plane Poiseuille flow; stokes flow; flow through a concentric annulus.

Mechanics of Turbulent Flow: structure and origin of turbulent flow - Reynolds, average concept, Reynolds equation of motion; zero equation model for fully turbulent flows; k-l, k-? and other turbulence models; turbulent flow through pipes; losses in bends, valves etc; analysis of pipe network - Hard cross method.

8 Hours

3. Exact and Approximate solutions of N-S Equations: Introduction; Parallel

flow past a sphere; Oseen's approximation; hydrodynamic theory of lubrication; Hele-Shaw Flow.

Boundary Layer Theory: Introduction; Boundary layer equations; displacement and momentum thickness, shape factor; flow over a flat plate – similarity transformation, integral equation for momentum and energy ; skin friction coefficient and Nusselt number; separation of boundary layer; critical Reynolds number; control of boundary layer separation.

12 Hours

4.Flow Around bodies: Introduction; flow past a circular cylinder; drag on a sphere; stream lined body, lift and drag on airfoil; Drag and lift on road vehicles.

8 Hours

5. Experimental Techniques: Introduction; improved modeling through experiments; design of fluid flow experiments; error sources during measurement; pressure transducers; hot wire anemometer; laser - Doppler velocity meter; methods of measuring turbulence fluctuations - flow visualization techniques; wind tunnel; analysis of experimental uncertainty - types of error, estimation of uncertainty.

10 Hours

TEXT BOOKS:

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

REFERENCE BOOKS:

3. Fluid Mechanics - F.M. White, McGraw-Hill publications.
4. Advanced fluid mechanics - K. Muralidhar and G. Biswas, Narosa publications, 1996.
5. Introduction to fluid dynamics - Principles of analysis & design - Stanley Middleman, Wiley, 1997.

Course Outcome:
Students will have a thorough knowledge about the basics of fluid flow, their kinematics and governing equations. Knowledge about types of flow, etc.

THERMODYNAMICS AND COMBUSTION ENGINEERING
(Common to MTP,MTH)

Sub Code	:	**14MTP14**	**IA Marks**	:	**50**
Hrs/ Week	:	**04**	**Exam Hours**	:	**03**
Total Hrs.	:	**50**	**Exam Marks**	:	**100**

Course Objective:
To enrich the knowledge of students in thermodynamics.To predict the availability and irreversibility associated with the thermodynamic processes. To analyze the properties of ideal and real gas mixtures, Behavior of pure substances and to understand the basic concepts of combustion, flame propagation and types of flames.

Course Content:
1.Work and heat interaction, first law of thermodynamics, steady and unsteady flows with energy transaction. Second law of thermodynamics, reversibility, corollaries of the second law and entropy.Available energy, availability analysis of open and closed systems.

12 Hours

2. Properties of pure substances, properties of gases and gas mixtures, combined first and second laws of thermodynamics.Phase and reaction equilibrium, equilibrium constants, calculation of equilibrium composition of multi component gaseous mixtures.

8 Hours

3. Equation of state and calculation of thermodynamics and transport properties of substances.Reaction rates and first, second and higher order reaction, in gaseous, liquid and solid phases.

10 Hours

4. Combustion and flame velocities, laminar and turbulent flames, premixed and diffusion flames, their properties and structures.

8 Hours

5. Theories of flame propagation, thermal, diffusion and comprehensive theories, problems of flame stability, flashback and blow off. Combustion of solid, liquid and gaseous fuels.Combustion of fuel droplets and sprays.Combustion system combustion in closed and open systems,

application to boiler, gas turbine combustors and rocket motors.

12 Hours

TEXT BOOKS:

1. Engineering Thermodynamics - P.K. Nag, Tata McGraw-Hill Publications.
2. Fundamentals of Classical Thermodynamics - G. Van Wylen and R.E. Sonntag, Wiley, 1986.

REFERENCE BOOKS:

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

Course Outcome:
Students will get an enriched knowledge about the availability and irreversibility associated with the thermodynamic processes,Properties of ideal and real gas mixtures, behavior of pure substances . The basic concepts of combustion, flame propagation and types of flames will also be known.

ELECTIVE - I
NON – CONVENTIONAL ENERGY SYSTEM
(Common to MTP,MTH)

Sub Code	**:**	**14MTP151**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:
To create awareness about the availability of various non-conventional energy sources, their conversion technology.

Course Content:
1.Man and Energy: World's Production and reserves of commercial energy sources, India's production and reserves, Energy alternatives, Different forms of non-conventional energy source, Limitation of conventional and non-conventional sources of energy.

Solar Energy: Solar radiation geometry, Estimation and measurement of solar energy. Photovoltaic application: Types and characteristics (I.V) of Photovoltaic cells, Solar cell arrays, balance of system (BOS)

12Hours

2. Thermal Application: Water heating, Drying, Cooking, Desalination, Solar refrigeration, solar ponds (Basic concepts).

8 Hours

3.Biomass Energy Sources: Thermo-chemical and Bio-chemical routes to biomass Utilization.

Wind Energy: Betz theory for wind energy conversion, Estimation of wind energy Potential, Characteristics of wind turbines (HAWT and VAWT), Aerofoil blade structure, Water pumping and power generation using wind turbines.
Wave energy: Wave energy conversion machine & recent advances.

12 Hours

4. Mini and micro hydro power generation: Basic concepts, Types of turbines, Hydrological analysis.Geothermal Energy Conversion: Forms of geothermal energy sources, geothermal electric power plants.

8 Hours

5. OTEC: Principle of operation, Open and Closed OTEC cycles. Tidal Energy: Single basin and double basin tidal systems (Basic concepts), nuclear fusion energy.

10 Hours

TEXT BOOKS:
1. Solar Energy-Principles of Thermal Collection & Storage - S.P. Sukhatme, Tata McGraw-Hill Publications.
2. Solar energy Thermal Process-John A. Duffie&, William A. Bechkam, Wiley-Inter science publication. New York.

REFERENCE BOOKS:
1. Non Conventional Energy Sources - G.D. Rai, Khanna Publishers, New Delhi.
2. Solar Energy - Fundamentals and Application - H.P. Garg& J. Prakash, Tata McGraw-Hill Publications.

Course Outcome:
Students will get an idea about the availability of Non- conventional energy sources, their conversion technologies, utilization, etc

NUCLEAR ENERGY CONVERSION
(Common to MTP,MTH)

Sub Code	:	**14MTP152**	**IA Marks**	:	**50**
Hrs/ Week	:	**04**	**Exam Hours**	:	**03**
Total Hrs.	:	**50**	**Exam Marks**	:	**100**

Course Objective:
To provide in-depth knowledge on Nuclear reaction materials reprocessing techniques and also to understand nuclear waste disposal techniques and radiation protection aspects.

Course Content:
1. Radioactivity, Nuclear reactions, Cross sections, Nuclear fission, Power from fission, Conversion and breeding.

10 Hours

2. Neutron transport equation, Diffusion theory approximation, Pick's law, Solutions to diffusion equation for point source, Planar source, etc. Energy loss in elastic collisions, Collision and slowing down densities.Moderation in hydrogen, Lethargy, concept.

