MECHANICAL ENGINEERING

M.Tech.(Thermal Engineering)

Effective from A. Y. 2011-12

INDEX

List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	DEC	Departmental Elective Course
2	PCC	Program Core Course
3	LC	Laboratory Course
4	HSSC	Humanities and Social Science Course
5	MLC	Mandatory Learning Course
6	LLC	Liberal Learning Course
7	OEC	Open Elective Course
8	SEC	Science Elective Course
9	PSEC	Program Specific Elective Courses

M. Tech., RULES AND REGULATIONS
(Effective from 2011-12)

COLLEGE OF ENGINEERING, PUNE
Wellesley Road, Shivajinagar, Pune 411005

1. Rules

1.1 The Senate and BOG, College of Engineering, Pune, recommends University of Pune to award the degree of Master of Technology (M. Tech) in Engineering to those who have successfully completed the stipulated Postgraduate Masters Program.

1.2 The Postgraduate Masters Program with the governing Rules and Regulations are formulated & approved by the Senate and BOG of the institute. The Senate can modify or change the course structure, the governing rules and regulations from time to time and shall recommend them to BOG for its approval. These rules and regulations will be applicable to any candidate seeking admission for M. Tech/P.G. programme in the institute.

1.3 A candidate becomes eligible for the recommendation to the Pune University for the award of the M. Tech. degree after fulfilling all the academic requirements prescribed by the Senate of the Institute.

1.4 Director, COEP and Chairman Senate would appoint a Professor from the Institute to work as a Chairman of the PG admission committee on his/behalf. Chairman, PG Admissions would be responsible for the entire admission process including scrutiny of applications and conduct of entrance test, interviews of the candidates etc. He/she would be assisted by the respective departmental heads and departmental admission committee appointed by the Director.

2. CATEGORIES OF M. TECH. STUDENTS

The Institute admits M. Tech students under the following categories:

I) REGULAR (FULL-TIME)

These are students who work **full time** for their M. Tech. degree and receive assistantship from the Institute or any other recognized funding agency.

II) SPONSORED (FULL-TIME) STUDENTS

A candidate in the category is sponsored by a recognized R&D organization, national institute, governmental organization or industry for doing M.Tech in the Institute **on a full time basis**. He/she should have at least two years of working experience in the respective field. He/She will not receive any financial support from the Institute. Sponsorship letter (Form I) should be attached with the application. During the course of programme if a regular student secures a job and wishes to join the same, then he/she will be treated as a sponsored candidate and he/she will have to get the sponsorship letter from him employer. He/she would be charged institutional fees as for sponsored candidates.

III) PROJECT STAFF

This category refers to candidates who are working on sponsored projects in the Institute and admitted to the M. Tech. program. The duration of the project at the time of admission should be at least 2 years. This category of students may be registered on a full-time or a part-time basis.

IV) INSTITUTE FACULTY

This category refers to the candidates who are the staff of College of Engineering , Pune, who can attend classes at the Institute while employed. These candidates should be able to attend regular

classes as per the schedule of the Institute. The applicant must be a regular employee of the institute with at least two years of experience with the institute at the time of admission and be engaged in professional work in the discipline in which admission is sought. No financial assistance will be provided by the Institute to such students. A No Objection Certificate from the Head of the Department must be enclosed at the time of applying. This candidate would pay regular fees of the institute under full/part time student category and no concession in institute fees can be allowed.

V) FOREIGN STUDENTS

This category refers to all the Foreign Nationals, who are eligible for Admission to the M.Tech program and who have a certification from the Pune University Foreign Students Cell about their admissions to M.Tech. These students will submit a certificate from the Pune University certifying their Equivalence of Courses at undergraduate levels. These students will have to appear for the institute entrance examination and also a English language test, conducted by the institute. If these students fail in the English language test their applications will be rejected even though they pass in the institute admission test. No financial assistance of any sort will be available for these students. Before admission, these students will have to get a clearance about their background check by the Department of Home, Government of India. A candidate in this category will be admitted **on a full time basis** subject to compliance of various norms laid down by the competent authority from time to time.

3. MINIMUM QUALIFICATIONS

Students for admission to the M. Tech. Program in Engineering Departments must satisfy one of the following criteria:

(i) Bachelor's degree in Engineering/Technology or equivalent in an appropriate area, with a minimum of First Class/60% marks or CGPA of 6.5 on a scale of 10 or equivalent (CGPA of 6.00 or equivalent in case of SC / ST).

(ii) Valid GATE score for Regular (full-time) students.

Departments may specify additional requirements over and above these minimum requirements. All the Non-GATE candidates will have to undergo an entrance test conducted by department in which he/she is applying. Passing in this test will be mandatory for admission.

For the Foreign Students the criteria as in para 2(V) above will be applicable. For these students Institute Admission Test as well as English Test will be mandatory.

4. ADMISSION PROCEDURE

4.1 Admission to the M. Tech. Program of the Institute will normally be in the months of June/July every year. For admission an advertisement will be issued in the month of April/May in National level English news paper, State level Marathi News papers as well as on the Institute website.

4.2 Admission to all the category of students is granted on the basis of GATE scores and / or an interview / admission test held usually during the month of June or July every year. It will be mandatory for every candidate to appear for the Entrance Test and Interview. No absentia of any sort would be allowed.

4.3 The applicants who have completed or are likely to complete all the examinations including the thesis oral examination, viva etc. of the qualifying degree by the date of admission to the program may be considered for admission; however, if admitted, they must produce the evidence of their having passed the qualifying degree examination with the specified minimum marks/CPI (as specified in clause 3) within 8 weeks of the beginning of the semester, failing which their admission is liable to

be cancelled. In case of any dispute or discrepancy decision of the Director COEP and Ex-officio Chairman of the Senate will be final and shall be binding on the candidate.

4.4 Candidates seeking admission for the M.Tech course other than the area in which candidate has completed his/her bachelor's degree will be eligible to apply provided they have a valid GATE score in the area in which they wish to pursue their M.Tech. These candidate will not be eligible for the scholarships from the external funding agencies. These students will have to under go Institute Entrance Test/Interview conducted by the concerned department.

5. FINANCIAL SUPPORT

Students admitted to the M. Tech. Programs will be considered for assistantships, fellowships etc. subject to the following norms:

5.1 A student must have a valid GATE score at the time of admission.

5.2 Students receiving assistantship from the Institute or from any other funding agencies will be required to perform academic duties assigned to them by the departments as per rules in force from time to time.

5.3 The continuation of the assistantship/fellowship will be subject to satisfactory performance of the duties assigned by the department and satisfactory progress in the postgraduate program. Financial assistance of the candidates failing to secure minimum grades in the semester examination would be stopped without any prior notice.

5.4 Financial assistance will normally be for a maximum period of two years. In no case, it will be extended beyond 2 years.

5.5 No financial assistance from the Institute will be available to foreign students. Project staff will get funding from project as per rules but will not get any additional assistance from the Institute.

5.6 Only those students who are currently registered in the postgraduate program shall be entitled to scholarships. The students on leave longer than that specified under the leave rules, and those who are not registered are not entitled to scholarship.

