HINDUSTAN UNIVERSITY
HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE
(Estd. u/s 3 of the UGC Act, 1956)
Padur, Kancheepuram District - 603 103.

DEPARTMENT OF
AUTOMOBILE ENGINEERING

Regulations Curriculum and Syllabus 2013

M.Tech.
INTERNAL COMBUSTION ENGINEERING

ACADEMIC REGULATIONS
(M.TECH./ M.B.A. / M.C.A.) (Full - Time / Part - Time)
(Effective 2013-14)

1. Vision, Mission and Objectives

1.1 The Vision of the Institute is "To make every man a success and no man a failure".

In order to progress towards the vision, the Institute has identified itself with a mission to provide every individual with a conducive environment suitable to achieve his / her career goals, with a strong emphasis on personality development, and to offer quality education in all spheres of engineering, technology, applied sciences and management, without compromising on the quality and code of ethics.

1.2 Further, the institute always strives

- To train our students with the latest and the best in the rapidly changing fields of Engineering, Technology, Management, Science & Humanities.
- To develop the students with a global outlook possessing, state of the art skills, capable of taking up challenging responsibilities in the respective fields.
- To mould our students as citizens with moral, ethical and social values so as to fulfill their obligations to the nation and the society.
- To promote research in the field of science, Humanities, Engineering, Technology and allied branches.

1.3 Our aims and objectives are focused on

- Providing world class education in engineering, technology, applied science and management.
- Keeping pace with the ever changing technological scenario to help our students to gain proper direction to emerge as competent professionals fully aware of their commitment to the society and nation.
- To inculcate a flair for research, development and entrepreneurship.

2. Admission

2.1 The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute, following guidelines issued by Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the (M.TECH / M.B.A. / M.C.A.) programme will be decided by BOM as per the directives from Ministry of Human Resource Development (MHRD), Government of India and taking into account the market demands. Some seats for Non Resident Indians and a few seats for foreign nationals shall be made available.

2.2 The selected candidates will be admitted to the (M.TECH / M.B.A. / M.C.A.) programme after he/she fulfills all the admission requirements set by the Institute and after payment of the prescribed fees.

2.3 Candidates for admission to the first semester of the Master's Degree Programme shall be required to have passed an appropriate Degree Examination recognized by Hindustan University.

2.4 In all matters relating to admission to the (M.TECH / M.B.A. / M.C.A.). Programme, the decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

2.5 If at any time after admission, it is found that a candidate has not fulfilled any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

3. Structure of the programme

3.1 The programme of instruction will have the following structure

i) Core courses of Engineering / Technology / Management.

ii) Elective courses for specialization in areas of student's choice

3.2 The minimum durations of the programmes are as given below:

Program	No. of Semesters
M.Tech.(Full-Time)	4
M.Tech.(Part -Time)	6
M.B.A. (Full - Time)	4
M.B.A. (Part - Time)	6
M.C.A.(Full - Time)	6
M.C.A.(Part -Time)	8

Every (M.TECH / M.B.A. / M.C.A.) programme will have a curriculum and syllabi for the courses approved by the Academic Council.

3.3 Each course is normally assigned certain number of credits. The following norms will generally be followed in assigning credits for courses.

- One credit for each lecture hour per week per semester
- One credit for each tutorial hour per week per semester
- One credit for each laboratory practical of three hours per week per semester.
- One credit for 4 weeks of industrial training and
- One credit for 2 hours of project per week per semester.

3.4 For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below.

Program	Minimum prescribed credit range
M.Tech. (Full time / Part time)	75 - 85
M.B.A. (Full time / Part time)	85 - 95
M.C.A (Full time / Part time)	115 - 125

3.5 The medium of instruction, examination and the language of the project reports will be English.

4. Faculty Advisor

4.1 To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned Department will assign a certain number of students to a Faculty member who will be called their Faculty Advisor.

5. Class Committee

5.1 A Class Committee consisting of the following will be constituted by the Head of the Department for each class:

(i) A Chairman, who is not teaching the class.

(ii) All subject teachers of the class.

(iii) Two students nominated by the department in consultation with the class.

The Class Committee will meet as often as necessary, but not less than three times during a semester.

The functions of the Class Committee will include:

(i) Addressing problems experienced by students in the classroom and the laboratories.

(ii) Analyzing the performance of the students of the class after each test and finding ways and means of addressing problems, if any.

(iii) During the meetings, the student members shall express the opinions and suggestions of the class students to improve the teaching / learning process.

6. Grading

6.1 A grading system as below will be adhered to.

Range of Marks	Letter Grade	Grade points
95-100	S	10
85 - 94	A	09
75- 84	B	08
65-74	C	07
55-64	D	06
50-54	E	05
< 50	U	00
	I (Incomplete)	–

6.2 GPA & CGPA

GPA is the ratio of the sum of the product of the number of credits C_i of course "i " and the grade points P_i earned for that course taken over all courses "i" registered by the student to the sum of Ci for all "i ". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, at any semester, considering all the courses enrolled from first semester onwards.

6.3 For the students with letter grade I in certain subjects, the same will not be included in the computation of GPA and CGPA until after those grades are converted to the regular grades.

6.4 Raw marks will be moderated by a moderation board appointed by the Vice-Chancellor of the University. The final marks will be graded using an absolute grading system. The Constitution and composition of the moderation board will be dealt with separately.

7. Registration and Enrollment

7.1 Except for the first semester, registration and enrollment will be done in the beginning of the semester as per the schedule announced by the University.

7.2 A student will be eligible for enrollment only if he/she satisfies regulation 10 (maximum duration of the programme) and will be permitted to enroll if (i) he/she has cleared all dues in the Institute, Hostel & Library up to the end of the previous semester and (ii) he/she is not

debarred from enrollment by a disciplinary action of the University.

7.3 Students are required to submit registration form duly filled in.

8. Registration requirement

8.1 **(i)** A Full time student shall not register for less than 16 credits or more than 26 credits in any given semester.

8.1 **(ii)** A part time student shall not register for less than 10 credits or more than 20 credits in any given semester.

8.2 If a student finds his/her load heavy in any semester, or for any other valid reason, he/she may withdraw from the courses within three weeks of the commencement of the semester with the written approval of his/her Faculty Advisor and HOD. However the student should ensure that the total number of credits registered for in any semester should enable him/her to earn the minimum number of credits per semester for the completed semesters.

9. Minimum requirement to continue the programme

9.1 For those students who have not earned the minimum required credit prescribed for that particular semester examination, a warning letter to the concerned student and also to his parents regarding the shortage of his credit will be sent by the HOD after the announcement of the results of the university examinations.

10. Maximum duration of the programme

The minimum and maximum period for the completion of various programs are given below.

Program	Min. No. of Semesters	Max. No. of Semesters
M.Tech (Full - time)	4	8
M.Tech (Part - time)	6	10
M.B.A. (Full Time)	4	8
M.B.A. (Part Time)	6	10
M.C.A. (Full - Time)	6	12
M.C.A (Part -Time)	8	14

11. Temporary discontinuation

11.1 A student may be permitted by the Director(academic) to discontinue temporarily from the programme for a semester or a longer period for reasons of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum duration of two semesters.

12. Discipline

12.1 Every student is required to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

12.2 Any act of indiscipline of a student reported to the Director (Academic) will be referred to a Discipline Committee so constituted. The Committee will enquire into the charges and decide on suitable punishment if the charges are substantiated. The committee will also authorize the Director(Academic) to recommend to the Vice-Chancellor the implementation of the decision. The student concerned may appeal to the Vice-Chancellor whose decision will be final. The Director (Academic) will report the action taken at the next meeting of the Council.

12.3 Ragging and harassment of women are strictly prohibited in the University campus and hostels.

13. Attendance

13.1 A student whose attendance is less than 75% is not eligible to appear for the end semester examination for that semester. The details of all students who have attendance less than 75% will be announced by the teacher in the class. These details will be sent to the concerned HODs and Director (Academic).

13.2 Those who have less than 75% attendance will be considered for condonation of shortage of attendance. However a condonation of 10% in attendance will be given on medical reasons. Application for condonation recommended by the Faculty Advisor, concerned faculty member and the HOD is to be submitted to the Director (Academic) who, depending on the merits of the case, may permit the student to appear for the end semester examination. A student will be eligible for this concession at most in two semesters during the entire degree programme. Application for medical leave, supported by medical certificate with endorsement by a Registered Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last instructional day of the semester, whichever is earlier.

13.3 As an incentive to those students who are involved in extra curricular activities such as representing the University in Sports and Games, Cultural Festivals, and Technical Festivals, NCC/ NSS events, a relaxation of up to 10% attendance will be given subject to the condition that these students take prior approval from the officer-in-charge. All such applications should be recommended by the concerned HOD and forwarded to Director (Academic) within seven instructional days after the programme/activity.

14. Assessment Procedure

14.1 The Academic Council will decide from time to time the system of tests and examinations in each subject in each semester.