10 Hours

3. Moderation in heavy nucleus, Moderation with absorption, Resonance absorption, NR and NRIM approximations. Multi-region reactors, Multi-group diffusion methods.

10 Hours

4. Thermal reactors, Heterogeneous reactors. Reactor kinetics, in hour equation, Coefficients of reactivity, Control, Fission product poison.Perturbation theory.

10 Hours

5. Environmental impact; Natural and artificial radioactivity, reactions from nuclear power plant, effluents, high level wastes.

10 Hours

REFERENCE BOOKS:
1. Introduction to Nuclear Reactor Theory - J.R. Lamarsh, Addison-Wesley, 1981.

2. Nuclear Reactor Analysis - J.J. Duderstadt and L.J. Hamilton, John Wiley & Sons, 1976.

Course Outcome:
Knowledge about fundamental study of nuclear reactions, nuclear fuels cycles, characteristics. Fundamental principles governing nuclear fission chain reaction and fusion will be demonstrated by the student.

ENERGY CONVERSION & MANAGEMENT
(Common to MTP,MTH)

Sub Code	**:**	**14MTP153**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:
To give an overview on the different technologies in vogue for converting one form of energy to another.To analyze the pros and cons of Conventional energy conversion techniques. Waste heat recovery, Economic Analysis.

Course Content:
1. General energy problem, Energy uses patterns and scope of conversion. Energy Management Principle: Need, Organizing and managing an energy management program.

Energy Auditing: Elements and concepts, Type of energy audits instruments used in energy auditing.

10Hours

2. Economic Analysis: Cash flows, Time value of money, Formulae relating present and future cash flows- single amount, uniform series.

Financial appraisal methods: Pay back periods, net present value, benefit cost ratio, internal rate of return and Life cycle cost / benefits.

10 Hours

3.Thermodynamics of energy conservation: Energy conservation in Boilers and furnace, Energy conservation in stream and condensate system.Cogeneration: Concepts, Type of cogeneration system, performance evaluation of a cogeneration system.

8 Hours

4.Waste Heat Recovery: Potential, benefit, waste heat recovery equipments. Space Heating, Ventilation Air Conditioning (HVAC) and water heating of building, Transfer of heat, space heating methods, Ventilation and air conditioning, Heat pumps, Insulation, Cooling load, Electric water heating systems, Electric energy conversation methods.

Industrial Insulation: Insulation materials, insulation selection, Economical thickness of insulation. Industrial Heating: Heating by indirect resistance, direct resistance heating (salt bath furnace), Heat treatment by induction heating in the electric furnace industry.

12 Hours

5. Energy conservation in Electric Utility and Industry: Energy cost and two -part tariff, Energy conservation in utility by improving load factor, Load curve analysis, Energy efficient motors, Energy conservation in illuminating system, Importance of power factor in energy conservation - Power factor improvement methods, Energy conservation in industries.

10 Hours

REFERENCE BOOKS:

1. Electrical Energy Utilization and Conservation - S.C. Tripathy, Tata McGraw-Hill, 1991.
2. Energy management handbook - Wayne C. Turner, CRC Press Publications, 2004.
3. Industrial Energy Conversation - D.A. Reay, Pergamon Press
4. Industrial energy conservation Manuals: MIT Press.

Course Outcome:
Knowledge about the different technologies, Waste heat recovery, Economic Analysis.Will be very well understood by the students.

REFRIGERATION AND AIR CONDITIONING
(Common to MTP,MTH)

Sub Code	:	**14MTP154**	**IA Marks**	:	**50**
Hrs/ Week	:	**04**	**Exam Hours**	:	**03**
Total Hrs.	:	**50**	**Exam Marks**	:	**100**

Course Objective:
To teach the students about the methods of Refrigeration and its types, Psychrometry and its principles.Teaching the cycle analysis pertaining to various Refrigeration systems, Air-conditioning systems, cooling load calculations.

Course Content:
1.Method of Refrigeration and Non-conventional refrigeration system: Ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, refrigeration by throttling of gas, Vapor refrigeration system, steam jet refrigeration system, refrigeration by using liquid using liquid gases, dry ice refrigeration, types of refrigerants, properties of refrigerants, thermoelectric refrigeration, vortex refrigeration, cooling by adiabatic demagnetization, pulse tube refrigeration.

Air refrigeration system: Bell Coleman air refrigerator, advantages and disadvantages of air refrigeration system, necessity of cooling the aero plane, factors considered in selecting the refrigeration system for aero plane, simple cooling with simple evaporative type aero plane air conditioning, boot strap and boot strap evaporative type, regenerative type, reduced ambient type, comparison of different systems, actual air conditioning system with control, limitations, merits and comparisons.

12 Hours

2.Vapor compression refrigeration system: Simple vapor refrigeration system, T-s, h-s, p-h diagrams for vapor compression refrigeration system, wet versus dry compression, vapor compression refrigeration systems with multiple evaporators and compressors.

Absorption refrigeration system: Basic- absorption system, actual ammonia absorption system, Electrolux refrigeration system, lithium bromide absorption refrigeration system, analysis of ammonia refrigeration system, comparison of compression and absorption refrigeration system.

10 Hours

3. Psychometry: Psychometry and psychometric properties, psychometric relations, psychometric chart, psychometric processes, requirements of comfort air conditioning, comfort chart, design consideration, summer air conditioning system, winter air conditioning.

Cooling load calculations and design of air conditioning system: Different heat sources, conduction heat load, radiation load of sun, occupants load, equipment load, infiltration air load, miscellaneous heat sources, fresh air load, design of air conditioning system, bypass factor consideration, effective sensible heat factor, cooling coils and dehumidifying air washers.

10 Hours

4. Air conditioning systems: Air conditioning systems central station air conditioning system, unitary air conditioning system, direct air conditioning system, self-contained air conditioning units, direct expansion system, all eater system, all air system air water system , arrangement of the components of some air conditioned systems used in practice, factory air conditioning.

9 Hours

5. Refrigeration and air conditioning equipments: Refrigeration Equipments- Compressors, condensers and cooling towers, evaporators, expansion devices, electric motors. Air conditioning Equipments- air cleaning and air filters, humidifiers, de-humidifiers from different reputed companies, fans and blower.

9Hours

REFERENCE BOOKS:

1. A Course in refrigeration and Air- Conditioning - Arora and Domkundawar, DanpatRai& Co Publications
2. Basic Refrigeration and Air Conditioning - P. N. Ananthanarayanan, McGraw-Hill Publications
3. Refrigeration & Air Conditioning - Manohar Prasad., New Age International Publications.

Course Outcome:
Students will be in a position to have a knowledge about the various refrigeration techniques, Psychrometry principles, cooling load calculations. Good understanding about components and equipments, etc...