6. LEAVE RULES

6.1 An M Tech student is eligible for maximum 30 days of leave in a calendar year.

6.1.1 The leave of 30 days includes medical and all other leaves, in an academic year. If any Saturday, Sunday or Holiday falls during the leave, they will be counted towards the leave except for such holidays prefixed or suffixed with the leave. **The accumulated leave can be availed during vacation only.**

6.1.2 Out of the 30 days of leave per annum, an M. Tech. Student will be permitted to avail maximum 15 days of leave on completion of each semester. However, any leave not availed at the end of any semester can be carried over to the next semester and the cumulative can be availed together, subject to a maximum of 30 days at a time.

6.1.3 During the semester period, (i.e. July – November and January – May), a student will be allowed only a maximum of 5 days of leave .

6.2 Absence without obtaining prior sanction of leave will be considered as an act of indiscipline and shall entail reduction of scholarship on a prorata basis, besides any other action that may be decided by the Institute.

6.3 Any absence over and above the prescribed limit of admissible leave shall entail deduction from the scholarship, besides other actions as may be decided by the Institute.

6.4 If a student remains absent or discontinues from the course for a period of more than 3 months his/her admission to the course will be automatically cancelled.
6.5 If a student is unable to complete his/her M.Tech within a period of two years, he/she must apply for permission for the extension of time by six months immediately after completion of two years, with recommendations of the concerned guide and head of the department to Dean Academics. Dean academics will seek the approval of the Director COEP and the Chairman, Senate for granting such extensions on case to case basis. Maximum two extensions of six months duration would be permissible for M.Tech student from any category of students as stipulated in Section(2) above. This extension period will not exceed the total period of three years from the date of admission of the candidate in the institute. Candidate will have to pay institute fees prevailing during this extension period.
6.6 If a student fails to complete his/her M.Tech within a period of four years from the date of admission for the course he/she will automatically cease to be a student of the institute and his/her admission would be automatically cancelled.

7. REGULATIONS

7.1 Rules and regulations

All the rules and regulations pertaining to academics, academic calendar, semesters, discipline etc. will be same as that of B.Tech. regulations.

7.2 Admission

Candidates whose selection is approved by the Chairman, Senate will be admitted to the M. Tech. program of the Institute after payment of the prescribed fees prevailing at the time of admission. BOG reserves the right to modify the Institute fees time to time.

7.3 Academic requirements

7.3.1 Semester load and course units

A semester load would be as per the Syllabus structure in force and as recommended/modified by the Senate from time to time. The minimum credit requirements for the successful completion of M.Tech. would be as specified in the syllabus structure prevailing at the time of admission for the course. The current minimum credits for the completion of M. Tech is 80 credits as specified in the syllabus structure. Any changes subsequently made by the Senate in the minimum credit requirements or syllabus structure will be applicable to only the new/fresh students and not applicable to the old candidates.

7.3.2 The residence requirements for students registered in M Tech. is four semesters. They will be required to complete a minimum credits of load as specified in the course structure in force. Every M Tech student must complete prescribed courses as specified in the syllabi structure. SGPA and CGPA will be calculated on the basis of all the courses taken by the student. No regular student/sponsored student/Research Staff/Institute Faculty/ Foreign student registered for the M Tech program shall continue in the program for more than 3 years after the first registration. The course and research requirements in individual departments/program may be over and above the minimum stated here. The departments/program shall obtain prior approval of the Senate of such requirements and will also inform the students in their postgraduate program at the time of their admission.

7.3.3 Grades and points

(a) The performance of the students in their course work will be evaluated in terms of letter grades: AA, AB, BB, BC, CC, CD, DD & F. These grades are equivalent to the following points/ratings on a 10 point scale representing the quality of performance.
AA = 10, AB = 9, BB = 8, BC = 7, CC = 6, CD = 5, DD = 4, FF = 0.
(b) If a student has done a part of the course work, but has for a genuine reason not been able to do the remaining part, the instructor may send the grade 'I' (incomplete). In this case the student must contact the Instructor soon after the examination and if the Instructor is convinced that the reasons for missing a part of the course/examinations are genuine he may let the student make up for the portion missed. The 'I' Grade can be converted into a regular grade by the Instructor within two weeks of the last date of the End Semester Examination. Otherwise, this will automatically be converted into 'F' Grade.

7.3.4. Academic performance requirements

(a) The SGPA (Semester Grade Point Average) or CGPA (Cumulative Grade Point Average) of a student in any particular semester is calculated as follows:
(i) The points equivalent to the grade awarded in each course for which the student has registered is multiplied by its unit rating.
(ii) These products are added and sum is divided by the total number of units. The ratio is the SGPA or CGPA depending on whether the number of units refer to those in that particular semester or to those in the total period of student's postgraduate program.
(b) **The minimum CGPA requirement for continuing in the M. Tech. program is 5.0**. However, M Tech student securing a CGPA between 4.5 and 5.0 may be allowed to continue in the following semester on the recommendation of the DPPC (Departmental Postgraduate Program Committee) and with approval of the Senate.
Students who secure a CGPA below 5.0 in two consecutive semesters will not be allowed to continue in the postgraduate program. Students must obtain a minimum CGPA of 5.0 in order to graduate. In the first semester in which the student registers the minimum CGPA (SGPA) requirement can be relaxed to 4.5.

7.3.5 Thesis/Project

(a) Project duration shall be one year or two semesters. Thesis supervisor(s) for a student will be appointed from amongst the faculty members of the College of Engineering, Pune. Departments will evolve modalities for appointing of supervisors keeping in view the students' aspirations and faculty interest. The DPPC will co-ordinate this activity and will formally communicate the appointment of thesis supervisor(s) of a student to the COE. No change/addition of Supervisor(s) is allowed after the thesis has been submitted to the academic section. In case there has been a change/addition in the Supervisor(s) the thesis will be submitted not earlier than three months from the date of communication of such change/addition to the academic section.

No student once registered for thesis/project units will be allowed to continue the program without a Thesis Supervisor having been appointed by the DPPC. No student will have more than two supervisors. No change in thesis supervisor(s) will be allowed without the consent of the Chairman, DPPC. In exceptional cases, with prior approval of the Chairman, Senate on the recommendation of the DPPC and COE a student may be allowed to have a co-supervisor from outside the institute.

(b) Project evaluation:

Project evaluation shall be done in two phases in both the semesters. First phase of evaluation shall be in the middle of the semester and second phase of the examination shall be after the end-semester theory examination of the semester.

There will be separate grades awarded for the project course in two semesters. The credits in the first semester shall be relatively less and evaluation shall be based on the literature survey, problem definition, problem formulation, fabrication or software development and preliminary results.

A brief report is required to be submitted at the end of semester. The evaluation and grading will depend on the candidate's performance in the two phases of evaluation in the semester.

The second semester of the project shall carry relatively more weightage and the evaluation shall involve external examiners. The details are provided in the following sub-section.

(c) Thesis/Project Oral Examination Committee :

The thesis/project will be examined by an oral examination committee consisting of the supervisor(s) or in his/her absence the program co-ordinator with prior consent of the supervisor and at least two but not more than four other faculty members of the institute proposed by the thesis supervisor(s)/program co-ordinator in consultation with Head of the Department, recommended by the convener, DPPC and approved by the Dean Academics and COE. The thesis supervisor/program co-ordinator will act as the convener of the committee and one of the members of the committee will be an External Examiner as a part of the panel of examiners.