14.2 For each theory course, the assessment will be done on a continuous basis as follows:

Test / Exam	Weightage	Duration of Test Exam
First Periodical Test*	10%	2 Periods
Second Periodical Test*	10%	2 Periods
Model exam	20%	3 hours
Seminar/ Assignments/Quiz	20%	
End - semester examination	50%	3 Hours

*** Best out of the two tests will be considered.**

14.3 For practical courses, the assessment will be done by the subject teachers as below:

(i) Weekly assignment/Observation note book / lab records - weightage 60%.

(ii) End semester examination of 3 hours duration including viva - weightage 40%

15. Make up Examination/model examination

15.1 Students who miss the end-semester examinations / model examination for valid reasons are eligible for make-up examination /model examination. Those

who miss the end-semester examination / model examination should apply to the Head of the Department concerned within five days after he / she missed examination, giving reasons for absence.

15.2 Permission to appear for make-up examination / model exam will be given under exceptional circumstances such as admission to a hospital due to illness. Students should produce a medical certificate issued by a Registered Medical Practitioner certifying that he/she was admitted to hospital during the period of examination / model exam and the same should be duly endorsed by parent / guardian and also by a medical officer of the University within 5 days.

16. Project evaluation

16.1 For Project work, the assessment will be done on a continuous basis as follows:

Review / Examination	Weightage
First Review	10%
Second Review	20%
Third Review	20%
End semester Examination	50%

For end semester exam, the student will submit a Project Report in a format specified by the Director (Academic). The first three reviews will be conducted by a Committee constituted by the Head of the Department. The end - semester examination will be conducted by a Committee constituted by the Controller of Examinations. This will include an external expert.

17. Declaration of results

17.1 A candidate who secures not less than 50% of total marks prescribed for a course with a minimum of 50% of the marks prescribed for the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

17.2 After the valuation of the answer scripts, the tabulated results are to be scrutinized by the Result Passing Boards of PG programmes constituted by the Vice-Chancellor. The recommendations of the Result Passing Boards will be placed before the Standing Sub Committee of the Academic Council constituted by the Chancellor for scrutiny. The minutes of the Standing Sub Committee along with the results are to be placed before the Vice-Chancellor for approval. After getting the approval of the Vice-Chancellor, the results will be published by the Controller of Examination/ Registrar.

17.3 If a candidate fails to secure a pass in a course due to not satisfying the minimum requirement in the end semester examination, he/she shall register and re-appear for the end semester examination during the following semester. However, the sessional marks secured by the candidate will be retained for all such attempts.

17.4 If a candidate fails to secure a pass in a course due to insufficient sessional marks though meeting the minimum requirements of the end semester examination, wishes to improve on his/ her sessional marks, he/she will have to register for the particular course and

attend the course with permission of the HOD concerned and the Registrar. The sessional and external marks obtained by the candidate in this case will replace the earlier result.

17.5 A candidate can apply for the revaluation of his/her end semester examination answer paper in a theory course within 2 weeks from the declaration of the results, on payment of a prescribed fee through proper application to the Registrar/Controller of Examinations through the Head of the Department. The Registrar/ Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Department. Revaluation is not permitted for practical courses and for project work.

17.6 The weightage for internal marks in finalizing results and grades shall be waived off after completion of 5 semesters.

18. Grade Card

18.1 After results are declared, grade sheet will be issued to each student, which will contain the following details:

(i) Program and branch for which the student has enrolled.

(ii) Semester of registration.

(iii) List of courses registered during the semester and the grade scored.

(iv) Semester Grade Point Average (GPA)

(v) Cumulative Grade Point Average (CGPA).

19. Class / Division

19.1 Classification is based on CGPA and is as follows:

CGPA $\geq$ 8.0 : **First Class with distinction**

6.5 $\leq$ CGPA < 8.0 : **First Class**

5.0 $\leq$ CGPA < 6.5 : **Second Class.**

19.2 (i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses in his/her first appearance within the minimum duration of the programme.

(ii) The award of 'First Class' is further subject to the candidate becoming eligible to the award of the degree having passed the examination in all the courses within the below mentioned duration of the programme.

Program	No. of Semesters
M.Tech.(Full-Time)	5
M.Tech.(Part -Time)	7
M.B.A. (Full - Time)	5
M.B.A. (Part - Time)	7
M.C.A.(Full - Time)	7
M.C.A.(Part -Time)	9

(iii) The period of authorized discontinuation of the programme (vide clause 11.1) will not be counted for the purpose of the above classification.

20. Transfer of credits

20.1 Within the broad framework of these regulations, the Academic Council, based on the recommendation of the transfer of credits committee so constituted by the Chancellor may permit students to earn part of the credit requirement in other approved institutions of repute and status in the country or abroad.

21. Eligibility for the award of (M.TECH / M.B.A. / M.C.A.) Degree

21.1 A student will be declared to be eligible for the award of the (M.TECH / M.B.A. / M.C.A.). Degree if he/she has

i) registered and successfully credited all the core courses,

ii) successfully acquired the credits in the different categories as specified in the curriculum corresponding to the discipline (branch) of his/her study within the stipulated time,

iii) has no dues to all sections of the Institute including Hostels, and

iv) has no disciplinary action pending against him/her.

The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

22. Power to modify

22.1 Notwithstanding all that has been stated above, the Academic Council has the right to modify any of the above regulations from time to time subject to approval by the Board of Management.

HINDUSTAN UNIVERSITY
HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

DEPARTMENT OF AUTOMOBILE ENGINEERING
M.TECH. INTERNAL COMBUSTION ENGINEERING

CURRICULUM 2011

SEMESTER - I

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Theory							
1	PMA101	Advanced Engineering Mathematics *	3	1	0	4	4
2	PTE101	Advanced Heat Transfer **	4	0	0	4	4
3	PTE102	Advanced Thermodynamics **	4	0	0	4	4
4	PTE103	Advanced Fluid Mechanics	4	0	0	4	4
5	PTE104	Instrumentation for Thermal Systems*	4	0	0	4	4
6	PIC101	Combustion in Engines	4	0	0	4	4
		Total				**24**	**24**

*** Common to Aero, Auto, CAD, ICE, R&AC and Thermal**

**** Common to ICE, R&AC and Thermal**

SEMESTER - II

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Theory							
1	PIC201	Alternative fuels for I.C. Engines	4	0	0	4	4
2	PIC202	Electronic Engine Management System	4	0	0	4	4
3	PIC203	Engine Pollution and Control	4	0	0	4	4
4	PIC204	Internal Combustion Engine Design	4	0	0	4	4
5		Elective - I	3	0	0	3	4
6		Elective - II	3	0	0	3	4
Practical							
7	PIC251	Engine Design Lab	0	0	3	2	3
8	PIC252	ICE Lab	0	0	3	2	3
		Total				**26**	**30**

SEMESTER - III

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Theory							
1		Elective - IV	3	0	0	3	4
2		Elective - V	3	0	0	3	4
3		Elective - VI	3	0	0	3	4
Practical							
4	PIC351	Seminar	0	0	3	2	3
5	PIC352	Industrial Training	0	0	4	2	4
6	PIC353	Project Work Phase - I	0	0	12	6	12
		Total				**19**	**31**

SEMESTER - IV

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Practical							
1	PIC451	Project Work Phase - II	0	0	24	12	24

Total No. of Credit = 81

ELECTIVE COURSES

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
1	PAU706	Computational fluid Dynamics **	3	0	0	3	4
2	PIC701	Automotive Engine Systems	3	0	0	3	4
3	PIC702	Engine Auxiliary Systems	3	0	0	3	4
4	PIC703	Gas turbine	3	0	0	3	4
5	PIC704	Jet and Rocket Propulsion	3	0	0	3	4
6	PIC705	Manufacturing and Testing of I.C. Engines and Components	3	0	0	3	4
7	PIC706	Marine Diesel Engines.	3	0	0	3	4
8	PIC707	Simulation of I.C. Engines**	3	0	0	3	4
9	PIC708	Specialty Engines	3	0	0	3	4
10	PIC709	Supercharging and Scavenging	3	0	0	3	4
11	PIC710	Microcontrollers and Micro Electronics for I.C. Engine Applications	3	0	0	3	4

**** Common to M.Tech. Auto & ICE**

HINDUSTAN UNIVERSITY

SEMESTER I
PMA101 ADVANCED ENGINEERING MATHEMATICS

L	T	P	C
3	1	0	4

GOAL

Develop the Mathematical skills to formulate certain practical problems, solve them and analytically and numerically and to interpret the results.