THERMAL ENGINEERING MEASUREMENT LABORATORY - LAB 1
(Common to MTP,MTH)

Subject Code	**: 14 MTP16**	**IA Marks :**	**25**
Hours/Week	**: 6**	**Exam Hours :**	**03**
Total Hours	**: 84**	**Exam Marks :**	**50**

Note:

1) These are independent laboratory exercises
2) A student may be given one or two problems stated herein
3) Student must submit a comprehensive report on the problem solved and give a Presentation on the same for Internal Evaluation
4) Any one of the exercises done from the following list has to be asked in the Examination for evaluation.

Course Content:

1. Develop a Diaphragm Gauge using steel diaphragm and electrical strain gauges mounted on the diaphragm to measure pressure of a gaseous source. Calibrate the gauge using a standard source of pressure. Enumerate the range of pressure measurement by such gauges and draw the calibration curves for loading and un-loading conditions.

2. Develop manometers to measure pressure of gaseous sources of the order of 1 atm to 3 atm pressure. Choose proper size of glass tube, the multiple loops of tube and various manometric fluids to achieve the pressure ranges indicated. Also conduct the sensitivity test to assess the dynamic response of this gauge.

3. Develop a diaphragm Gauge with LVDT to measure low pressures. Calibrate the instrument against a standard pressure source of means and draw the calibration curves.

4. Design a venturimeter to measure the flow rate of a fluid of specific gravity 0.85 to measure flow rate upto 2 litres per second at atmospheric temperature of 30 degree centigrade. Use standard charts for determining the coefficient of discharge of venturimeter. Suppose the differential pressure gauge used to measure the pressure difference across the throat and convergent portion has an accuracy of 0.3 % of full scale, determine the percentage error of measurement of mass flow through the venturimeter at maximum flow rate.

5. Design a rotameter to measure the flow rate of water with a maximum flowrate of 0.25 litres per second. Obtain the calibration curve for the scale fixed on the rotameter for entire range of flow. Suppose a liquid of specific gravity 0.85 used instead of water, obtain the correction factor for the same.

6. Using a hot wire anemometer obtain the mean velocity profile in the test section of a laboratory wind tunnel and measure the turbulence intensity across the depth of the test section. The work should include the critical analysis of hot wire technique for measurement of velocity including design parameters and limitations of this technique.

7. Develop a shadowgraph and Schlieren to obtain the first order and second order density variation in the flow field. Using these techniques obtain the images of two fluid flow fields such as a jet of salt water flowing into distilled water, smoke coming out a insane-stick, thermal plumes raising from hot objects etc. Critical analysis of both techniques is a must.

8. Develop Mach-Zehnder interferometer and obtain the iso-temperature contours from a heated ball losing heat to ambient by natural convection. For these fringe lines obtained in free-convection boundary layers, obtain the expression for number of fringes and related density change in the temperature field.

9. For subsonic flows through an experimental wind tunnel, develop smoke visualisation technique and obtain the flow visualisation photographs for flow past a sharp edged flat plate at various angles of attack at different wind speeds and show the regimes of flow through photographs captured. Critical analysis of the image is essential to explain the phenomena of boundary layer separation.

10. Conduct a series of test to obtain the stagnation pressure response of pitot probe in a wind tunnel for varied yaw angle of the stagnation pitot and obtain the response curve in terms of error, (percentage of velocity head) to yaw angle. Repeat the experiment for other any two different type of stagnation pitot probes of various c/s and obtain the response curves for varying yaw angle. Critical analysis of curves obtained is desired.

11. Conduct a series of test to obtain the static pressure response of pitot probe in a wind tunnel for varied yaw angle of the static pitot and obtain the response curve in terms of error, (static percentage head) to yaw angle.

Repeat the experiment for other any two different types of static pitot probes of different c/s and obtain the response curves for varying yaw angle. Critical analysis of curves obtained is desired.

12. Develop a simple constantan-iron or other suitable combination of thermocouple and calibrate it at freezing point and boiling point of water and draw the calibration curves. Integrate this instrument with a computer to log-in the data of changing temperature of a source and develop a code to obtain the temperature values which would automatically take care of changing atmospheric temperature for compensation of cold junction. Obtain the time constant of this thermocouple depending on the bead diameter of the tip of the thermocouple.

13. Develop a system to measure the thermal conductivity of liquid. Use either guarded hot-plate apparatus or concentric cylinder concept for the same. Develop the equations for determining the thermal conductivity of liquids. Using this instrument measure the thermal conductivity of water, alcohol and any liquid fuel.

14. Conduct performance test on IC engine and obtain the characteristic curves of mass flow of fuel to brake power (BP) at various operating loads and brake mean effective pressure (BMEP) show that for same BP and BMEP, two distinct values of mass flow of fuel is possible.

15. Conduct performance test on any IC engine and draw the conclusions on the effect of variation of load on the engine to its emission of pollution in terms of particulate matter (in case of diesel engine), CO, and NOX. Draw conclusions suitably.

16. Conduct performance test on any IC engine to evaluate the performance and emission characteristics of engine for various blends of bio-fuel with petroleum fuel and draw the conclusions. Critical analysis of performance and emission is essential.

17. Establish the effect of Exhaust Gas Recirculation (EGR) in IC engine to reduce the NOX formation. Draw the emission curves at various percentage of exhaust recirculation and also comment on the relative change in the performance of engine in terms of Brake Power.

II SEMESTER
ADVANCED HEAT TRANSFER
(Common to MTP,MTH)

Sub Code	**:**	**14MTP21**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:
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 fluid flow, phase change processes and radiation heat transfer.

Course Content:
1. Introduction and one-dimensional heat transfer: The modes of heat transfer, the laws of heat transfer, problems Heat conduction in solids: Simple steady state problems in heat conduction, concept of thermal resistance, the critical radius problem, the differential equation of heat conduction, heat generation, two dimensional steady state heat conduction, unsteady state processes, extended surfaces- fins, other techniques for solving heat conduction problems, the finite difference method for steady state situations, the finite difference method for unsteady state situations, problems.

Steady state conduction in multiple dimensions: Mathematical analysis of 2-D heat conduction, graphical analysis, the conduction shape factor, numerical method of analysis, Gauss-Siedel iteration, electrical anology for 2-D conduction.

10 Hours

2. Thermal radiation: basic concepts, emission characteristics and laws of black body radiation, radiation incident on a surface, solid angle and radiation intensity, heat exchange by radiation between two black surface elements, heat exchange by radiation between two finite black surfaces, the shape factor, radiant heat exchange in an enclosure having black surfaces, heat exchange by radiation between two finite parallel diffuse-gray surfaces, heat exchange by radiation in an annular space between two infinitely long concentric cylinders , radiant heat exchange in an enclosure having diffuse gray surfaces, problems.

10Hours

3. Principles of fluid flow: the law of conservation of mass –the differential equation of continuity, differential equations of motion in fluid flow – Navier-strokes equations, laminar flow in a circular pipe, turbulent flow in a pipe, the velocity boundary layer, laminar flow over a flat plate, the integral method-an appropriate technique for solving boundary layer problems, turbulent flow over a flat plate, problems.