(d) The Convenor, DPPC will submit to the academic section for approval of the Chairman, DPPC the names of the thesis/project examiners on the prescribed form, at least two weeks before the submission of the thesis. Unbound typed copies of thesis/project one for each examiner prepared according to the prescribed format available in the academic section will be submitted at least one week before the probable date of the oral examination. The oral

examination will be held within two months from the date of submission of the thesis/project. If however the student does not make available for the examination, his/her program will be deemed to have been terminated. Request for revival of the program by such a student should be addressed to the Chairman, Senate.

The Department will record the date of submission of the thesis/project and arrange to send the thesis to the examiners. The supervisor/program co-ordinator will inform the examiners of the date of the oral examination and send a copy to the academic section. The thesis/project will be evaluated and the Oral Examination conducted by the Committee on the scheduled date. The report will be communicated by the Convener, DPPC to the academic section for record and necessary action.

The grade to be awarded to a student shall be evolved by the committee by consensus. The report of the oral examination committee including the grade shall be submitted to the Convenor, DPPC by the committee.

(e) Acceptance/Rejection of the Thesis/Project

A thesis/project will be considered to have been accepted if all members of the committee recommend its acceptance. Otherwise thesis/project will be considered to have been rejected. If a thesis/project is rejected along with a recommendation by the Committee for resubmission after incorporating and modification/correction suggested by the Committee, oral examination for the re-submitted thesis/project will be conducted by the same Committee unless otherwise approved by the Chairman Senate. If the resubmitted thesis/project is rejected, the matter will be reported to the Senate for appropriate action. Acceptance of thesis/project will be reported by the COE to the Senate for approval.

7.3.6. Provision for the Change of Guide

Project Guide may submit his request for change of guide to the HoD of the concerned department stating the reasons for the change request. HOD of the concerned department will forward the Application with his/her recommendations and name of the new proposed guide to the Dean Academics for the permission. Dean Academics in consultation with the Director, COEP and Chairman of the Senate may approve such applications.

Procedure for submission of M. Tech. Project Thesis and Oral Examination

1. The supervisor(s) shall be satisfied that the work has been completed. The supervisor(s) shall forward a list of examiners (comprising of at least two but not more than four faculty members from the department, in addition to the supervisor(s) and one member from outside the department or an external expert) through the Departmental PG Coordinator, to HOD.
2. The HOD will then forward the list of examiners to the Dean of Academics for the approval at least 15 days before submission of the thesis.
3. Following the approval, unbound copies of the thesis (one each for every examiner) shall be submitted to the Department (PG Coordinator) at least one week before probable date of the examination.
4. The PG Coordinator, will fix the date of oral examination, make an announcement (through notices and e-mail) and forward unbound copies of thesis to the examiners. The date of oral examination shall be communicated to the COE.
5. The oral examination of a M. Tech. Project shall be held as per announced schedule and it shall be an open one.
6. The Supervisor / PG Coordinator (if Supervisor is not available at the time of oral examination) shall be the convener of the oral examination committee. The committee shall evaluate the project of the candidate on the basis of presentation of the report, originality of the contents therein, demonstration of equipment model/ hardware/ software developed, the oral presentation and oral examination. In case the committee recommends a major revision and recommends a re-examination of the project, Grade "I" shall be awarded and the student shall be required to continue the project and resubmit the thesis within a period of two months. In case the committee rejects the thesis, Grade "F" shall be awarded and the student shall be required to re-register for the project in the next semester.
7. On successful completion of Oral Examination, each student shall submit bound copies of the thesis making corrections, if any, suggested by the examiners (one each to the supervisor(s), Academic

Section and the department). The academic section will forward the copy of the thesis/report to the Central library after verification.

8. The candidate should also submit a soft copy of the thesis in pdf format to the PG Coordinator who shall compile all the M. Tech project reports of the academic year of the department on a CD and same shall be placed in the dept library and institute website server.

FORM-I

Format of Certificate by the Employer/Management for Sponsored Candidates

This is to certify that ,

Shri./Smt._____

is working in this Institute as _____ since _____and he/she is permitted to study for **M.Tech program** at College of Engineering, Pune. If he/she is admitted to the said program, he/she will be permitted to attend the College as a full time student during the working hours of the College till completion of his/her program. We understand that he/she will fulfill institute norms for the attendance.

This is further to certify that he/she has been appointed on regular basis and his/her appointment is not temporary.

FORM II – APPLICATION FOR THE EXTENSION OF TIME

Reference No.
Date:
To
The Dean Academics,
College of Engineering , Pune

Sub : Grant of six months extension in order to complete M. Tech. Program

Dear Sir,

I of Mr./ Ms .....who is M.Tech student in .....Department and pursuing my M. Tech in .....specialization. I have joined the M.Tech. course in the academic year ..... . I am unable to complete my M.Tech. in the prescribed period of two years. I am aware that maximum duration of my M.Tech. course is four years and my admission for the M.Tech will get cancelled after a period of four years from the date of admission and no extension of time is permissible after three years.

I may be permitted Six months extension for completing M. Tech. Program at your Institute as a full - time student.

Date: Signature of the Student

Recommendation of the Project Guide

FORM III – Undertaking By the Full Time M.Tech (Non-Sponsored Student)

Reference No.
Date:
To
The Dean Academics,
College of Engineering , Pune

Sub : Undertaking by the M.Tech Students who is a Non-Sponsored Full Time Student

Dear Sir,

I of Mr./ Ms ..... is M.Tech student in ……..Department and pursuing my M. Tech in ……..specialization. I have joined the M.Tech course in the academic year …… .

I here by solemnly affirm that I am not in any sort of full time/Part Time or Visiting employment of any sort in any organization while joining my M.Tech as fulltime student. I do here by undertake that I will not engage myself in any sort of employment either fulltime/part time or visiting during my studentship as fulltime M.Tech student of College of Engineering, Pune, unless otherwise I am offered such privilege by COEP under a sponsored project.

I do understand that if I am found to indulge in such employment any time during my tenure as a Full Time M.Tech student of College of Engineering, Pune , my admission to M.Tech course will be immediately cancelled by the institute in addition to financial penalty and other disciplinary action initiated by Dean Academics, on behalf of the institute.