OBJECTIVES

The course should enable the student to:

- Understand the functional and the concepts of calculus of variation and its properties. Learns techniques to find the extremals of the variational problems involving one many unknown functions, functional dependent on higher order derivatives and isoperimetric problems.
- Learn to classify the initial and boundary value problems. Understands the D'Alemberts solution of the one dimensional wave equation. Understand the Fourier transform techniques for solving heat flow problems in infinite and semi infinite rod.
- Learn Harmonic functions and their properties. Understands solving the Laplace equation using Fourier transforms in a half plane with infinite strip and in a semi infinite strip.
- Understand to classify the partial differential equations. Learn the methods of solving second order partial differential equations numerically.
- Understands mapping and learns the concept of conformal mapping by doing the transformation from z plane to w plane

OUTCOME

The students should be able to:

- Find the extremals of the functional of different types and uses their technique to find the geodesic and solves isoperimetric problems. Using direct method finds the approximate solution and compares with the exact solutions using Ritz and Kantorovich methods.
- Form the wave equations with initial conditions and solve them using D'Alemberts solutions. Solves the wave equations using Laplace transform for displacements in long string - long string under its weight and free and forced vibrations. Applies Fourier transform techniques for solving the heat flow problems with infinite and semi infinite rods.
- Find the steady state temperature by solving the Laplace equation using Fourier transform techniques. Solves the heat flow problems in a half plane with infinite strip and in a semi infinite strip.
- Solve the initial and boundary value problems related heat flow, both one and two dimensional and vibration problems and obtains their numerical solutions. Understands the numerical techniques of solving the partial differential equation in engineering applications.
- Applies conformal mapping to fluid and heat flow problems.

UNIT I CALCULUS OF VARIATIONS **12**

Concept of variation and its properties- Euler's Equation-Functional dependant on first and higher order derivatives - Functional dependant on functions of several independent variables- Isoperimetric problems - Direct methods-Ritz and Kantrovich methods

UNIT II TRANSFORM METHODS **12**

Laplace transform methods for one dimensional wave equation - Displacements in a long string - Longitudinal vibration of an elastic bar - Fourier Transform methods for one dimensional heat conduction problems in infinite and semi-infinite rod

UNIT III ELLIPTIC EQUATIONS **12**

Laplace equation - Properties of Harmonic functions - Solutions of Laplace equation by means of Fourier transform in a half plane in an infinite strip and in a semi-infinite strip.

UNIT IV NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Solution of Laplace and Poisson equation on a rectangular region by Lieebmann's method - Diffusion equation by the explicit and Crank Nicolson - Implicit methods - Solution of wave equations by explicit scheme Cubic spline interpolation.

UNIT V CONFORMAL MAPPING AND APPLICATIONS **12**

The Schwarz - Christoffel transformation - Transformation of boundaries in parametric form - Physical applications - Application to fluid and heat flow.

Total : 60

REFERENCES

1. Gupta A.S., "Calculus of Variations with Applications", Prentice Hall of India (P) Ltd., New Delhi, 6th print, 2006
2. Sankar Rao K. - "Introduction to Partial Differential Equations", Prentice Hall of India(P) Ltd., New Delhi, 5th print, 2004
3. Jain R.K, and Iyengar S.R.K.,- "Advanced Engineering Mathematics", Narosa publications 2nd Edition, 2006
4. Grewal, B.S - "Numerical Methods in Science and Engineering", Kanna Publications, New Delhi.
5. Kandasamy P., Thilagavathy. K and Gunavathy, K - "Numerical Methods", S Chand and Co., Ltd., New Delhi, 5th Edition, 2007
6. Spiegel M. R., "Theory and problems of Complex Variables with an Introduction to Conformal Mapping and Its applications", Schaum's outline series, Mc Graw Hill Book Co., 1987.

PTE101 ADVANCED HEAT TRANSFER

L	T	P	C
4	0	0	4

GOAL

The course is intended to build up necessary background for understanding the physical behaviour of various modes of heat transfer like conduction, Turbulent convective Heat Transfer, Phase change Heat Transfer and radiation.

OBJECTIVES

The course should enable the students to:

1. Learn the physical behaviour of various modes of heat transfer like conduction, Turbulent convective Heat Transfer, Phase change Heat Transfer and radiation
2. Know the application of various experimental heat transfer correlations in engineering calculations.
3. Understand the thermal analysis and sizing of heat exchangers.
4. Understand the concepts of Radiation Heat Transfer.
5. Learn the concepts of Turbulent boundary layer and its importance in convection phenomenon.
6. Give insight to Numerical Methods In Heat Transfer.

OUTCOME

The students should be able to:

1. Understand the difference between various modes of Heat Transfer.
2. Know about Finite Difference Method and Finite Volume Method.
3. Understand various correlations involve in Compact Heat Exchanger and Fins.
4. Learn to apply various correlations used in Convective Heat Transfer.
5. Design/size Heat Exchanger.

UNIT I CONDUCTION AND RADIATION HEAT TRANSFER 12

One dimensional energy equations and boundary condition, three-dimensional heat conduction equations, Extended surface heat transfer, Conduction with moving boundaries, Radiation in gases and vapour. Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media - interaction of radiation with conduction and convection.

UNIT II TURBULENT FORCED CONVECTIVE HEAT TRANSFER 12

Momentum and Energy Equations, Turbulent Boundary Layer Heat Transfer, Mixing length concept, Turbulence Model - K-ε Model, Analogy between Heat and Momentum Transfer - Reynolds, Colburn, Vou Karman, Turbulent flow in a Tube, High speed flows.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER 12

Condensation with shear edge on bank of tubes, Boiling - pool and flow boiling, Heat exchanger, ε - NTU approach and design procedure, compact heat exchangers.

UNIT IV NUMERICAL METHODS IN HEAT TRANSFER 12

Finite difference formulation of steady and transient heat conduction problems - Discretization schemes - Explicit, Crank Nicolson and Fully Implicit schemes,Control volume formulation, Steady one dimensional convection and Diffusion Problems, Calculation of the flow field - SIMPLER Algorithm.

UNIT V MASS TRANSFER AND ENGINE HEAT TRANSFER CORRELATION 12

Mass Transfer, Vaporization of droplets, Combined heat and mass transfer, Heat Transfer Correlations in various applications like I.C. Engines, Compressors & turbines.

TOTAL: 60

REFERENCES

1. Incropera F.P. and DeWitt. D.P., Fundamentals of Heat & Mass Transfer, John Wiley & Sons, 5th Edition , 2009.
2. Ozisik. M.N., Heat Transfer - Basic Approach, McGraw-Hill Co., 1985
3. Schlichting, Gersten, Boundarylayer Theory, Springer, 8th Edition, 2009.
4. P.K. Nag, Heat Transfer, Tata McGraw-Hill, 2nd Edition,2009.
5. Rohsenow. W.M., Harnett. J.P., and Ganic. E.N., Handbook of Heat Transfer Applications, McGraw-Hill, NY, 3rd Edition , 1998.
6. Ghoshdasdidar. P.S., Compiler simulation of flow and Heat Transfer, Tata McGraw-Hill,1998

6. Patankar. S.V.Numerical heat Transfer and Fluid flow,Hemisphere Publishing Corporation,2009

PTE102 ADVANCED THERMODYNAMICS

L	T	P	C
4	0	0	4

GOAL

To provide the students with knowledge on various thermodynamic properties and make them aware of the practical implications of themodynamic relations.

OBJECTIVES

The course should enable the students to:

1. Gain knowledge availability analysis and thermodynamic properties.
2. Understand real gas behaviours and multi - component systems.
3. Learn chemical thermodynamics and equilibrium.
4. Gain knowledge on statistical thermodynamics.
5. Learn irreversible thermodynamics

OUTCOME

The students should be able to:

1. Availability analysis and thermodynamic properties.
2. Real gas behaviours and multi - component systems.
3. Chemical thermodynamics and equilibrium.
4. Statistical thermodynamics and it impact on various applications.
5. Irreversible thermodynamics and it's varied application.

UNIT I AVAILABILITY ANALYSIS AND THERMODYNAMICS PROPERTY RELATIONS 12

Reversible work, Availability, Irreversibility and Second-Law Efficiencyfor a closed System and Steady-State Control Volume. Availability Analysis of Simple Cycles. Thermodynamics Potentials, Maxwell relations, Generalised relations for changes in Entropy. Internal Energy and Enthalpy, Generalised Relations for Cp and Cv' Clausius Clayperon Equation, Joule-Thomson Coefficient, Bridgman Tables for Thermodynamics relations.

UNIT II REAL GAS BEHAVIOUR AND MULTI-COMPONENT SYSTEMS 12

Different Equations of State, Fugacity, Compressibility, Principles of Corresponding states, Use of generalised charts for enthalpy and entropy departure, fugacity coefficient,Lee-Kesler generalised three parameter tables. Fundamental property relations for systems of variable composition, partial molar properties, Real gas mixtures, ideal solution of real gases liquids, Activity, Equilibrium in multi phase systems, Gibbs phase rule for non-reactive components.

UNIT III CHEMICAL THERMODYNAMICS AND EQUILIBRIUM 12

Thermochemistry, First Law analysis of reacting systems, Adiabatic Flame temperature. Entropy change of reacting systems. Second Law analysis of reacting systems, Criterion for reaction equilibrium, Equilibrium constant for gaseous mixtures, evaluation of equilibrium composition, Chemical availability, Availability of reacting systems.