10Hours

4. Heat transfer by forced convection: the differential equation of heat convection, laminar flow heat transfer in circular pipe, turbulent flow heat transfer in a pipe, the thermal boundary layer, heat transfer in laminar flow over a flat plate, the integral method, analogy between heat and momentum transfer, heat transfer in turbulent flow over a flat plate, flow across a cylinder, flow across a bank of tubes, problems.

Heat transfer by natural convection: natural convection heat transfer from a vertical plate, correlations for a horizontal cylinder and a horizontal plate, correlations for enclosed spaces, problems.

10 Hours

5. Heat exchangers: types of heat exchangers, direct transfer type of heat exchangers, classification according to flow arrangement, fouling factor, logarithmic mean temperature difference, the effectiveness-NTU method, other design consideration, Compact heat exchangers.

Condensation and boiling: film and drop condensation, film condensation on a vertical plate, condensation on horizontal tubes, bank of tubes, effect of superheated vapor and of non-condensable gases, types of boiling: correlations in pool boiling heat transfer, forced convection boiling, problems.

10Hours

REFERENCE BOOKS:

1. Heat Transfer – A Basic Approach - Ozisik M.N., McGraw-Hill Publications, 1985.
2. Heat Transfer - Holmon J.P., McGraw-Hill Publications, 2002.
3. Principles of Heat Transfer - Frank Kreith& M. S. Bohn, Thomson Publications, 2001.

Course Outcome:

Students will have a good understanding and the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows. Ability to analyze and size heat exchangers.

STEAM &GAS TURBINES
(Common to MTP,MTH)

Sub Code	**:**	**14MTP22**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:
To learn the working principle, operations and analysis of nozzles, diffusers, steam and gas turbines.

Course Content:
1. Nozzles and diffusers: Introduction types of nozzles, types of Diffusers, Equation of Continuity Sonic Velocity and Mach Numbers, The Steady Flow Energy Equation in Nozzles, Gas Nozzles The Momentum Equation for the flow Through Steam Nozzles, Entropy Changes with friction, Nozzle Efficiency, The Effect of Friction on the Velocity of steam Leaving the Nozzles, Diffusion Efficiency, shape of Nozzle for Uniform Pressure Drop, Mass of Discharge of Critical Pressure in Nozzle Flow or Chocked Flow, Physical Explanation of Critical Pressure, Maximum Discharge of Saturated Steam, Maximum Discharge of Steam initially Superheated, Critical Pressure Ratio for Adiabatic and Frictionless Expansion of Steam from Ratio for Adiabatic and Frictionless Expansion of Steam from a given initial Velocity, Idea of Total or Stagnation Enthalpy and Pressure, General Relationship Between or Area Velocity and pressure in Nozzle Flow ,Effect of Friction on Critical Pressure Ratio Critical Pressure Ratio in a Frictionally Resisted Expansion from a Given Initial Velocity, Supersaturated Flow in Nozzles, Effect of Variation of Back Pressure, Parameters Affecting the Performance of Nozzles, Experimental Methods to Determine Velocity Coefficient, Experimental Results.

10 Hours

2. Steam Turbines Types and Flow of Steam through Impulse Blades
Principal of operation of turbine, Comparison of Steam Engines and Turbines, Classifications of Steam Turbine, The Simple Impulse Turbine, Compounding of Impulse Turbine, Pressure Compounded Impels Turbine, Simple Velocity –Compounded Impulse Turbine, Pressure Velocity –Compounded Impulse Turbine, Impulse –Reaction Turbine, Combination Turbines, Difference between Impulse and Reaction Turbines. Velocity Diagram for Impulse Turbines, Combination of Vector Diagram , Forces on the Blade and Work done by Blades, Blade or Diagram Efficiency ,Axial Thrust or end thrust

on the rotor, Gross Stage Efficiency, Energy Converted heat by blade friction, Influence of ratio of blade speed to steam speed on blade efficiency in single stage impulse turbine, Efficiency of multistage impulse turbine with single row wheel, Velocity diagram for three row velocity compound wheel, Most economical ratio of blade speed for a two row velocity compounded impulse wheel, Impulse blade suctions, Choice of blade angle, Inlet blade angles, Blade heights in velocity compounded impulse turbine.

10 Hours

3. Flow of Steam Through Impulse-Reaction Turbine Blades: Velocity diagram, degree of reaction, impulse- reaction turbine with similar blade section and half degree reaction turbine, height of reaction turbine blading, effect of working steam on the stage efficiency of Parson's turbine, operation of impulse blaring with varying heat drop or variable speed, impulse- reaction turbine section.

State Point Locus Reheat Factor and Design Procedure: Introduction, stage efficiency of impulse turbines, state point locus of an impulse turbine, reheat factor, internal and other efficiencies, increase in isentropic heat drop in a stage due to friction in proceeding stage, correction for terminal velocity, reheat factor for an expansion with the uniform adiabatic index and a constant stage efficiency, correction of reheat factor for finite number of stages, design procedure of impulse turbine, design procedure for impulse- reaction turbines.

10 Hours

4. Axial Flow and Centrifugal Compressors : Elementary theory, compressibility effects, factors affecting stage pressure ratio, blockage in compressor annulus, degree of reaction, 3-dimensional flow, design process and blade design, off design performance, compressor characteristics.

Shaft power Cycles and Gas turbine cycles for Air-craft propulsion: Ideal cycles, methods of accounting for component cycles, design point performance calculations, comparative performance of practical cycles, COGAS cycles and cogeneration schemes, closed cycle gas turbines, simple turbojet cycle, turbo fan engine, turbo prop engine, thrust augmentation.

10 Hours

5. Axial and Radial Flow Gas Turbines and Prediction of performance: Elementary theory of axial flow turbine, vortex theory, choice of blade profile, pitch and chord, estimation of blade performance, overall turbine performance,

the tooled turbine, the radial flow turbine. Component characteristics, off-design operation of the single-shaft gas turbine, equilibrium running of a gas generator, off-design operation of free turbine engine, off-design operation of the jet engine, methods of displacing the equilibrium running line, incorporation of variable pressure losses.

Jet and Rocket Propulsion : The ram jet engine, pulse jet engine, turbo prop engine, turbo jet engine, thrust equation, specific thrust, principles of rocket propulsion, ideal chemical rocket, advantages of liquid over solid propellants, free radical propulsion, nuclear propulsion, electro dynamics propulsion, photonpropulsion.

10 Hours

REFERENCE BOOKS:

1. Steam and Gas Turbines - R. Yadav, Central Publishing House, Allahabad.
2. Gas Turbine Theory - H.I.H. Saravanamuttoo, G.F.C. Rogers & H Cohen, Pearson Education.
3. Gas Turbines - V. Ganesan, Tata McGraw-Hill Publications.

Course Outcome:

Students will get a good understanding about **the working of nozzles, diffusers, flow of steam in steam turbine, compressors and rocket and jet propulsion .**

ADVANCED POWER PLANT CYCLES
(Common to MTP,MTH)

Sub Code	**:**	**14MTP23**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:

To provide a knowledge about the analysis of various cycles used for power generation, Combustion, kinetics involved in combustion. To impart knowledge about feed water circulation, working of FWH.