Date: Signature of the Student

Recommendation of the HOD

M Tech (Mechanical Engineering)

Specialization: Thermal Engineering
Structure

Semester I

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	OEC-I IS-501	Mathematics	3	0	0	3
2	PCC-I TE-501	Fluid Dynamics	3	0	0	3
3	PCC-II TE-503	Advanced Heat Transfer	3	0	0	3
4	PCC-III TE-505	Thermodynamics and Combustion	3	0	0	3
5	PSEC -I TE-515	A. Refrigeration and Cryogenics B. Fundamentals of Gas Dynamics	3	0	0	3
6	LC TE-509	Seminar	0	0	3	2
7	PGL TE-511	Thermal Engineering Lab Practice - I	0	0	6	3
		Total	**15**	**0**	**9**	**20**

Semester II

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	OEC-II IS-502	Open Elective /Science Elective/Humanities	3	0	0	3
2.	PCC-I TE-502	Design of Heat Exchangers	3	0	0	3
3.	PCC-II TE-504	Computational Fluid Dynamics	3	0	0	3
4.	PSEC –II TE-514,TE-516 TE-518	A. Mathematical Modelling of IC Engines B. Energy Conservation and Management C. Microfluidics D. Environnemental Pollution and Control	3	0	0	3
5.	PSEC –III TE-520,	A. Air Conditioning System Design B. Gas Turbines C. Two phase flow D. Non Conventional Energy Sources	3	0	0	3
6.	MLC ML-504	Intellectual Property Rights	1	0	0	1
7.	PGL TE-510	Thermal Engineering Lab Practice - II	0	0	8	4
		Total	**16**	**0**	**8**	**20**

Semester-III

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	MLC ML-603	Environmental Studies	2	--	--	2
2	MLC ML-601	Constitution of India	2	--	--	2
3	Project TE-601	Project Stage I				16
		Total	--	--	--	20

Semester-IV

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	Project TE-602	Project Stage II	--	--	--	20
		Total	--	--	--	20

OEC-I IS 501: Engineering Mathematics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Students will be able to analyse and develop the mathematical model of thermal system.
2. Student should able analyse the reliability and maintainability of the series and parallel thermal system.
3. Students will be able to solve differential equations using numerical techniques.

Syllabus Contents:

Boundary Value Problems and Applications: Linear second order partial differential equation in two independent variables – Normal forms hyperbolic, parabolic and elliptic equations – Cauchy problem. Wave equations – Solution of initial value problem – Significance of characteristic curves. Laplace transform solutions – Displacements in a long string – long string under its weight – a bar with prescribed force on one end – Free vibrations of a string.
Calculus of Variations: Concepts of functional and their stationary values – Euler's equation
and solution for the problem and for more general cases – Natural boundary conditions – Variation problems with moving boundaries – Conditional variation problems – Isoparametric problems.
Direct Methods: Ritz, Kantorovich and Galerkin techniques.
Eigen Value Problems: Standard Eigen value problems – properties of Eigen values and Eigen vectors – Generalized Eigen value problems – strum sequence – Jacobi, Givens and House holder transformations.
Numerical Methods: Forward and inverse iteration schemes – Graham Schmidt deflation – Simultaneous iteration method – Subspace iteration – Lanczo's algorithm – Estimation of core and time requirements.
Computer Methods in Mechanical Engineering: Applications of digital computers to solutions of problems in mechanical engineering, matrices, roots of equations, solution of simultaneous equations, curve fitting by least squares, differential and integration, differential and partial differential equations.
Statistical Techniques and Design of Experiments: The scientific method. - The phases of an experiment. - Specifying the problem and the hypotheses - Experimental designs - Analyses of experiments - Statistical inference Hypothesis testing. - The Z-test, the T-test, the X2-test, and the F-test. Sample size
Design Optimization Techniques. Methods of numerical optimization techniques applied to engineering design. Methods for optimization of both single and multiple variable functions, constrained, and unconstrained. Real-world problems as examples and student projects
Multi-Disciplinary Design Optimization Methods of numerical optimization techniques applied to engineering design. Statistical design optimization methodologies utilizing design of experiments and meta-modelling techniques. Multi-criteria formulations and multidisciplinary design optimization (MDG) frameworks Real-world problems as examples and student projects.

References

1. Jennings. A., Matrix Computation for Engineers and Scientists. John Wiley and Sons, 1992.
2. Prem.K.Kythe, Pratap Puri, Michael R.Schaferkotter, Introduction to Partial Differential Equations and Boundary Value problems with Mathematics, CRC Press, 2002.
3. Kreyszig, Erwin, I.S., Advanced Engineering Mathematics, Wiley, 1999.
4. Ramamurthy. V., Computer Aided Design in Mechanical Engineering., Tata McGraw Hill Publishing Co., 1987
5. Fundamental Concepts in the Design of Experiments, 5th Ed., by Hicks and Turner
6. Devore, Jay L., Probability and Statistics for Engineering and the Sciences, 5th edition, Brooks- Cole (1999)

PCC TE-501: Fluid Dynamics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Students will be able to explain concepts of fluid dynamics such as Lagrangian method, Eulerian method, Material Derivative, Translation, Rate of deformation and Rotation, Vorticity, Generalized Expression of the Movement of a Fluid Element
2. Students will be able to develop governing equations, such as continuity equation, momentum equations and energy equation in integral forms and differential forms and applying these to the various control volumes.
3. Students will be able to derive Euler's equation for ideal fluid and Navier-Stokes Equation for viscous fluid by using control volume approach.
4. Students will be able to explain concepts of boundary layer theory such as Prandlt boundary layer equation, Blasius flow over a flat plate and speed of sound, Stagnation and Sonic Properties, Isentropic flow through convergent–divergent nozzles and Normal Shocks.

Syllabus Contents:

Fluid kinematics: Fluid properties, Description of Fluid Motion- Lagrangian method, Eulerian method. Steady and unsteady flows, uniform and non-uniform flows. Material Derivative and Acceleration, Streamlines, path lines and streak lines one-, two-, and three-dimensional flows. Translation, Rate of deformation and Rotation, Vorticity, Generalized Expression of the Movement of a Fluid Element.

Conservation equations and analysis of finite control volume: continuity equation-differential form, Stream function, continuity equation-Integral form, momentum theorem, Reynolds Transport Theorem, application of Reynolds Transport Theorem to conservation of Mass and Momentum, analysis of finite control volume.

Flow of ideal fluids: A Control Volume approach for the derivation of Euler's Equation, Euler's equation along a streamline, Potential function, Bernoulli's Equation, Uniform flow, Source or sink flow, Vortex flow.

Viscous incompressible flows: General viscosity law, Derivation of Navier-Stokes Equation, Exact solutions of Navier-Stokes Equation, parallel flow in a straight channel, Couette flow, Hagen Poiseuille flow.
Boundary Layer theory: Laminar Boundary layer theory, Prandlt boundary layer equation Blasius flow over a flat plate, boundary layer thickness, displacement thickness and momentum thickness.
Compressible flows: Thermodynamic relations of perfect gases, speed of sound, Stagnation and Sonic Properties. Isentropic flow through convergent, convergent–divergent nozzles, Normal Shocks, Oblique Shock.

Reference Books:
1. Streeter V.L., Wylie E.B., Bedford K.W "Fluid Mechanics", McGraw Hill, 1998.
2. Fox R.W., McDonald A.T "Introduction to Fluid Mechanics", John Wiley and Sons Inc, 1985.
3. White F.M "Fluid Mechanics", McGraw Hill.
4. Shames I.H "Mechanics of Fluids", McGraw Hill, 2003.
5. Anderson John D.J "Computational Fluid Dynamics" The basics with Applications, McGraw Hill.
6. Bird R.B., Stewart W.F., Lightfoot E.N. "Transport Phenomena", John Wiley & Sons, 1960.
7. Som S. K. and Biswas G, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2008.