UNIT IV STATISTICAL THERMODYNAMICS 12

Microstates and Macrostates, Thermodynamic probability, Degeneracy of energy levels, Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein Statistics, Microscopic Interpretation of heat and work, Evaluation of entropy, Partion function, Calculation of the Macroscope properties from partition functions, Equilibrium constant statistical thermodynamics approach.

UNIT V IRREVERSIBLE THERMODYNAMICS 12

Conjugate Fluxes and Forces, Entropy Production, Onsager's Reciprocity relations, Thermo-electric phenomena, formulations, Power Generation, Refrigeration.

TOTAL : 60

REFERENCES

1. Kenneth Wark Jr., Advanced Thermodynamics for Engineers , McGraw-Hill Inc., 1995.
2. Bejan, A., Advanced Engineering Thermodynamics, John Wiley and Sons, 3rd Edition, 2006.
3. Holman, J.P. Thermodynamics, 4th edition, McGraw-Hill Inc., 4th Edition , 1988.
4. Smith, J.M. and Van Ness., H.C., Introduction to Chemical Engineering Thermodynamics, McGraw-Hill Inc., 6th Edition , 2007.
5. Sonntag, R.E., and Van Wylen, G, Introduction to Thermodynamics, Classical and statistical, Third Edition, John Wiley and Sons, 1991.
6. Sears, F.W. and Salinger G.I. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Third Edition, Narosa Publishing House, New Delhi, 1998.
7. Dehoff, R.T., Thermodynamics in Materials Science, McGraw-Hill, 1993.
8. Rao, Y.R.C., Postulational and Statistical Thermodynamics, Allied Publisher Limited, New Delhi, 1994.

PTE103 ADVANCED FLUID MECHANICS

L	T	P	C
4	0	0	4

GOAL

The goal of the programme is to provide advance concepts for ideal and non-ideal flows, to impart the knowledge of various types of flow like two dimensional flow, turbulent flow and compressible flow through ducts and to provide the details shock waves.

OBJECTIVES

The course should enable the students to:

1. Understand advance concepts for ideal and non-ideal flows.
2. Understand various types of flow like two dimensional flow, turbulent flow and compressible flow through ducts.
3. Understand the details of shock waves.

OUTCOME

The students should be able to:

1. Know advance concepts for ideal and non-ideal flows.
2. Get the knowledge of various types of flow like two dimensional flow, turbulent flow and compressible flow through ducts.
3. Know the details of shock waves.

UNIT I INTRODUCTION **12**

Ideal and non-ideal flows, general equations of fluid motion, Navier - stokes equations and their exact solutions. Boundary layer theory, wedge flows, laminar flow over plates and through cylinders.

UNIT II TWO DIMENSIONAL FLOW **12**

Subsonic flow, physical significance of irrotational motion - Kelvin's theorem - Differential equation in terms of velocity Potential and stream function - Flow with small purtubaration - flow past a wave shaped wall - Gothert's rule - Prandtl Glanert rule - Hodograph method

UNIT III TURBULENT FLOW **12**

Turbulence, models and flow equations: steady and unsteady turbulent boundary layers

UNIT IV COMPRESSIBLE FLOW THROUGH DUCTS **12**

Introduction to compressible viscous flow, governing equations, flow with friction flow with heat transfer flow though nozzle and diffusers

UNIT V SHOCK WAVE **12**

Normal and oblique shocks - Prandtl - Meyer expansion - Rankine - Hugnoit relation, Application of method of characteristics applied to two dimensional case - simple supersonic wind tunnel Design of supersonic wind tunnel and nozzle.

TOTAL: 60

REFERENCES

1. T Radhakrishnan - Gas Dynamics, Prentice Hall, New Delhi.
2. Mohanty A K- Fluid Mechanics, Prentice Hall of India, 1986
3. Shapiro A F -The Dynamics of Compressible flow Vol 1, The Ronald Press company 1963
4. Shames- Mechanics of Fluids, Megraw-Hill Inc
5. Schlichting H - Boundary layer theory, McGraw Hill-Inc
6. Yahya S.M, "Fundamentals of Compressible flow", New Age International (P) Ltd.New Delhi,1996.

PTE104 INSTRUMENTATION IN THERMAL SYSTEMS

L	T	P	C
4	0	0	4

GOAL

To provide the students with knowledge on various instrument and methods of measurement used in thermal engineering.

OBJECTIVES

The course should enable the students to:

1. Classify the measuring instruments and understand the type of errors as to arrive at the correct measurement.
2. Understand the use of microprocessors in measuring instruments.
3. Learn the methods of measuring the physical quantities
4. Gain knowledge about various flow visualization methods.
5. Learn the various measurement analysis techniques.

OUTCOME

The students should be able to:

1. Identifying the various measuring instruments and read error free measurement.
2. Use microprocessors as a part of measuring system.
3. Measuring various physical quantities with apt methods.
4. Various types of flow visualization methods
5. Various measurement analysis techniques for apt applications.

UNIT I MEASUREMENT CHARACTERISTICS 12

Instrument Classification,Characteristics of Instruments - Static and dynamic, Experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

UNIT II MICROPROCESSORS AND COMPUTERS IN MEASUREMENT 12

Data logging and acquisition, Use of intelligent instrument for error reduction, Elements of micro-computer interfacing, Intelligent instruments in use.

UNIT III MEASUREMENT OF PHYSICAL QUANTITIES 12

Measurement of thermo-physical properties, Instruments for measuring temperature pressure and flow, Use of intelligent instruments for the physical variables.

UNIT IV FLOW VISUALISATION 12

Techniques, Shadow graph, Schileren, interferometer, Laser Doppler anemometer, Heat flux measurement, Telemetry in engines.

UNIT V MEASUREMENT ANALYSIS **12**

Chemical,. Thermal, Magnetic and Optical gas analysers, Measurement of smoke, dust and moisture, Gas Chromatography, Spectrometry, Measurement pf pH, Review of basic measurement techniques.

TOTAL : 60

REFERENCES

1. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 7th Edition , 2008..
2. Barney, Intelligent Instrumentation, Prentice Hall of India, 1988.
3. Prebrashensky. V., Measurement and Instrumentation in Heat Engineering, Vol.1 and 2 MIR Publishers, 2nd Edition, 1988.
4. Raman, C.S. Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw-Hill, New Delhi, 2009.
5. Doeblin, Measurement System Application and Design, McGraw-Hill, 1978.
6. Morris. A.S, Principles of Measurements and Instrumentation Prentice Hall of India, 1998.

PIC101 COMBUSTION IN ENGINES

L	T	P	C
4	0	0	4

GOAL

To provide the students with the understanding of the significance of various process in IC. Engines.

OBJECTIVES

The course should enable the student to:

1. Develop knowledge in various cycles, such as otto, diesel Stirling and brayton cycles.
2. Understand the combustion process in engines.
3. Learn about the basic concepts of engine simulation.
4. Learn advances in I.C. engines.
5. Know about various electronics used in engines.

OUTCOME

The students should be able to:

1. Compare with various cycles with actual cycles..
2. Be familiar with combustion reactions and stoichiometry.
3. Optimize the concepts of engine simulation governing equations.
4. Evaluate performance and emission characteristics of engines
5. Apply appropriate electronic system in engine to needs.

UNIT I COMBUSTION PRINCIPLES **12**

Thermodynamics, Concepts of Combustion - Combustion equations, Heat of combustion: Theoretical flame temperature, Chemical equilibrium and dissociation.

UNIT II CHEMICAL KINETICS **12**

Theories of Combustion, Pre-flame reactions, Reaction rates, Laminar and Turbulent Flame propagation in Engines.

UNIT III COMBUSTION IN S.I. ENGINES **12**

Initiation of combustion, Flame velocities, Normal and Abnormal combustion, Knocking combustion, Pre-ignition, Knock and engine variables, Features and design consideration of combustion chambers, Stratified charge combustion, Concepts of lean burn engines, Heat release correlations.

UNIT IV COMBUSTION IN C.I. ENGINES **12**

Various stages of combustion, Vaporization of fuel droplets and spray formation, Air motion, Sswirl, Squish, Tumble flow, Velocities, Swirl measurement, Delay period correlations, Diesel knock and engine variables, Features and design considerations of combustion chambers, Heat release correlations.

UNIT V COMBUSTION IN GAS TURBINE **12**

Flame stability, Re-circulation zone and requirements. Combustion chamber configuration, materials.

TOTAL: 60

TEXT BOOKS

1. Ganesan, V, Internal Combustion Engines, Tata McGraw Hill Book Co., 1995.
2. John B.Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Book, 1998

REFERENCES

1. Ramalingam,K.K., Internal Combustion Engines, Scitech Publications (India) Pvt. Ltd., 2000.
2. Mathur,M.L.,and Sharma, R.P., A Course in Internal Combustion Engines,hanpat Rai Publications Pvt. New Delhi-2, 1993.
3. Obert,E.F., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 1983.
4. Cohen,H, Rogers,G,E.C, and Saravanamuttoo, H.I.H., Gas Turbine Theory, Longman Group Ltd., 1980.