Course Content:

1. Analysis of Steam cycles: Rankine cycle, Carnot cycle, mean temperature of heat addition, effect of variation of steam condition on thermal efficiency of steam power plant, reheating of steam, regeneration, regenerative feed water heating, feed water heaters, carnotization of Rankine cycle, optimum degree of regeneration, Super critical pressure cycle, steam power plant appraisal, Deaerator, typical layout of steam power plant, efficiencies in a steam power plant, Cogeneration of Power and Process Heat, Numerical Problems.

Combined cycle power generation: Flaws of steam as working fluid in Power Cycle, Characteristics of ideal working fluid in vapor power cycle, Binary vapor cycles, coupled cycles , combined cycle plants, gas turbine- steam turbine power plant, MHD-steam power plant, Thermionic- Steam power plant, Numerical problems.

10 Hours

2. Fuels and combustion : Coal, fuel oil, natural and petroleum gas, emulsion firing, coal – oil and coal – water mixtures, synthetic fuels, bio-mass, combustion reactions, heat of combustion and enthalpy of combustion, theoretical flame temperature, free energy of formation, equilibrium constant, effect of dissociation, Numerical problems.

Combustion Mechanisms : Kinetics of combustion, mechanisms of solid fuel combustion, kinetic and diffusion control, pulverized coal firing system, fuel-bed combustion, fluidized bed combustion, coal gasifiers, combustion of fuel oil, combustion of gas, combined gas fuel oil burners, Numerical problems.

10Hours

the tooled turbine, the type of steam generators, fire tube boilers, water design operation of superheaters, reheaters, steam generator control, generator, off-d boilers, electrostatic precipitator, fabric filters and the jet eng g system, feed water treatment, de-aeration, incorpor nent, boiler blow down, steam purity, Numerical

Je

nd circulating water systems: Need of condenser, rs, feed water heaters, circulating water system, cooling towers, calculations, Numerical Problems.

10 Hours

4. Nuclear Power Plants: Chemical and nuclear reactions, nuclear stability and binding energy, radioactive decay and half life, nuclear fission, chain reaction, neutron energies. Neutron flux and reaction rates, moderating power and moderating ratio, variation of neutron cross sections with neutron energy, neutron life cycle. Reflectors, Types of Reactor, PWR, BWR, gas cooled reactors. Liquid metal fast breeder reactor, heavy water reactors, Fusion Power reactors, Numerical problems.

10 Hours

5. Hydro Electric Power Plant: Introduction, advantages and disadvantages of water power, optimization of hydro – thermal mix, hydrological cycles, storage and pondage, essential elements of hydro electric power plant, classification, hydraulic turbines – Pelton wheel, Francis turbine, propeller and Kaplan turbines, Deriaz turbine, bulb turbine, comparisons of turbines, selection of turbines, Numerical problems.

10 Hours

REFERENCE BOOKS:

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

Course Outcome:

Students will have an idea about the use of various cycles for power generation. The types of turbine tom be selected for power generation, etc.

THEORY OF IC ENGINES
(Common to MTP,MTH)

Sub Code	:	**14MTP24**	**IA Marks**	:	**50**
Hrs/ Week	:	**04**	**Exam Hours**	:	**03**
Total Hrs.	:	**50**	**Exam Marks**	:	**100**

Course Objective:

To impart the knowledge of working cycle, Engine design and operating conditions, combustion phenomena, Engine emission and control, use of alternate fuels in IC engines.

Course Content:

1. Engine Design and Operating Parameters: Engine characteristics, geometrical properties of reciprocating engines, brake torque, indicated work, road load power, M.E.P., S.F.C. and efficiency, specific emissions and emission index, relationships between performance parameters, Engine design and performance data.

Ideal models for engine cycles: Thermodynamic relation for engine process, Ideal Cycle analysis, fuel-air cycle analysis, over expanded engine cycles, Availability analysis of engine processes, comparison with real engine cycle.

10 Hours

2. SI Engines fuel metering, manifold phenomena: S.I. Engine mixture requirements, carburetors, fundamentals and design, fuel injection systems, feed back systems, flow past throttle plate, flow in in-take manifold.

Combustion in IC Engines: Combustion in SI Engines – Flame front propagation, flame speed, rate of pressure rise, knock in SI engines; combustion in CI engines – ignition delay period, rapid and controlled combustion, factors affecting delay period, knock in CI engines.

10 Hours

3. Engine Operating Characteristics: Engine performance parameters, Effect of spark-timing, Mixture composition, load and speed and compression ratio on engine performance, efficiency and emissions, SI engine combustion chamber design and optimization strategy, Testing of SI engine.

10 Hours

4. Instrumentation: Pressure measurement in engines, recording pressure and crank angle diagram, measurement of pollutants.

Engine emissions and their control: Air pollution due to IC engines, Euro norms I & II, engine emissions, emission control methods – thermal converters, catalytic converters, particulate traps, Ammonia injection systems, exhaust gas recirculation.

10 Hours

5. Alternate fuels for I.C engines: Vegetable oils, alcohol's, L.P.G, C.N.G, properties, Fuel Air ratio, emission characteristics.

10 Hours

REFERENCE BOOKS:

1. V. Ganesan, "Internal Combustion Engines", Tata McGraw-Hill Publications
2. John B. Heywood, "IC Engines fundamentals", McGraw-Hill Publications
3. C.R. Fergusan, "Internal Combustion Engines: Applied Thermo sciences", John Wiley & Sons.

Course Outcome:

Agoodunderstanding about combustion and emissions from IC engine, Engine instrumentation, Fuels, Alternate fuel usage, etc…

ELECTIVE - II
THERMAL POWER STATION – I
(Common to MTP,MTH)

Sub Code	**:**	**14MTP251**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:

To impart knowledge about various components and equipments used in a thermal power plant, their maintenance and performance analysis.

Course Content:

1.Steam Generator and Auxiliaries: High pressure boilers, classification, schemes, circulation, nature of fuels and its influence on design, furnaces, PF burners, PF milling plant, oil and gas burner types and location, arrangement of oil handling plant.

Waste heat recovery systems: Furnace circuit, steam side and waterside corrosion, pressure parts, super heater, re-heater, and economizer, de-super heater, air heater, on-load cleaning of boilers.

12 Hours

2. Dust Extraction Equipment: Bag house, electrostatic precipitator, draught systems, FD, ID and PA fans, chimneys, flue and ducts, dampers, thermal insulation and line tracing, FBC boilers and types., waste heat recovery boilers.

8 Hours

3. Feed Water system: Impurities in water and its effects, feed and boiler water corrosion, quality of feed water, boiler drum water treatment and steam purity, water treatment, clarification, demineralization, evaporation and reverse osmosis plant.

Circulating water system: Introduction, System classification, The circulation system, Wet-Cooling towers, Wet-cooling tower calculations, Dry cooling towers, Dry-cooling towers and plant efficiency and economics, wet-dry cooling towers, cooling-tower icing, Cooling lakes and ponds, Spray ponds and canals.