PCC TE-503: Advanced Heat Transfer

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

With this subject curriculum the students are expected to understand the subject of Heat Transfer in detail with capability to solve Industrial Problems. This will also create the base and interest among the students to carry out the Future Research

Syllabus Contents:

Conduction- one and two dimensional, Fins, conduction with heat source, unsteady state heat transfer, Natural and forced convection, integral equation, analysis and analogies, Transpiration cooling, ablation heat transfer, boiling, condensation and two phase flow mass transfer, cooling, fluidized bed combustion, heat pipes, Radiation, shape factor, analogy, shields, radiation of gases & vapours.

Reference Books:

1. J.P. Holman, "Heat Transfer", McGraw Hill Book Company, New York, 1990.
2. Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, NewYork, 2000.
3. Frank Kreith, "Principles of Heat Transfer", Harper and Row Publishers, New York, 1973.
4. Donald Q. Kern "Process Heat Transfer", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1975.

5. Gupta and Prakash, “Engineering Heat Transfer”, New Chand and Bros, Roorkee (U.P.) India, 1996.
6. R.C. Sachdeva “Fundamentals of Engineering Heat and Mass Transfer”, Wiley Eastern Ltd., India,

PCC TE-505: Thermodynamics and Combustion

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Student will get Knowledge of exergy, basic laws governing energy conversion in multi-component systems and application of chemical thermodynamics.
2. Student will be aware about advanced concepts in thermodynamics with emphasis on thermodynamic relations, equilibrium and stability of multiphase multi-component systems.
3. Student will be aware about the molecular basis of thermodynamics.
4. To present theoretical, semi-theoretical and empirical models for the prediction of thermodynamic properties.
5. Student will be acquire the confidence in analyze the motion of combusting and non-combusting fluids whilst accounting for variable specific heats, non-ideal gas properties, chemical non-equilibrium and compressibility
6. Student should apply the fundamental principles of thermodynamics to non-ideal models of numerous engineering devices

Student can use a systems approach to simplify a complex problem

Syllabus Contents:

First law, Second law, Tds equations, Maxwell relations, Clapeyron equation, pure substances, thermodynamic property relations, thermo-electricity, equations of state, Gas mixtures, Chemical Thermodynamics and Equilibrium, Statistical thermodynamics, statistical interpretations of first and second law, Third law of thermodynamics, Nerst heat theorem.

Reference Books:

1. Cengel, “Thermodynamics”, Tata McGraw Hill Co., New Delhi, 1980.
2. Howell and Dedcius, “Fundamentals of Engineering Thermodynamics”, McGraw Hill Inc., U.S.A.
3. Van Wylen & Sonntag, “Thermodynamics”, John Wiley and Sons Inc., U.S.A.
4. Jones and Hawkings, “Engineering Thermodynamics”, John Wiley and Sons Inc., U.S.A, 2004.
5. Holman, “Thermodynamics”, McGraw Hill Inc., New York, 2002.
6. Faires V.M. and Simmag, “Thermodynamics”, Macmillan Publishing Co. Inc., U.S.A.
7. Rao Y.V.C., “Postulational and Statistical Thermodynamics”, Allied Publishers Inc, 1994.

PSE TE-515: Refrigeration and Cryogenics

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks, End-Sem- 60 marks

Course outcomes:

1. In this subject curriculum the students are expected to understand the subject of Refrigeration and cryogenics. and its application area .
2. The another intention of this subject is to develop and design the refrigeration and cryogenics system for various industrial, medical, space and other application . This will also create the base and interest among the students to carry out the Future Research.

Syllabus Contents:

Introduction, refrigeration applications, nonconventional refrigeration systems, aircraft refrigeration, Vapour compression refrigeration, actual cycle, second law efficiency, multistage compression with inter-cooling, Multi-evaporator systems, Cascade systems. Refrigerants, CFC/HCFC phase-out regulations, Classification of compressors, various compressors used in RAC, Performance, selection as per the requirement. Capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor. Design, selection of evaporators, condensers, system balance, control systems, motor selection, refrigerants, alternative refrigerants, Food preservation, transport, vapour absorption refrigeration, single effect and double effect systems, alternative working fluids, Applications of cryogens, Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle. Cryogenic air separation Technology

Reference Books:

1. R.J.Dossat, “Principles of Refrigeration”, Pearson Education Asia, 2001.
2. C.P.Arora, “Refrigeration and Air-conditioning”, Tata McGraw-Hill, 2000.
3. Stoecker & Jones, “Refrigeration and Air-conditioning”, McGraw Hill Book Company, New York, 1982.
4. Jordan & Priester, “Refrigeration and Air-conditioning”.
5. A.R.Trott, “Refrigeration and Air-conditioning”, Butterworths, 2000.
6. J.L.Threlkeld, “Thermal Environmental Engineering”, Prentice Hall, 1970.
7. R.Barron, “Cryogenic systems”, McGraw–Hill Company, New Yourk, 1985.
8. G.G.Hasseldon. “Cryogenic Fundamentals”, Academic Press.
9. Bailey, “Advanced Cryogenics”, Plenum Press, London, 1971.
10. W.F.Stoecker, “Industrial Refrigeration Handbook”, McGraw-Hill, 1998.
11. John A.Corinchock, “Technician’s Guide to Refrigeration systems”, McGrawHill.
12. P.C.Koelet, “Industrial Refrigeration: Principles, Design and Applications”, Macmillan, 1992.
13. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration.
    Graham Walker, “Miniature Refrigerators for Cryogenic Sensors and Cold Electronics”, Clarendon Press, 1989.

PSE Fundamentals of Gas Dynamics

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

Students will be able to understand and explain concepts of gas dynamics and should acquire the capability to solve the industrial problem. This will also create the base and interest among the students to carry out the Future Research

Syllabus Contents:

Introduction, Cycles, Performance characteristics and improvement, Gas dynamics, Centrifugal, axial and mixed flow compressor, principles and characteristics, Turbine construction, Blade materials, manufacturing techniques, blade fixing, problems of high temperature operation, blade cooling, practical air cooled blades Combustion Systems, various fuels and fuel systems, Jet propulsion cycles and their analysis, parameters affecting performance, thrust augmentation, environmental considerations and applications.

Reference Books

1. H Cohen, GFC Rogers and HIH Saravanamuttoo, “Gas Turbine Theory”, Pearson Education,2000.
2. V. Ganesan, “Gas Turbines”, Tata McGraw Hill, 2003.
3. S.M.Yahya “Turbines, Compressors and Fans”, Tata McGraw Hill, 1992.
4. Vincent “The theory and design of Gas Turbine and Jet Engines”, McGraw Hill, 1950.
5. W W Bathic, “Fundamentals of Gas Turbines”, John Wiley and Sons.

LC TE-509: Seminar

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Marks – 100

Course outcomes

1. Student should develop thought process of their own liking subject
2. Students will learn to write technical reports.
3. Students will develop skills to present and defend their work in front of technically qualified audience.

Syllabus Contents

The seminar shall consist of the preparation of the report by the candidate on the topic mutually decided by himself and the supervisor. The topic should be a problem in the field of Thermal Engineering and should have the sufficient research orientation. The recent development in the field of the chosen topic needs to be understood by the candidate. The report has to be presented in front of the examiners committee and other faculty members and students of the department.

The committee should be set by the PG coordinator and Head, Mechanical Engineering.