SEMESTER - II (THEORY)
PIC201 ALTERNATIVE FUELS FOR IC ENGINES

L	T	P	C
4	0	0	4

GOAL

To provide the students with the knowledge of alternate fuels and the changes in the engine design and to understand various energy systems for use in the automobiles.

OBJECTIVES

The course should enable the student to:

1. Gain knowledge of various alternate fuels.
2. Understand properties, performance and emission characteristics of Alcohols.
3. Know about Natural gas, LPG, hydrogen and biogas.
4. Study in depth of various vegetable oils used for engines.
5. Know about Electric vehicle.

OUTCOME

The students should be able to:

1. Apply various alternate fuels appropriately to the needs.
2. Learn in details about methanol and ethanol usage, storage, chemical structure , pros and cons.
3. Be acquainted with the knowledge of natural gas, LPG, hydrogen and biogas.
4. Evaluate the performance characteristics of various vegetable oils.
5. Be familiar with electric and hybrid vehicles.

UNIT I FUELS **12**

\Availability and Suitability to Piston Engines, Concept of conventional fuels, Potential alternative fuels - Ethanol, Methanol, DEE/DME - Hydrogen, LPG, Natural gas, Producer gas, Bio gas and Vegetable oils - Use in I.C.Engines - Merits and Demerits of various fuels.

UNIT II ALCOHOL FUELS **12**

Properties as engine fuels - Performance in S.I.Engines - Alcohol & Gasoline blends - Flexible Fuel Vehicle - Reformed alcohols - Use in C.I.Engines - Emulsions - Dual fuel systems - Spark assisted diesel engines - Surface ignition engines - Ignition accelerators - Manufacture of alcohol fuels.

UNIT III GASEOUS FUELS **12**

Hydrogen - Properties - Use in C.I.Engines - Use in S.I.Engines - Storage methods - Safety precautions - Production methods, Producer gas and bio gas - Raw materials - Gasification - Properties - Cleaning up the gas - Use in S.I. and dual fuel engines, LPG & CNG - Properties - Use in S.I. and C.I.Engines.

UNIT IV VEGETABLE OILS **12**

Types - Properties - Biodiesel Esterification - Performance in Engines

UNIT V LUBRICATION FOR ALTERNATIVE FUELS **12**

Concept of Lubrication and Conventional Lubricants - Properties - Effect of Lubricants for alternate fuels on Lubricants and its effects.

TOTAL : 60

TEXT BOOKS

1. Osamu Hirao and Richard K.Pefley, Present and Future Automotive Fuels, John Wiley and Sons, 1988.
2. SAE Fuels Hand Book.

PIC202 ELECTRONIC ENGINE MANAGEMENT SYSTEM

L	T	P	C
4	0	0	4

GOAL

To impart knowledge in various engine control systems.

OBJECTIVES

The course should enable the students to:

1 Understand the automotive instruments and sensors.

2 Understand the measurement of engine parameter by using sensor.

3 Understand the working Electronic Ignition System.

4. Understand the Principles of Digital Control systems

5 Understand the application of on board diagnosis.

OUTCOME

The students should be able to:

1. Describe the sensor classification and sensor product selection guide and measurements of automotive sensors.
2. Describe the working of Pressure, position, flow, temperature, humidity, speed, acceleration, oxygen, torque, light, distance and level.
3. Differentiate the electronic fuel injection system in SI and CI engines and describe the advantages of using direct fuel injection over the indirect fuel injection system.
4. Describe the advantages of electronic ignition system over the conventional ignition system.
5. Describe the algorithms for digital controllers.

UNIT I SENSORS **12**

Types - Air flow, Pressure, Temperature, Speed Oxygen, Detonation, Position - Principle of operation, Arrangement and material.

UNIT II GASOLINE INJECTION SYSTEM **12**

Open loop and closed loop systems, Mono point, Multi point and Direct injection systems - Principles and Features, Bosch injection systems.

UNIT III DIESEL INJECTION SYSTEM **12**

Inline injection pump, Rotary pump and injector - Construction and principle of operation, Common rail and unit injector system - Construction and principle of operation.

UNIT IV IGNITION SYSTEMS **12**

Ignition fundamentals, Types of solid state ignition systems, High energy ignition distributors, Electronic spark timing and control.

UNIT V ENGINE MAPPING **12**

Combined ignition and fuel management systems. Digital control techniques - Dwell angle calculation, Ignition timing calculation and Injection duration calculation. Hybrid vehicles and fuel cells.

TOTAL: 60

TEXT BOOKS

1. Bosch Technical Instruction Booklets.
2. Tom Denton, Automotive Electrical and Electronic Systems, Edward Amold,1995.

REFERENCES

1. Robert N.Brady, Automotive Computers and Digital Instrumentation, Prentice Hall,1988.
2. Duffy Smith, Auto Fuel Systems, The god Heart Willcox Company Inc., Publishers, 1987.
3. Heinz Heisler, Advanced Engine Technology. SAE Publications, 1995.

PIC203 ENGINE POLLUTION AND CONTROL

L	T	P	C
4	0	0	4

GOAL

To make the students to realize the impact of automobile emissions on the environment and expose student to factors affecting the formation and control of automobile pollutants.

OBJECTIVES

The course should enable the students to :

1 Understand effect of vehicle population and emitted pollutants on human health and environment and various types of emissions.

2 Understand the formation mechanism of various types of pollutants from SI and CI engines.

3 Conceive the significance of emission control methods.

4. Understand the construction and working of emission measuring instruments.

5. Be familiar with emission standards and test procedures.

OUTCOME

The students should be able to :

1. Analyse the impact of vehicle population on pollution and the effects HC, CO, CO2, NOX, smoke, particulates, lead and aldehydes on health and environment.

2. Describe the effects of transient operation of vehicle on emissions and types of emissions. Describe the formation mechanism of HC, CO, CO2, NOX, smoke, particulates and aldehydes in SI and CI engines.

3. Comprehend the factors that lead to global warming and the issues. Analyse the design and operating parameters on emissions. Describe about noise pollution, measurement and control.

4. Aware of US, Euro, Japan and Indian emission norms, standards CVS sampling and test procedures. Analyse in-cylinder emission control methods such as EGR, air injection, fuel modifications, water injection, ignition and injection timing.

5. Describe engine-out emission control method such as thermal reactors and catalytic converters. Describe the construction and working of emission measuring instruments such as NDIR, FID, smoke meters Chemiluminiscent analyser and gas chromatograph. Differentiate between two stroke and four stroke engine pollutions.

UNIT I POLLUTANT FORMATION - ENGINES AND TURBINES 12

Atmospheric pollution from piston engines and gas turbines, Global warming. Formation of oxides of nitrogen, Carbon monoxide, Hydrocarbon, aldehydes and Smoke, Particulate emission, Effects of pollutions on environment.

UNIT II POLLUTION MEASUREMENT 12

Non dispersive infrared gas analyzer, Gas chromatography, Chemiluminescent analyzer and flame ionization detector, Smoke measurement, Noise pollution, Measurement and control.

UNIT III POLLUTION CONTROL - IN CYLINDER METHODS 12

Engine component, Fuel modification, Evaporative emission control, EGR, Air injection, Water Injection, Application of microprocessor in emission control.

UNIT IV POLLUTION CONTROL AFTER TREATMENT 12

Thermal reactors, Catalytic converters, & Particulate Traps

UNIT V CYCLES AND EMISSION STANDARDS 12

Use of driving cycles for emission measurement, Chassis dynamometer, CVS system, National and International emission standards.

TOTAL : 60

REFERENCES

1. Crouse William, Automotive Emission Control, Gregg Division /McGraw-Hill. 1980
2. Ernest,S., Starkman, Combustion Generated Air Pollutions, Plenum Press, 1980.
3. George, Springer and Donald J.Patterson, Engine emissions, Pollutant Formation and Measurement, Plenum press, 1972.
4. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 1980.

PIC204 INTERNAL COMBUSTION ENGINE DESIGN

L	T	P	C
4	0	0	4

GOAL

To make the students understand the design concept and principles of various engine components. These concepts and principles are familiarized for design of components.

OBJECTIVES

The course should enable the students to:

1. Know about various types of materials, properties of materials and various applications of the materials, and computer aided application.
2. Know about the fits, clearance and tolerances concepts, also the design of the helical springs.
3. know about design procedure to design piston and its parts, cylinder and cylinder block, lubrication of piston assembly.
4. Understand the designing the parts of connecting rod and crankshaft, know about the materials of connecting rod and crankshaft, and also know about the balancing of crankshaft.
5. Understand the design aspects of Inlet and exhaust valves, valve mechanism, and also the materials for the valves.

OUTCOME

The students should be able to:

1. Know about the types of materials and material properties, Application of the materials, CAD application in the Automobile industry and Differentiate between the concepts of Fits, Clearance and Tolerance.
2. Design the helical springs and its application. The cylinder block and cylinder parts based on the engine specification of and also based on the engine application and the piston and its parts based on the engine specification of and also based on the engine application.
3. Design the connecting rod and its parts based on the engine specification of and also based on the engine application. The crankshaft and its parts based on the engine specification of and also based on the engine application also with the balancing weight of the crankshaft.