12 Hours

4. Operation and Maintenance of Steam Generators and auxiliaries: Pre commissioning activities, Boiler start up and shut down procedures, emergencies in boiler operation, Maintenance of Steam generator and auxiliaries.

8 Hours

5. Performance: Boiler efficiency and optimization, coal mill, fans, ESP.
EIA study: Pollutants emitted, particulate matter, SOx and NOx and ground level concentration, basic study of stack sizing.

10 Hours

REFERENCE BOOKS:

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

Course Outcome:
The students will have a good understanding about the components used, their operation and maintenance and performance of it.

ALTERNATIVE FUELS FOR IC ENGINES
(Common to MTP,MTH)

Sub Code	**:**	**14MTP252**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:
To impart the idea of various alternate fuels available for IC Engine, Engine classification depending upon the fuel used, Emission Norms.

Course Content:
1. Fuels: Introduction, Structure of petroleum, Refining process, Products of refining process, Fuels for spark ignition, Knock rating of SI engine fuels, Octane number requirement, Diesel fuels.

Properties of petroleum products: Specific gravity, Density, Molecular weight, Vapour pressure, Viscosity, Flash point, Fire point, Cloud point, Pour point, Freezing point, Smoke point & Char value, Aniline point, Octane Number, Performance Number, Cetane Number, Emulsification, Oxidation Stability, Acid Value/Number, Distillation Range, and Sulphur content.

12 Hours

2. Alternative fuels for I.C. engines: Need for alternative fuels such as Ethanol, Methanol, LPG, CNG, Hydrogen, Biogas and Producer gas and their methods of manufacturing.

Single Fuel Engines: Properties of alternative fuels, Use of alternative fuels in SI engines, Engine modifications required, Performance and emission characteristics of alternative fuels in SI mode of operation v/s gasoline operation.

10Hours

3. Dual fuel Engine: Need and advantages, The working principle, Combustion in dual fuel engines, Factors affecting combustion in dual fuel engine, Use of alcohols, LPG, CNG, Hydrogen, Biogas and Producer gas in CI engines in dual fuel mode. Engine modifications required. Performance and emission characteristics of alternative fuels (mentioned above) in Dual Fuel mode of operation v/s Diesel operation.

10 Hours

4. Bio-diesels: What are bio-diesels Need of bio-diesels, Properties of bio-diesels v/s petro-diesel, Performance and emission characteristics of bio-diesels v/s Petro diesel operation.
Availability: Suitability & Future prospects of these gaseous fuels in Indian context.

10Hours

5. Environmental pollution: with conventional and alternate fuels, Pollution control methods and packages.Euro norms I & II, Engine emissions, Emission control methods, EPA.

8Hours

REFERENCE BOOKS:

1. A Course in Internal Combustion Engines - R.P Sharma & M.L. Mathur, DanpatRai& Sons.
2. Elements of Fuels, Furnaces & Refractories - O.P. Gupta, Khanna Publishers.
3. Internal Combustion Engines -Domkundwar V.M., I Edition, DhanpatRai& Sons.
4. Internal Combustion Engines Fundamentals - John B. Heywood, McGraw Hill International Edition.
5. Present and Future Automotive Fuels - Osamu Hirao& Richard Pefley, Wiley Interscience Publications.
6. Internal Combustion Engines - V. Ganesan, Tata McGraw-Hill Publications.

Course Outcome:
Various fuels available, their usage in IC Engines, Emissions Norms, performance analysis will be very well understood by the students.

MODELING & SIMULATION OF THERMAL SYSTEMS
(Common to MTP,MTH)

Sub Code	**:**	**14MTP253**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:
To provide review and use knowledge from thermodynamics, heat transfer and fluid mechanics, modeling and simulation techniques for thermal system component analysis and their synthesis in integral engineering systems and processes

Course Content:
1.Principle Of Computer Modeling And Simulation: Monte Carlo simulation, Nature of computer modeling and simulation, limitations of simulation, areas of application.

System And Environment: components of a system —discrete and continuous systems. Models of a system-a variety of modeling approaches.

10 Hours

2. Random Number Generation: technique for generating random numbers —mid square method- The mid product method- constant multiplier technique-additive congruential method —linear congruential method —tests for random numbers —the kolmogorov-simrnov test-the Chi-square test.

Random Variable Generation: inversion transform technique- exponential distribution- uniform distribution-weibul distribution empirical continuous distribution- generating approximate normal variates —Erlang distribution.

12Hours

3. Empirical Discrete Distribution: Discrete uniform distribution — poisson distribution- geometric distribution- acceptance-rejection technique for poission distribution-gamma distribution.

Design And Evaluation Of Simulation Experiments: variance reduction techniques-antithetic variables- variables-verification and validation of simulation models.

10Hours

4. Discrete Event Simulation: concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue, two server queue simulation of inventory problem.

9 Hours

5. Introduction to GPSS: Programming for discrete event systems in GPSS, case studies.

9Hours

REFERENCE BOOKS:

1. Discrete event system simulation - Jerry Banks & John S Carson II, prentice hall Inc, 1984.
2. Systems simulation - Gordon g, prentice Hall of India Ltd,1991.
3. System simulation with digital Computer - NarsinghDeo, Prentice Hall of India, 1979.
4. Thermal Power Plant Simulation & Control - D. Flynn (Ed), IET,2003.

Course Outcome:

Students will be in a position to learn basic principles underlying piping, pumping, heat exchangers; modeling and optimization in design of thermal systems. They can also develop representational modes of real process

COMPUTATIONAL METHODS IN HEAT TRANSFER & FLUID FLOW
(Common to MTP,MTH,MCS)

Sub Code	**:**	**14MTH254**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:

To impart the knowledge of computational methods in heat transfer and fluid flow, Finite volume method, various techniques, boundary conditions.

Course Content:

1.Governing Equations: Review of equations governing fluid flow and heat transfer. Neumann boundary conditions, partial differential equations, Dirichlet boundary conditions.

Finite difference: Discretization, consistency, stability and fundamentals of fluid flow modeling, application in heat conduction and convection, steady and unsteady flow.

12 Hours

2. Finite volume method: application to steady state Heat Transfer: Introduction, regular finite volume, discretization techniques.
Finite Volume Method: application to transient Heat Transfer.

10 Hours

3. Finite Volume Method: application to Convective Heat Transfer.
Finite Volume Method: application to Computation of Fluid FlowSimple algorithms.

12 Hours

4. Solution of viscous incompressible flow: Stream function and vorticity formulation. Solution of N S equations for incompressible flow using MAC algorithm.

8 Hours

5. Compressible flows via Finite Difference Methods

8Hours

REFERENCE BOOKS:

1. Numerical Heat Transfer and Fluid Flow - S.V. Patankar, Hemisphere Publishing Company.
2. Computational Fluid Dynamics - T.J. Chung, Cambridge University Press
3. Computational fluid flow and heat transfer - K. Murlidhar and T. Sounderrajan, Narosa Publishing Co.
4. Computational fluid mechanics and heat transfer - D. A. Anderson, J. C. Tannehill, R.H. Pletcher, Tata McGraw-Hill Publications
5. Computational fluid dynamics - J.A. Anderson, McGraw-Hill Publications

Course Outcome:

Students will have a good knowledge about the computational methods to be used in heat transfer and fluid flow problems. Good knowledge about Finite Volume Methods.