LC TE-511: Thermal Engineering Lab Practice – I

Teaching Scheme
Practical: 8 hrs/week

Examination Scheme
Marks – 100

Course outcomes

1. Students will acquire hands on experience on the various test-rigs, Experimental set up.
2. Students should able to measure the various technical parameters by instrument and by mathematical relationship.
3. Students will able to identify the effect of various parameters on the system and able to co- relate them.

The lab practice consists of the tutorials and experiments as decided by the course supervisors of the Program Core Courses (PCC) namely Fluid Dynamics, Advanced Heat Transfer and Thermodynamics and Combustion

M Tech (Mechanical Engineering)
Specialization: Thermal Engineering

Semester II

Open Elective Course : Institute level-OEC 1

The candidate has to select one of the following courses offered at Institite level

Open Elective Courses *To be selected for "Open Elective-I" and "Open Elective-II"* **(This list is dynamic)**	**Offered by**
Engineering Mathematics for Problems Solving	COEP
Mechanics of Composite Materials	COEP
Engine Tribology	COEP
Finite Element Method	COEP
Automotive Electronics	COEP
Industrial Automation	COEP
Industrial Drives	COEP
ERP	COEP
FEM	COEP
Complex Analysis	COEP
Quantum Information Theory	COEP

PCC TE-502: Design of Heat Exchangers

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem – 60 marks

Course outcomes:

1. Students will demonstrate a basic understanding of several types of heat exchangers that will include shell-and-tube, double pipe, plate-and-frame, finned tube, and plate-fin heat exchangers, Heat pipes.
2. Students will design and analyses of shell-and-tube double pipe, compact, plate heat exchangers**.**
3. Students will demonstrate the performance degradation of heat exchangers subject to fouling**.**

Syllabus Contents:

Heat Exchangers – Classification according to transfer process, number of fluids, surface compactness, and construction features. Tubular heat exchanger, plate type heat exchangers, extended surface heat exchangers, heat pipe, Regenerators. Classification according to flow arrangement: counter flow, parallel flow, cross flow exchanger.
Heat exchanger design methodology, assumption for heat transfer analysis, problem formulation, e-NTU method, *P*-NTU method, Mean temperature difference method, fouling of heat exchanger, effects of fouling, categories of fouling, fundamental processes of fouling.
Double Pipe Heat Exchangers: Thermal and Hydraulic design of inner tube, Thermal and hydraulic analysis of Annulus, Total pressure drop
Compact Heat Exchangers: Thermal and Hydraulic design of compact heat exchanger
Shell and Tube heat exchangers – Tinker's, kern's, and Bell Delaware's methods, for thermal and hydraulic design of Shell and Tube heat exchangers
Mechanical Design of Heat Exchangers – design standards and codes, key terms in heat exchanger design, material selection, and thickness calculation for major components such as tube sheet, shell, tubes, flanges and nozzles. Introduction to simulation and optimization of heat exchangers, flow induced vibrations.

Reference Books:

1. Ramesh K. Shah and Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" John Wiley & sons Inc., 2003.
2. D.C. Kern, "Process Heat Transfer", McGraw Hill, 1950.
3. Sadik Kakac and Hongton Liu, "Heat Exchangers: Selection, Rating and Thermal Design" CRC Press, 1998.
4. A .P. Frass and M.N. Ozisik, "Heat Exchanger Design", McGraw Hill, 1984
5. Afgan N. and Schlinder E.V. "Heat Exchanger Design and Theory Source Book".
6. T. Kuppan, "Hand Book of Heat Exchanger Design".
7. . "T.E.M.A. Standard", New York, 1999.
8. G. Walkers, "Industrial Heat Exchangers-A Basic Guide", McGraw Hill, 1982.

PCC TE-504: Computational Fluid Dynamics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

With this subject curriculum the students are expected to understand the subject of Computational Fluid Dynamics and know how to use it as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems. This will also create the base and interest among the students to carry out the Future Research.

Syllabus Contents:

Introduction to CFD: Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations.
Governing Equations: Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.
Finite Volume Method: Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach
Geometry Modeling and Grid Generation: Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance
Methodology of CFDHT: Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation
Solution of N-S Equations for Incompressible Flows: Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non Staggered Grid System of N-S Equations for Incompressible Flows

Reference Books:

1. Computational Fluid Dynamics, The Basic with applications by John A. Anderson, Jr., McGraw Hill International editions, Mechanical Engineering series.
2. Numerical Methods in Fluid Flow & Heat Transfer by Dr. Suhas Patankar.
3. An Introduction to Computational Fluid Flow (Finite Volume Method), by H.K. Versteeg, W.Malalasekera, Printice Hall
4. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication.
5. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.
6. Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa Publication.

PSE TE-514: Mathematical Modelling of IC Engines

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Students will demonstrate a basic understanding of several types of engine models that will include zero dimensional thermodynamic model, one dimensional and multi dimensional, single zone, two zone etc models.
2. Students will develop models and simulate them for diesel engine petrol engine, gas engine**.**
3. Students will demonstrate the performance evaluation and emission standards for such modelled engines.

Syllabus Contents:

Fundamentals: Governing equations, Equilibrium charts of combustion chemistry, chemical reaction rates, and approaches of modeling, model building and integration methods, gas exchange through valves, engine and porting geometry, exhaust gas recirculation, valve lift curves.
Thermodynamic Combustion Models of CI Engines: Single zone models, premixed and diffusive combustion models, combustion heat release using wiebe function, wall heat transfer correlations, ignition delay, internal energy estimations, two zone model, application of heat release analysis.
Fuel spray behavior: Fuel injection, spray structure, fuel atomization, droplet turbulence interactions, droplet impingement on walls.
Modeling of charging system: Constant pressure and pulse turbo charging, compressor and turbine maps, charge air cooler.
Mathematical models of SI Engines: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Autoignition modeling, single zone models, mass burning rate estimation, SI Engine with stratified charge. Friction in pumping, piston assembly, bearings and valve train etc. friction estimation for warm and warm up engines.

Reference Books:

1. Haywood, “I.C. Engines”, Mc Graw Hill.
2. Ramos **J** (1989**)** Internal Combustion Engine Modeling**.** Hemisphere Publishing Company
3. C. D. Rakopoulos and E. G. Giakoumis, “Diesel Engine Transient
4. Operation Principles of Operation and Simulation Analysis”, Springer, 2009.
5. V. Ganeshan, “Internal Combustion Engines”, Tata McGraw Hill, New Delhi, 1996.
6. P.A. Lakshminarayanan and Y. V. Aghav, “ Modelling Diesel Combustion” Springer, 2010
7. Bernard Challen and Rodica Baranescu, “Diesel Engine Reference Book” Butterworth-Heinemann, 1999.

PSE TE-516: Energy Conservation and Management

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Acquire insight about the importance of energy
2. Capable to analyze all scenarios from energy consumption
3. Generate scenarios of energy consumption and predict the future trend
4. Suggest and plan energy conservation solutions

Syllabus Contents:

The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management. Energy auditing- methodology and analysis, Energy economics, Energy conservation in industries, Cogeneration, Combined heating and power systems, relevant international standards and laws.