4. Design the valves and its mechanism for both the inlet and exhaust valve based on the engine specification of and also based on the engine application.

5. identify the different types of materials used for the manufacturing of the valve and its components.

UNIT I GENERAL CONSIDERATIONS IN ENGINE DESIGN 12

Principle of similitude, Choice of cycle, Speed, Fuel, Bore and Stroke, Cylinder arrangement, choice of material, Stress and Fatigue considerations, Design for manufacture, Factors for NHV and Control.

UNIT II DESIGN OF MAJOR COMPONENTS 12

Piston system, Connecting rod assembly, Crankshaft system, Valve gearing, Stress analyses.

UNIT III DESIGN OF OTHER COMPONENTS. 12

Inlet and exhaust manifolds, Cylinder block, Cylinder liner, Cylinder head, Crankcase, Engine foundations and mountings, Gaskets, Bearings, Flywheel. Turbocharger, Supercharger, computer controlled fuel injection system.

UNIT IV DESIGN OF TWO-STROKE ENGINES 12

Arrangement and sizing of ports, Piston assembly, Intake and exhaust system, Scavenging, application to automotive gasoline and marine diesel engines.

UNIT V CONCEPTS OF COMPUTER AIDED DESIGN 12

Preparation of working drawings of designed components using CAD system.

TOTAL : 60

REFERENCES

1. Gordon P.Blair, Basic design of Two-stroke Engines, S.A.E., 1992.
2. Gordon P.Blair, Advanced Concepts of Two-stroke Engines, S.A.E., 1990.
3. Pounder, C.C., Marine Diesel Engines, Butterworths, 1981.
4. A.Kolchin and V.Demidov, Internal Combustion Engine Design, MIR Publishers, Moscow, 1984.
5. Gordon P.Blair, Design and Simulation of Four-Stroke Engines, Society of Automotive Engineers, Inc., USA, 1999.
6. D.E.Winterbone and R.J.Pearson, Design Techniques for Engine Manifolds, Wave action methods for I.C.Engines, Professional Engineering Publishing Ltd., UK, 2000.
7. John Fenton (Editor), Gasoline Engine Analysis for Computer Aided Design, Mechanical Engineering Publishing Ltd., UK, 1986.
8. Rodica Baranescu and Bernard Challen (Editors), Diesel Engine Reference Book, Second Edition, Society of Automotive Engineers, Inc., USA, 1999.
9. SAE Special Publication SP-700, Adiabatic Engines and Systems, Society of Automotive Engineers, Inc., USA, 1987.

PIC251 ENGINE DESIGN LAB

L	T	P	C
0	0	3	2

GOAL

To make the students to understand the design and calculations of gear box assembly, clutch assembly and bearing loads by using various drafting software like Pro-E, Catia etc.

OBJECTIVES

The course should enable the students to:

1. Understand the gear box assembly calculations by using drafting software like Catia.
2. Draw and calculate the clutch components assembly by using drafting software like Catia.
3. design and analysis the selection of bearing and calculation of bearing loads by using drafting software.
4. Know about the design of engine component piston.
5. Know about the design of engine component piston pin and piston ring.
6. Know about the design of engine component connecting rod and its components.
7. Know about the design of connecting rod.
8. Know about the design of flywheel.
9. Know about the design of inlet and exhaust valve.
10. Know about the design of cam,camshaft and the design of engine cylinder and cylinder block.

OUTCOME

The students should be able to:

1. Complete design of clutch components and Assembly drawing of clutch using drafting software.
2. Gear train calculations. Layout of gear box.
3. Calculate of bearing loads, Selection of bearings and Assembly drawing of gear box using drafting software.
4. Design and draw the piston, piston pin and piston rings as per the engine specification.
5. Design and draw the crank shaft components such as small end, big end, shank design, design of big end cap and bolt as per the engine specification.
6. Design and draw the crankshaft and the balancing weight as per the engine specification.
7. Design and draw the flywheel as per the engine specification.
8. Design and draw the IC engine valve for both inlet and exhaust as per the engine specification.
9. Design and draw the cam, cam shaft as per the engine specification.
10. Design the cylinder and cylinder block dimensions as per the engine specification.

EXPERIMENT

1. Students should design and develop model of Engine systems and validate the results.

TOTAL : 45

PIC252 INTERNAL COMBUSTION ENGINE LAB

L	T	P	C
0	0	3	2

GOAL

The students will be able to understand the list of the experiments and the various types of equipment.

OBJECTIVES

The course should enable the student to:

1. Understand the Working principle of hydraulic, electrical and eddy current dynamometers
2. Understand the Valve timing and port timing diagram
3. Understand the Importance of Performance Testing of IC Engines.

OUTCOME

The students should be able to:

1. Carryout the Experiment to determine the Performance of Various IC engines
2. Define the Engine Parameters and their effects over the Performance
3. Determine the P-θ and P-V Values.

PART - A PERFORMANCE TESTS **30**

1. Performance test on Spark Ignition engines using Alternate fuels such as ethanol and LPG.
2. Emission measurement in Spark Ignition and Compression Ignition Engines.
3. Performance test using pressure transducers in S.I. Engines.
4. Performance test using pressure transducers in C.I. Engines.
5. Performance test on variable compression ratio petrol and diesel engines.

PART - B SIMULATION STUDIES **15**

1. Simulation studies of Petrol and Diesel Engine Cycles.
2. Simulation of Gas Turbine Cycles
3. Simulation of Adiabatic flame temperature in constant volume heat addition process.
4. Simulation of Adiabatic flame temperature in constant pressure heat addition process.
5. CFD analysis for a fluid flow problem with heat transfer.

Note: The end semester examination shall be conducted in both Part - A and Part - B.

TOTAL : 45

EQUIPMENTS REQUIRED

1. Single cylinder / Multi cylinder petrol engine
2. Dynamometer suitable for the above

3. CO / HC / NOX Analysers
4. Smoke meter
5. Pressure transducers (0 -250 bar)
6. Pressure transducer with spark plug adaptor
7. Charge amplifier
8. AD controller with PC or FFT analyzer or CRO (dual beam)
9. Variable Compression ratio petrol and diesel engines
10. Pentium 4 with 1 GB ram - 15 Nos
11. CFD Packages / STAR CD / Fluents / CFX for 15 users.

SEMESTER - III (LAB)

PIC352 INDUSTRIAL TRAINING

L	T	P	C
0	0	4	2

Students should undergo Industrial visit to reputed Industrial visit for a period of 4 weeks (minimum) during the vacation period at the end of 2nd semester. Examination will be conducted along with the 3rd semester as a practical subjects. Students should prepare a Report and presentation seminar for the exam.

ELECTIVE COURSES

PAU706 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

GOALS

To introduce numerical modeling and its role in the field of heat transfer and fluid flow. To enable the students to understand the various discretization methods and solving methodologies. To create confidence to solve complex problems in the field of heat transfer and fluid dynamics by using high speed computers.

OBJECTIVES

The course should enable the students to:

1. Introduce numerical modelling and its role in the field of heat transfer and fluid flow.
2. Enable the students to understand the various discretisation methods and solving methodologies.
3. Create confidence to solve complex problems in the field of heat transfer and fluid dynamics by using high speed computers.

OUTCOME

The students should be able to:

1. Know the equations governing fluid flow and heat transfer.
2. Understand the process of converting the PDE to difference equations using various discretisation techniques.
3. Appreciate the tools available for solving the algebraic equations.
4. Appreciate the problems associated with discretisation of incompressible flow
5. Solve the practical problems associated with Fluid Flow and Heat Transfer using commercial software.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

Basics of computational fluid dynamics - Governing equations of fluid dynamics - Continuity, Momentum and Energy equations - Chemical species transport - Physical boundary conditions - Time-averaged equations for Turbulent flow - Turbulence -Kinetic -Energy Equations - mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

UNIT II DISCRETIZATION AND SOLUTION METHODOLOGIES 9

Methods of Deriving the Discretization Equations - Taylor Series formulation - Finite difference method - Control volume Formulation - Spectral method. Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

UNIT III HEAT CONDUCTION, CONVECTION AND DIFFUSION 9

Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems, Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, Upwind, Hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

UNIT IV CALCULATION OF FLOW FIELD 9

Representation of the pressure - Gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure - Correction equation, SIMPLE algorithm and its variants. Turbulence models: Mixing length model, Two equation (k-) models.

UNIT V APPLICATION AND ANALYSIS OF CFD 9

Case Studies: Thermal Analysis on flow of Lubrication, Fuel and Coolant Flow, Thermal analysis of Engine Compartment and extreme flow conditions

TOTAL : 45

TEXT BOOKS

1. Versteeg, H.K, and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Longman, 1998
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw-Hill Publishing Company Ltd., 1998.

REFERENCES

1. Patankar, S.V., "Numerical Heat Transfer and Fluid Flow", McGraw-Hill, 1980. Ane-Books2004 Indian Edition.
2. Muralidhar, K and Sundarajan .T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
3. Bose, T.K., "Numerical Fluid Dynamics", Narosa publishing House, 1997.
4. Muralidhar, K and Biswas "Advanced Engineering Fluid Mechanics", Narosa Publishing House, New Delhi, 1996.