SIMULATION LABORATORY PROJECTS ON THERMAL ENGINEERING - LAB 2
(Common to MTP,MTH)

Subject Code:14MTP26	**IA Marks :**	**25**
Hours/Week : 6	**Exam Hours :**	**03**
Total Hours : 84	**Exam Marks :**	**50**

Note:

- These are independent laboratory exercises
- A student may be given one or two problems stated herein
- Student must submit a comprehensive report on the problem solved and give a Presentation on the same for Internal Evaluation
- Any one of the exercises done from the following list has to be asked in the Examination for evaluation.
- Computer programme can be developed in 'C' or MATLAB.
- MATLAB Simulink can be used wherever applicable.

Course Content:

1. Build a generic IC engine (petrol /diesel) Model in MATLAB Simulink and draw the performance curves (a) torque v/s speed, (b) power v/s speed, (c) overall efficiency v/s brake power (d) specific fuel consumption v/s brake power and analyse the curves for varied Air:Fuel ratio.
2. Use a comprehensive model for combustion of fuel at atmospheric pressure and develop a computer programme to estimate the heat released assuming a single step reaction.
3. Develop computer programme to estimate adiabatic flame temperature of simple fuels such as methane. Use Gibb's Free Energy principle for determining the adiabatic flame temperature.
4. Using MATLAB Simulink environment SIMDRIVELINE, import a four-wheeler model and run this model at various acceleration and speed and obtain the fuel consumption report. The report must be comprehensive and critical analysis of the result is essential.
5. Develop programmes in C or MATLAB to solve $\frac{\partial u}{\partial t} = x \frac{\partial^2 4}{\partial x^2}$ and draw the characteristic curves for various boundary conditions. Use Forward Time Central Space (FTCS) scheme.
6. Develop programmes in C or MATLAB to solve $\frac{\partial u}{\partial t} = x \frac{\partial^2 4}{\partial x^2}$ and draw the characteristic curves for various boundary conditions. Use Dufort-Frankel Model.

7. Develop programmes in C or MATLAB to solve $\frac{\partial u}{\partial t} = x \frac{\partial^2 4}{\partial x^2}$ and draw the characteristic curves for various boundary conditions. Use Lasoonen Model.
8. Develop programmes in C or MATLAB to solve $\frac{\partial u}{\partial t} = x \frac{\partial^2 4}{\partial x^2}$ and draw the characteristic curves for various boundary conditions. Use Crank Nicholsen Model.

IV SEM
DESIGN OF HEAT TRANSFER EQUIPMENTS FOR THERMAL POWER PLANT
(Common to MTP,MTH)

Sub Code	**:**	**14MTP41**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**
Practical/ Field Work /Assignment Hrs./week	**:**	**02**	**Second Semester**	**:**	**18 weeks**

Course Objective:
To impart the idea of design of heat transfer equipment for thermal power stations.

Course Content:
1. Design of Double Pipe Heat Exchanger,Design of Shell and Tube Heat Exchanger,Design of Recuperative Air Pre Heater,Design of Economizer: Estimation of Sulphur acid due point.

10 Hours

2. Boiler furnace design: Heat transfer in coal fired boiler furnace (gas side) – Estimation of furnace exit gas temperature, estimation of fin-tip temperature. Heat transfer in two phase flow- Estimation of inside heat transfer coefficient using Jens &Lottes equation and Thom's correlation. Estimation of pressure drop in two phase flow using Thom's method.

10 Hours

3. Superheater and Reheater Design: Estimation of flow in each element of a tube assembly. Estimation of attenuation factor and direct radiation from furnace, flame, or cavity Qr.

9 Hours

4. Design of Steam Condenser: Effect of tube side velocity on surface area and pressure drop for various tube sizes (It involves estimation of tube side velocity, surface area and pressure drop for various tube sizes & Plot the graph) and estimation of shell diameter of steam condenser.

9 Hours

5.Design of Fuel Oil Suction Heater, Design of Fuel Oil Heater, Design of

Cooling Tower

12 Hours

REFERENCE BOOKS:

1. Process Heat Transfer - D.Q. Kern, McGraw-Hill Publications
2. Applied Heat Transfer - V. Ganapathy, Penn Well Publishing Company, Tulsa, Oklahoma.
3. Process Heat Transfer - Sarit Kumar Das, A. R. Balakrishan, Alpha Science International, 2005.

Note: Use of design data hand book prepared by the tutor using the prescribed reference books, steam tables charts and standards are permitted in the examination.

Course Outcome:

At the end of the course students will have an idea about various design aspects and considerations about the equipment used for thermal power plants.

ELECTIVE -III
CONVECTIVE HEAT AND MASS TRANSFER
(Common to MTP,MTH)

Sub Code	:	**14MTP421**	**IA Marks**	:	**50**
Hrs/ Week	:	**04**	**Exam Hours**	:	**03**
Total Hrs.	:	**50**	**Exam Marks**	:	**100**

Course Objective:

To impart knowledge in momentum transfer. Various PDE's, Solutions to practical problems, convective mass transfer.

Course Content:

1. Introduction, Conservation Principles and Fluid Stresses and Flux Laws.The Differential Equations Of The Laminar Boundary Layer, The Integral Equations Of The Boundary Layer, The Differential Equations Of The Turbulent Boundary Layer.

12 Hours

2. Momentum transfer and Heat transfer for Laminar Flow inside Tubes.Momentum transfer and Heat transfer in Laminar External Boundary layer.

10Hours

3. Momentum transfer and Heat transfer in Turbulent Boundary Layer.Momentum transfer and Heat transfer for Turbulent Flow inside Tubes.

10Hours

4. The Influence of Temperature-Dependent Fluid Properties, Free-Convection Boundary Layers.

9Hours

5. Convective Mass Transfer: Basic Definitions and Formulation of a Simplified Theory, Evaluation of The Mass-Transfer Conductance, Examples for application of the Simplified Method.

9 Hours

REFERENCE BOOKS:

1. W.M. Kays, Convective Heat and Mass Transfer, McGraw-Hill Publications. 1984
2. Ozisik M.N., "Heat Transfer – A Basic Approach", McGraw-Hill Publications, 1985.
3. Holmon J.P., "Heat Transfer", McGraw-Hill Publications, 2002.

Course Outcome:

Good knowledge in momentum heat transfer, solutions to practical problems will be very well be received.

ENGINE FLOW& COMBUSTION
(Common to MTP,MTH)

Sub Code	**:**	**14MTP422**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:

To impart the knowledge of gas exchange process, movement of fuel, combustion and pollution formation. Knowledge about engine heat transfer

Course Content:

1.Gas exchange process: Inlet & exhaust processes in four stroke cycle, volumetric efficiency, flow through valves, residual gas fraction, exhaust gas flow rate and temperature variation, super charging, turbo charging.