Reference Books

1. L.C. Witte, P.S. Schmidt, D.R.Brown, “Industrial Energy Management and Utilization”, Hemispherical Publication, 1988.
2. Callaghan “Energy Conservation”.
3. D.A. Reeg, “Industrial Energy Conservation”, Pergamon Press, 1980.
4. T.L. Boyen, “Thermal Energy Recovery” Wiley, 1980.
5. L.J. Nagrath, “Systems Modeling and Analysis”, Tata McGraw Hill, 1982.
6. W.C. Turner, “Energy Management Handbook “, Wiley, New York, 1982.
7. I.G.C. Dryden, “The Efficient Use of Energy “, Butterworth, London, 1982.
8. R. Loftnen, Van Nostrarid Reinhold C. “Energy Handbook”, 1978.
9. TERI Publications.

PSE Microfluidics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Student should understand physics at the micrometric scale
2. Student should understand Hydrodynamics of microfluidics systems.
3. Students should get awareness to MEMS (Microelectromechanical systems) and microfluidics.
4. Students should conceptualise Diffusion, mixing, and separation in micro-systems, Microfluidics and thermal transfers, microfluidics devices

Syllabus Contents:

Introduction to MEMS and microfluidics, Physics at the micrometric scale, Hydrodynamics of microfluidic systems, Diffusion, mixing, and separation in microsystems, Microfluidics and thermal transfers, microfluidic devices

Reference Books

1. Introduction to Micro-fluidics, Patrick Tabling, MIT Cambridge
2. Theoretical Microfluidics, Henrick Burus, Oxford University Press 2008

PSE TE-518: Environnemental Pollution and Control

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. To identify the effect of various types of pollutant on the environment and to design the system to control it .
2. To know the legal basis of environmental protection and provision
3. To acquaint with source of Noise, its, measurement and control.
4. To gain in depth knowledge of waste water treatment

Syllabus Contents:

Air Pollution, effects, sampling and control, equipments and systems, control of gaseous contaminants, automotive emission and control, Industrial Air Pollution Water Pollution: pollutants and their effects, waste water treatment Pollution Control and Conservation The legal basis of environmental protection and provision, Noise -sources, measurement and control.

Reference Books

1. M.N. Rao, H.V. Rao, “Air Pollution”, Tata McGraw Hill , New Delhi, 1993
2. C.S. Rao, “Environmental Pollution Control Engineering”, New Age International Publishers (p)
Ltd., 1996.
3. Howard S. Peavy, D.R. Rowe, “Environmental Engineering”, McGraw Hill International.
4. DeNevers, “Air Pollution Control Engineering”, McGraw Hill companies, 1994.
5. S.P. Mahajan, “Pollution Control in Process Industries”, Tata McGraw Hill, 1985.
6. Metcalf and Eddy, “Waste Water Engineering”, Tata McGraw Hill

PSE TE-520: Air Conditioning System Design

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Student should understand construction and design features Air-conditioning system.
2. To understand various types and its adoptability in the various environment and application areas.
3. To understand various health issues
4. To design seasonal energy efficient system

Syllabus Contents:

Air conditioning systems, various air-conditioning processes, enthalpy deviation curve, psychrometry , SHF, dehumidified air quantity, human comfort, indoor air quality, design conditions and load calculations, air distribution, pressure drop, duct design, fans &, blowers, performance & selection, noise control.

Reference Books :

1. ASHRAE Handbook.
2. "Handbook of air-conditioning system design", Carrier Incorporation, McGraw Hill Book Co.,
U.S.A, 1965.
3. "Refrigeration and air-conditioning", ARI, Prentice Hall, New Delhi, 1993.
4. Norman C. Harris, "Modern Air Conditioning", New York, McGraw-Hill,1974.
5. Jones W.P., "Air Conditioning Engineering", Edward Arnold Publishers Ltd., London, 1984.
6. Hainer R.W., "Control Systems for Heating, Ventilation and Air-Conditioning", Van Nostrand
Reinhold Co., New York, 1984. 7. Arora C.P., "Refrigeration & Air Conditioning", Tata Mc Graw Hill, 1985.
8. Manohar Prasad, "Refrigeration & Air Conditioning", New Age Publishers.
9. Stoecker, "Refrigeration & Air Conditioning", Mc Graw Hill, 1992.
10. Stoecker, "Design of Thermal Systems", Mc Graw Hill, 1992.

PSE Gas Turbines

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Student should understand construction and design features of gas turbines as used for power generation.
2. Student should understand thermodynamics cycles a, and different sizes and layouts of gas turbine plant

3. Able to understand thermodynamics and fluid mechanics component for enhancing the efficiency and effectively of gas turbines

Syllabus Contents:

Introduction, Cycles, Performance characteristics and improvement, Gas dynamics, Centrifugal, axial and mixed flow compressor, principles and characteristics, Turbine construction, Blade materials, manufacturing techniques, blade fixing, problems of high temperature operation, blade cooling, practical air cooled blades Combustion Systems, various fuels and fuel systems, Jet propulsion cycles and their analysis, parameters affecting performance, thrust augmentation, environmental considerations and applications.

Reference Books :

1. H Cohen, GFC Rogers and HIH Saravanamuttoo, "Gas Turbine Theory", Pearson Education,
2000.
2. V. Ganesan, "Gas Turbines", Tata McGraw Hill, 2003.
3. S.M.Yahya "Turbines, Compressors and Fans", Tata McGraw Hill, 1992.
4. Vincent "The theory and design of Gas Turbine and Jet Engines", McGraw Hill, 1950.
5. W W Bathic, "Fundamentals of Gas Turbines", John Wiley and Sons.

PSE Non-conventional Energy Source

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Update about the technological status of implementation of NCES in India
2. Capable to analyze various techno economical obstacles in the commercial development of NCES in India
3. Capable to conceptually model and design general NCES systems and predict the long term performance.
4. Suggest and plan hybrid NCES solutions to conventional energy systems

Syllabus Contents:

Conventional sources of energy, Nuclear, Alternative energy sources, Solar Radiation-estimation, prediction & measurement, Solar energy utilization, Performance of Solar flat plate collectors, concentrating collectors, thermal storage, Wind energy, Direct Energy conversion- PV, MHD, Fuel cells, thermionic, thermoelectric, Biomass, biogas, hydrogen, Geothermal.

Reference Books:

1.J.A. Duffie and W.A. Beckman, "Solar Engineering of Thermal Processes", John Wiley, 1991.

2. D.Y. Goswami, F. Kreith and J.F. Kreider, “Principle of Solar Engineering”, Taylor and Francis,
2000.
3. Sukhatme S.P., “Solar Energy”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
4. Bansal and othes, “Non-Conventional Energy Sources”.
5. J.F. Kreider, F. Kreith, “Solar Energy Handbook”, McGraw Hill, 1981

MLC ML 504: Intellectual Property Rights

Teaching Scheme	Examination Scheme
Practical: 2hrs/week	Marks - 100

Course outcomes:

1. Students will understand the rights of an individual towards intellectual property.
2. Students will know the procedure to file a national/international patent.

Syllabus Contents:

Patent as an intellectual property right; Patent act and patent rules; patent for process, product and product and process together; Jurisdiction of patent; Invention as an intellectual property; Patent offices; Submission of application for patent; Patent of addition, granted on convention application, applicants for patent, application for ordinary patent; applicant working in Government; Patentable invention; Term of patent, Procedure to obtain patent in India, Overview of patenting abroad.