5. Anderson, J.D., "Computational fluid dynamics - the basics with applications", 1995

5. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and Heat Transfer " Hemisphere Publishing Corporation, Newyork, USA, 1984.

PIC701 AUTOMOTIVE ENGINE SYSTEMS

L	T	P	C
3	0	0	3

GOAL

To make the students understand the different types of engines and its associated technologies.

OBJECTIVES

The course should enable the students to:

1. Know about various types of engines and its various parameters.
2. Know about concept of petrol and diesel injection.
3. know about the concept of fuel quality and its methods to determine it
4. Understand the various electrical and electronics system.
5. Understand the various emerging engine technologies.

OUTCOME

The students should be able to:

1. Know about the various types of engines and its applications, efficiency and other parameters.
2. Understand the concept of fuel injection , the various types of injection.
3. Know about the various methodologies to measure the various types of fuel qualities used in Engines.
4. Understand the various sensors, ignition system , batteries and other electrical and electronics components used in Engines.
5. Know about the recent and upcoming technologies in engine system.

UNIT I AUTOMOTIVE ENGINE TYPES **9**

Automotive Engine Types - On-highway, Off-highway, Gasoline, Diesel and Alternate Fuel. Characteristics of Automotive Engines - Power, Torque, Fuel Consumption, Pollutant Emissions, Thermal Efficiency, Life Cycle Cost.

UNIT II GASOLINE INJECTION **9**

Gasoline Injection - TBI and Multipoint Injection, Engine Management System, Catalytic Conversion of Engine Pollutants, Electrical Catalyst Heaters, Diesel Particulate Trapping and Trap Regeneration, GDI.

UNIT III FUEL QUALITY **9**

Fuel - Quality and Methods of Admission Fuel quality standards for Automotive Engines - Lead free gasoline, Low and Ultra - Low Sulphur diesels, LPG, CNG, Alcohols, Biodiesels, Gaseous Fuel Injections, Dual Fueling and Controls - CNG and Gasoline, Hydrogen and Diesel, Alcohols and Diesels etc.

UNIT IV ENGINE ELECTRONICS **9**

Engine electrical and Electronic systems - Engine sensors, Distributor less ignition and Direct ignition systems, 12V, Dual voltage and 42V systems.

UNIT V NEW ENGINE TECHNOLOGIES **9**

Current trends - Multi-valving, Tuned manifolding, camless valve gearing, variable valve timing, Turbo and supercharging - Waste gating, EGR, Part-load charge stratification in GDI systems.

TOTAL : 45

REFERENCES

1. Robert Bosch, GmbH, Automotive Hand Book, Germany, 2000.
2. Tom Denton, Automobile Electrical and Electronic Systems, SAE International USA, 2000.
3. Eric Chowanietz, Automobile Electronics, SAE International, 1995.
4. SAE Inc., Advanced Power Plant Concepts, SP - 1325, 1998.
5. Michae Plint and Anthony Martyr, Engine testing Theory and Practice (Second Edition) SAE International, 1999.
6. SAE Inc, Advancements in Electric and Hybrid Electric Vehicle Technology, SP - 1023, 1994.

PIC702 ENGINE AUXILLARY SYSTEMS

L	T	P	C
3	0	0	3

GOAL

To make the students understand the various allied and auxiliary systems used in engines.

OBJECTIVES

The course should enable the students to:

1. Know about the concept of carburation.
2. Know about the concept of gasoline injection and ignition systems.
3. Understand diesel fuel injection.
4. Understand the design and construction of various intake systems and its components.
5. Know about the various types and the concepts of lubrication and cooling system.

OUTCOME

The students should be able to:

1. Understand the concept of air fuel mixture and the various components in the carburetor
2. Understand the types of gasoline fuel injection , and the mechanism of ignition system.
3. Know about the various techniques involved in diesel fuel injection.
4. Understand the various design constraints and the types of intake and exhaust manifolds.
5. Understand the concept and various types of lubrication and cooling system.

UNIT I CARBURETION 9

Properties of air-petrol mixtures, Mixture requirements for steady state and transient operation, Mixture formation studies of volatile fuels, Design of elementary carburetor, Chokes, Effects of altitude on carburetion, Carburetor for 2-stroke and 4-stroke engines, Carburetor systems for emission control.

UNIT II GASOLINE INJECTION AND IGNITION SYSTEMS 9

Petrol Injection, Pneumatic and Electronic Fuel Injection Systems types. Ignition system requirements, Timing, Ignition Systems, Breaker mechanism and Spark plugs, Factors affecting energy requirement of the ignition system, Factors affecting spark plug operation, Electronic Ignition Systems.

UNIT III DIESEL FUEL INJECTION 9

Factors influencing fuel spray atomization, Penetration and Dispersion of diesel and heavy oils and their properties, Rate and duration of injection, Fuel line hydraulics, Fuel pump, Injectors.

UNIT IV MANIFOLDS AND MIXTURE DISTRIBUTION 9

Intake system components, Discharge coefficient, Pressure drop, Air filter, Intake manifold, Connecting pipe, Exhaust system components, Exhaust manifold and exhaust pipe, Spark arresters, Waste heat recovery, Exhaust mufflers, Type of mufflers, exhaust manifold expansion.

UNIT V LUBRICATION AND COOLING SYSTEMS 9

Lubricants, Lubricating systems, Lubrication of piston rings, Bearings, Oil consumption, Oil cooling. Heat transfer coefficients, liquid and air cooled engines, Coolants, Additives and lubricity improvers, Concept of adiabatic engines.

TOTAL : 45

REFERENCES

1. Ramalingam,K.K, Internal Combustion Engine, Scitech Publication (India) Pvt.Ltd.2000.
2. Domkundwar, V.M, A Course in Internal Combustion Engines, Dhanpat Rai and Co., 1999.
3. Mathur,M.L., and Sharma,R.P., A Course in Internal Combustion Engines, Dhanpat Rai Publications (P) Ltd., 1998.
4. Ganesan, V., Internal Combustion Engines, Tata McGraw-Hill Book Co., 1995.

5. Duffy Smith, Auto Fuel Sytstems, The Good Heart Willcox Company Inc., Publishers, 1987.

6. Edward F, Obert, Internal Combustion Engines and Air Pollution, Intext Education Publishers, 1980.

PIC703 GAS TURBINES

L	T	P	C
3	0	0	3

GOAL

To make the students understand the importance of gas turbines.

OBJECTIVES

The course should enable the student to:

1. Know about the power plant cycles.
2. Know about the different types of compressors.
3. Understand the velocity diagrams and blade design principles of the turbine.
4. Understand the different types and flow pattern in the combustors.
5 Know the matching procedure of power plant components.

OUTCOME

The students should be able to:

1. Describe the power plant cycles for stationary and aircraft applications.
2. Describe centrifugal axial flow compressors momentum and energy transfer in rotors.
3. Design the blade in radial flow turbine.
4. Describe the material requirement and cooling system in combustors.
5. Analyse the engine off-design performance.

UNIT I INTRODUCTION **9**

Power plant cycles for stationary and aircraft applications, Component behaviors, Analysis of ramjet, Turbojet and turbo-propeller. Inlets and nozzles.

UNIT II COMPRESSORS **9**

Centrifugal and axial flow compressors momentum and energy transfer in rotors, Velocity diagrams, Stage performance, Compressibility effects, Cascade testing and characteristics.

UNIT III AXIAL AND RADIAL FLOW TURBINE **9**

Stage velocity diagrams, Reaction stages, losses and coefficients, Blade design principles, materials, Testing and performance characteristics.

UNIT IV COMBUSTORS **9**

Different types and flow pattern, Material requirement and cooling systems, Air pollution and reduction.

UNIT V MATCHING **9**

Matching procedure of power plant components, Engine off-design performance.

TOTAL : 45

REFERENCES

1. Cohen, H., Rogers, G.E.C., and Saravanamuttoo, H.I.H., Gas Turbine Theory, Longman Group Ltd, 1989.
2. Gordon C, Dates, Aero-thermodynamics of Gas Turbine and Rocket Propulsion - AIAA Education Series, NY 1984.
3. Kerrebrock, J.L., Aircraft engines and gas turbines, The MIT Press.
4. Yahya, S.H., Turbines, Compressors and Fans, Tata McGraw-Hill, 1983.
5. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker, Inc., USA, 1992
6. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachinery, Pergamon Press, 1978.

PIC704 JET AND ROCKET PROPULSION

L	T	P	C
3	0	0	3

GOAL

To impart knowledge to the students on compressible flow through ducts, jet propulsion and space propulsion.

OBJECTIVES

The course should enable the students to:

1. Understand advances in aviation and space Transportation are linked to
2. Understand the aero-thermodynamics of Jet propulsion subsystems
3. Understand the performance of Rocket vehicles.
4. Understand the performance characteristics of nozzles, rocket heat transfer and liquid propellant rocket performance.
5. Understand the combustion and expansion of chemical rocket propellant.