Charge motion with in the cylinder: Intake jet flow, mean velocity turbulence characteristics, swirl, squish, pre chamber engine flows, crevice flow and blow by, flows generated by piston cylinder wall interaction.

10 Hours

2. Combustion in SI engines: Essential features of the process, thermodynamics analysis, burned and unburned mixture states, analysis of cylinder pressure data, combustion processes characterization, flame structure and speed, cyclic variations in combustion, partial burning and misfire, spark ignition and alternative approaches, abnormal combustion, knock and surface ignition.

Combustion in CI engines: Essential features of the process, types of diesel combustion systems, fuel spray behavior, and ignition delay, mixing controlled combustion.

10 Hours

3. Pollutant formation and control: Nature of the problem, nitrogen oxide, carbon monoxide, un-burnt hydrocarbon emissions, particulate emissions, exhaust gas treatment.Catalytic converter construction, its types.

10Hours

4. Engine heat transfer: VariousModels of heat transfer, engine energy balance, intake and exhaust heat transfer, radiations from gases, flame radiation component, temperature distributions, effect of engine variables.

10 Hours

5. Super Charging, its types/methods,Turbocharging, its types/methods, Exhaust Gas Recirculation, Effects of the above on Engine Performance.

10 Hours

REFERENCE BOOKS:

1. Internal Combustion Engines - V. Ganesan, Tata McGraw-Hill Publications.
2. IC Engines fundamentals - John B. Heywood, McGraw-Hill Publications.
3. Internal Combustion Engines: Applied Thermo sciences - ,C.R. Fergusan, John Wiley & Sons.

Course Outcome:

Students get exposure to knowledge about gas exchange and combustion in IC engine .

DESIGN & ANALYSIS OF THERMAL SYSTEMS
(Common to MTP,MTH)

Sub Code	**:**	**14MTP423**	**IA Marks**	**:**	**50**
Hrs/ Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**100**

Course Objective:

To provide an introduction to thermal system design, Exergy analysis. Design of piping and pumping systems.Thermo Economic analysis.

Course Content:

1. Introduction to Thermal System Design: Introduction; Workable, optimal and nearly optimal design; Thermal system design aspects; concept creation and assessment; Computer aided thermal system design.

Thermodynamic modeling and design analysis: First and second law of thermodynamics as applied to systems and control volumes, Entropy generation; Thermodynamic model – Cogeneration system.

12 Hours

2. Exergy Analysis :- Exergy definition, dead state and exergy components ; Physical Exergy – Exergy balance ; Chemical Exergy ; Applications of exergy analysis; Guidelines for evaluating and improving thermodynamic effectiveness.

Heat transfer modeling and design analysis:- Objective of heat transfer processes; Review of heat transfer processes involving conduction, convection and radiation and the corresponding heat transfer equations used in the design.

12Hours

3. Design of piping and pump systems:- Head loss representation ;Piping networks ; Hardy – Cross method ; Generalized Hardy – Cross analysis ; Pump testing methods ; Cavitation considerations ; Dimensional analysis of pumps ; piping system design practice.

8 Hours

4.Thermo-economic analysis and evaluation:- Fundamentals of thermo-economics, Thermo-economic variables for component evaluation ; thermo-economic evaluation ; additional costing considerations.

8 Hours

5.Thermo-economic optimization:- Introduction ; optimization of heat exchanger networks ; analytical and numerical optimization techniques ; design optimization for the co-generation system- a case study ; thermo-economic optimization of complex systems.

10 Hours

REFERENCE BOOKS:

1. Thermal Design & Optimization - Bejan, A., et al., John Wiley, 1996
2. Analysis & Design of Thermal Systems - Hodge, B.K., 2nd edition, Prentice Hall, 1990.
3. Design of Thermal Systems - Boehm, R.F., John Wiley, 1987
4. Design of Thermal Systems - Stoecker, W.F., McGraw-Hill

Course Outcome:

To learn basic principles underlying piping, pumping, heat exchangers; modeling and optimization in design of thermal systems.Todevelop representational modes of real processes and systems. To develop thermo economic optimization concerning design of thermal systems.

EXPERIMENTAL METHODS IN THERMAL POWER ENGINEERING
(Common to MTP,MTH)

Sub Code	:	**14MTP424**	**IA Marks**	:	**50**
Hrs/ Week	:	**04**	**Exam Hours**	:	**03**
Total Hrs.	:	**50**	**Exam Marks**	:	**100**

Course Objective:

To enhance the knowledge of the students about various measuring instruments, techniques and importance of error and uncertainty analysis.

Course Content:

1.Introduction: Basic concepts of measurement methods, single and multi point measurement Min space and time. Processing of experimental data, curve fitting and regression analysis. Data Acquisition systems: Fundamentals of digital signals and their transmission, A/D-and D/A converters, Basic components of data acquisition system. Computer interfacing of digital instrument and data acquisition systems; Digital multiplexes, Data acquisition board (DAQ), Digital image processing fundamentals.

Design and Construction of Experimental facilities: wind tunnel, general test rigs, Test cells for flow visualization and temperature mapping.

10Hours

2. Modeling and Simulation of Measurement System: Lumped analysis, first order and second order systems: Frequency response and time constant calculation. Response of a generalized instrument to random data input, FFT analysis.

Temperature Measurement: Measurement Design, Construction and Analysis of liquid and gas thermometers, resistance thermometer with wheat stone bridge, Thermo-electric effect, Construction, testing and calibration of thermocouples and thermopiles, Analysis of effect of bead size and shielding on time constant and frequency response, characteristics of thermocouple, pyrometers, radiation thermometers.

12 Hours

3. Interferometry& Humidity measurement: interferometers, Humidity measurement: Conventional methods, electrical transducers, Dunmox

humidity and microprocessor based dew point instrument, Calibration of humidity sensors.

Flow and Velocity Measurement: industrial flow measuring devices, design, selection and calibration, velocity measurements, pitot tubes, yaw tubes, pitot static tubes; frequency response and time constant calculation. Hot-wire anemometer; 2d/3d flow measurement and turbulence measurement, Laser application in flow measurement, Flow visualization techniques, Combustion photography.

12 Hours

4. Measurement of Pressure, Force, and Torque: Analysis of liquid manometer, dynamics of variable area and inclined manometer, Pressure transducers, Speed and torque measurement: rotor speed and torque measurement of rotating system.

8 Hours

5. Air Pollution sampling and measurement; Units for pollution measurement, gas sampling techniques, particulate sampling technique, gas chromatography.

8 Hours

REFERENCE BOOKS:

1. Experimental Methods for Engineers - J.P. Holman, McGraw-Hill Publications.
2. Mechanical Measurements - Beckwith M.G., Marangoni R.D. and Lienhard J.H., Pearson Education.
3. Measurements systems-Application and Design - E.O. Doebelin, Tata McGraw-Hill Publications.

Course Outcome:

Knowledge on various measuring instruments will be very well understood. Knowledge on advance measurement techniques. Good understanding about the various steps involved in error analysis and uncertainty analysis.