Reference Books:

1. Manual of Patent (Practice and Procedure) Patent office, India
2. Patent law, P Narayanan, Eastern Law House Pvt Ltd, Third Edition 1998
3. Terrel on law of patents, Douglas Falconer & William Aldous & David Young

PGL TE-510: Thermal Engineering Lab Practice – II

Teaching Scheme	Examination Scheme
Practical: 8 hrs/week	Marks – 100

Course outcomes:

1. Students will acquire hands on experience on the various test-rigs, Experimental set up.
2. Students should able to measure the various technical parameters by instrument and by mathematical relationship.
3. Students will able to identify the effect of various parameters on the system and able to co- relate them.

The lab practice consists of the tutorials and experiments as decided by the course supervisors of the Program Core Courses (PCC) namely Design of Heat Exchangers and Computational Fluid Dynamics

M Tech (Mechanical Engineering)
Specialization: Thermal Engineering

Semester III

PS-I TE-601: Project I

Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

MLC ML 603: Environmental Studies

Teaching Scheme	Examination Scheme
Lectures: 2 hrs/week	T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Students will understand multidisciplinary nature of Environmental studies.
2. Students will be aware of renewable and non-renewable resources of energy, their advantages, and problems associated with them and exploitation of those resources.
3. Students will understand the importance of Biodiversity and its conservation, the value of biodiversity, its consumptive use, productive use and its social, ethical, aesthetic and option values.
4. Students will be aware of different types of pollutions and their cause, effects and control.
5. Students will recognize Social and Environmental Issues related to unsustainable and sustainable development.

Syllabus Contents:

Natural Resources Renewable and non-renewable resources – Associated problems – Forest Resources – mineral resources – water resources - Food resources - Energy resources(Renewable and non-renewable) - Land

resources - Role of intellectuals in conservation of natural resources . **Eco-systems:** Concept of an ecosystem - Structure of ecosystems – Elements in living and non-living systems Energy laws, biotic structure Bio diversity & importance Conservation of Bio diversity - Categories of organisms, feeding and non-feeding relationship Nutrient cycles. **Pollution :** Air pollution and their impact – primary and secondary pollutants – control strategies Indoor pollutants – global warming – International Treaties. **Human Population and the Environment** Population growth, variation among nations - Women and Child Welfare – Global Atmospheric changes - Public awareness. **Field Work:** Visit to a local area to document environmental assets –river / forest / grassland / hill / mountain - Visit to a local polluted site – Urban / Rural / Industrial / Agricultural - Study of common plants, insects, birds - Study of simple ecosystems – pond, river, hill slopes, etc.

Reference Books:

1. Anjaneyulu Y, Introduction to Environmental Science, BS Publications, Hyderabad, 2004.
2. Bharucha Erach, Textbook of Environmental Studies for Undergraduate Courses,
University Press, 2009
3. Daniel B, Botkin et.al, Environmental Science, John Wiley & Sons, 2000.
4. Meenakshi. P, Elements of Environmental Science and Engineering, Prentice – Hall of India, New Delhi, 2006.
5. William P,Cunnigham et.al, Principles of Environmental Science, Tata McGraw Hill Edition, 2002.

MLC ML 601: Constitution of India

Teaching Scheme
Lectures: 2 hrs/week

Examination Scheme
T1, T2 – 20 marks, End-Sem– 60 marks

Course outcomes:

1. Students will be aware of Fundamental rights of a citizen of India, their limitations and duties of a citizen of India and their significance.
2. Students will realize the hierarchy in the governance of country and the state.
3. Students will know the constitutional provisions for Scheduled Castes & Tribes, Women & Children & Backward classes. Emergency Provisions.
4. Students will also know Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments.

Syllabus Contents:

Preamble of the Constitution, Concept of Federal State, Fundamental Rights,Directive Principles of State, Structure of the Executive, Legislative and Judiciary at Union and State level, Powers and responsibilities of Executive, Legislative and Judiciary at Union and State level, Amendment acts, writ petitions, Schedules of the Constitutions.

References:
Constitution of India, D. D. Basu (publication ….)

M Tech (Mechanical Engineering)
Specialization: Thermal Engineering

Semester III

PS TE 602: Project II

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

Annexure I

Sample list of Professional Science/Elective courses offered by various departments

Branch Name	Subject Name
Civil Engineering (Construction and Management)	Environmental Impact Assessment
Civil Engineering (Environmental and Water)	Numerical Method
Civil Engineering (Geotechnical Engineering)	Advanced Mathematical Methods
Civil Engineering	Introduction to Coastal Engineering
Civil Engineering	Fortran Programming for Engineering Application
Civil Engineering	Housing and Social aspects of planning
Computer/ Information Technology	Financial Computing
Electrical Engineering (Control System)	Matrix and linear Algebra
Electrical Engineering (Power System)	Wind and Solar Energy
Electrical Engineering (Power System)	Engineering Optimization
Electrical Engineering (Power System)	Linear Systems Theory and Design
Electrical Engineering	Industrial Motion Control
Electronics and Telecommunications (Signal Processing)	Mobile Communication
Electronics and Telecommunications	Applied Statistical Physics
Electronics and Telecommunications(VLSI and Embedded)	Image processing and analysis
Electronics and Telecommunications	Artificial Intelligence
Mechanical Engineering	Finite Element and Boundary Element Methods
Mechanical Engineering	Energy Conservation and Management
Mechanical Engineering	Operation Research
Mechanical Engineering	Introduction to Nuclear Energy
Metallurgical Engineering (Physical/Process)	Electronics and Magnetic Materials
Metallurgical Engineering (Physical/Process)	Thermomechanical Processing of Metals
Metallurgical Engineering	Nanotechnology
Town and Country Planning	Quantitative Techniques
Production Engineering (Manufacturing Engineering and Automation)	Microcontroller and Applications
Production Engineering (Manufacturing Engineering and Automation)	Reliability Engineering
Production	Robot Dynamics and Analysis
Production	Commercial Law
Project Management	Project Planning and Control
Applied Physics	Laser Technology
Mathematics	Complex Analysis
Mathematics	Advanced Mathematical Methods (for all except Mech. and Instru.)
Mathematics	Advanced Mathematics
Mathematics	Engineering Mathematics for Problem Solving
Mathematics	Linear Algebra

Annexure-II:

Sample list of Liberal Learning courses offered at Institute level

Course Outcome:
Student will be able to choose and enhance practical learning and application in the subject of his/her choice.

One credit course spread over the semester to enhance practical learning and application

1. **Agriculture (**Landscaping, Farming, etc.**)**
2. **Business (**Management, Entrepreneurship, etc.**)**
3. **Defense (**Study about functioning of Armed Forces**)**
4. **Education (**Education system, Policies, Importance, etc.**)**
5. **Fine Arts (**Painting, Sculpting, Sketching, etc.**)**
6. **Linguistics**
7. **Medicine and Health (**Diseases, Remedies, Nutrition, Dietetics, etc.**)**
8. **Performing Arts (**Music, Dance, Instruments, Drama, etc.**)**
9. **Philosophy**
10. **Social Sciences (**History, Political Sc., Archeology, Geography, Civics, Economics, etc.**)**