OUTCOME

The students should be able to:

1. A detailed analysis of the ideal thermodynamics cycles for ramjet, scramjet, turbojet turbofan and turboprop engine is presented

2. Define the key fundamental terms and equations used for determining rocket operation.
3. Calculate problems about total impulse, mass flow, specific impulse, thrust chamber and nozzle design, flight performance.
4. Analyze general chemical rocket propellant performance and formulate optimals performance of rocket propulsion.
5. Discuss and apply applicable liquid rocket fundamentals including propellants, combustion principles, component and general systems design.

UNIT I THERMODYNAMICS OF AIRCRAFT JET ENGINES 9

Theory of Jet Propulsion - Thrust and efficiency - Ram Jet - Turbojet and Turbofan engines - Turboprop and Turboshaft Engines - Thrust augmentations - Typical engine performance - Engine - Aircraft matching, Fuels.

UNIT II AERO-THERMODYNAMICS OF JET PROPULSION SUBSYSTEMS 9

Subsonic inlets - Supersonic inlets - Gas turbine combustors - After burners and Ramjet Combustors - Supersonic Combustion - Exhaust Nozzles, Cryogenic Engines.

UNIT III PERFORMANCE OF ROCKET VEHICLES 9

Static performance - Vehicle acceleration - Chemical rockets - Electrical rocket vehicles - Space missions.

UNIT IV CHEMICAL ROCKET THRUST CHAMBERS 9

Performance Characteristics - Nozzles - Rocket Heat Transfer - Liquid Propellant Rocket Performance.

UNIT V CHEMICAL ROCKET PROPELLANT COMBUSTION & EXPANSION 9

Liquid propellants - Equilibrium composition - Non equilibrium expansion - Solid and Liquid Propellant Combustion Chambers - Combustion Instabilities.

TOTAL : 45

REFERENCES

1. Philip G. Hill and Carl R.Peterson, Mechanics and Thermodynamics of Propulsion, Second Edition, Addition - Wesley Publishing Company, New York, 1992.
2. Zucrow N.J. Principles of Jet Propulsion and Gas Turbines, John Wiley and Sons Inc, New York, 1970.
3. Zucrow N.J. Aircraft and Missile Propulsion , Vol. I and Vol. II, John Wiley and Sons Inc, New York, 1975.
4. Bonney E.A. Zucrow N.J. Principles of Guided Missile Design, Van Nostranc Co., 1985.
5. S.M.Yahya, Gas Dynamics and Jet Propulsion.

PIC705 MANUFACTURING AND TESTING OF I.C. ENGINES AND COMPONENTS

L	T	P	C
3	0	0	3

GOAL

To make the students to realize and understand various manufacturing processes like forming, milling, casting and moulding involved in production of automotive components.

OBJECTIVES

The course should enable the students to:

1 Understand the powder metallurgy manufacturing process.

2. Understand the forming process in which various automotive components , manufacturing process.

3. Understand the casting & machining process in which various automotive components manufacturing process.

4. Understand the various gear manufacturing process.

5 Understand recent trends in automotive manufacturing process.

OUTCOME

The students should be able to:

1. Process flow chart , Production of metal powders and Manufacturing of friction lining materials for clutches and brakes as well as Testing and inspection of PM parts.

2. Various Forging process of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles.

   Various extrusion process of manufacturing transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets.

   Various Hydro forming Process of manifold, tail Lamp housing. , auto body panels

3. Various casting process of cylinder block , liners ,flywheel, piston rings, bearing bushes and liners, piston, carburetor and other small auto parts.

   Various Machining process of connecting rods, crank shafts, cam shafts, pistons, piston pins, piston rings, valves, front and rear axle housings , flywheel , Honing of cylinder bores, copy turning and profile grinding machines.

4. Various Gear Manufacturing process like milling, Hobbing and shaping Gear finishing and inspection process.

5. Various process like Powder injection moulding - Shot peen hardening ,Production of aluminum MMC, Plasma spray coating, Squeeze casting ,aluminum composites.

UNIT I CYLINDER BLOCK AND CYLINDER HEAD **9**

Casting practice and special requirements, Materials, Machining, Methods of testing, Cylinder liners - Mat, Types and Manufacture.

UNIT II PISTON ASSEMBLY **9**

Types, requirements, Casting, Forging, Squeeze casting, Materials, Machining, Testing, manufacture piston rings - Material, Types and manufacture - Surface treatment, Bimetallic pistons, Articulated pistons.

UNIT III DRIVE SYSTEMS **9**

Requirements, Materials, Forging practice, Machining, Balancing of crankshaft, Testing, CR, CS, CAS, VT.

UNIT IV COMPUTER INTEGRATED MANUFACTURING **9**

Integration of CAD, CAM and Business functions CIM- Networking, CNC programming for machining of I.C.Engines Components.

UNIT V QUALITY AND TESTING **9**

SPC - Introduction to ISO 9000, ISO 14000, TS 16949, its importance, BIS codes for testing various types of engines, Equipments required, Instrumentation, Computer aided engine testing, metrology for manufacturing I.C.Engine Components, In situ measurement - Telemetry and sensors.

TOTAL : 45

REFERENCES

1. Grover, M.P., CAD/CAM, Prentice Hall of India Ltd., 1985.
2. Heldt, P.M., High speed internal combustion engines, Oxford & IBH Publishing Co., 1960.
3. Judge, A.W., Testing of high speed internal combustion engines, Chapman & Hall., 1960.
4. Richard, W., Heine Carl R. Loper Jr. and Philip, C., Rosenthal, Principles of Metal Casting, McGraw-Hill Book Co., 1980.
5. IS: 1602 - 1960 Code for testing of variable speed internal Combustion engines for Automobile Purposes, 1966.
6. SAE Handbook, 1994.
7. P.Radhakrishnan and S.Subramaniayn, CAD/CAM/CIM, New Age International (P) Limited, Publishers, 1997.
8. Mikett P.Groover, Automation, production Systems and Computer - Integrated Manufacturing Printice Hall of India Private Limited, 1999.

PIC706 MARINE DIESEL ENGINES

L	T	P	C
3	0	0	3

GOAL

Impart knowledge in marine engines.

OBJECTIVES

The course should enable the student to:

1. Know about the fundamentals of sub marine diesel engine.
2. Know about the mechanics oof marine engines.
3. Understand the procedures for testing, instrumentation and control engines.
4. Understand the system of modern marine propulsion.
5. Know the system of fuel, cooling and lubrication.

OUTCOME

The students should be able to:

1. Describe the submarine engine system and basic performance factors.
2. Describe dynamics of crank gear, engine vibration and design aspects of Marine diesel engine system.
3. Analyse the marine engine control system.
4. Describe the typical modern marine propulsion engine system.
5. Analyse the starting and reversing gears of marine diesel engines.

UNIT I MARINE DIESEL ENGINE FUNDAMENTALS 9

Theory of Engine Operation; Engine Operating Cycles; Power Economy and basic performance factors; Supercharging and Scavenging Systems for 2 stroke and four-stroke cycle engines, Submarine Engine Systems.

UNIT II MECHANICS OF MARINE ENGINES 9

Dynamics of crank gear, Engine Vibration, Design aspects of Marine Diesel Engine Systems, Speed governors and miscellaneous accessory equipment.

UNIT III INSTRUMENTATION AND CONTROL OF ENGINES 9

Automatic instruments and remote control of marine engines, Testing of Marine Diesel Engines, Standard codes of test procedures, Rating of engines.

UNIT IV TYPICAL MODERN MARINE PROPULSION ENGINE SYSTEMS 9

M.A.N - B & W, Pielstick etc.

UNIT V MARINE ENGINE AUXILIARY SYSTEMS **9**

Starting and reversing gears of Marine Diesel Engines, Fuel system, Cooling system, Lubrication system.

TOTAL : 45

REFERENCES

1. The Running and Maintenance of the Marine Diesel Engine, John Lamb, Charles Griffin and Company Ltd., U.K., (Sixth Edition), 1976.
2. Marine Diesel Engines,C.C. Pounder. Newnes - Butterworths, UK, (Fifth Edition),1981.
3. Marine Internal Combustion Engines, N.Petrovsky, Translation from Russian by Horace E. Isakson,MIR Publishers, Mascow,1974.
4. Pounder's Marine Diesel Engines, Doug Woodyard (Editor), Butterworth-Heinemann, UK (Seventh Edition), 1998
5. Pounder's Marine Diesel Engines, C.T.Wilbur and D.A.Wight, Butterworth-Heinemann, UK (Sixth Edition), 1991.
6. Industrial and Marine Fuels Reference Book, George H.Clark, Butterworth-and Company,(Publishers) Ltd. U.K., 1998.

PIC707 SIMULATION OF IC ENGINES

L	T	P	C
3	0	0	3

GOAL

To understand combustion phenomenon inside the cylinder and its computer simulation.

OBJECTIVES

The course should enable the student to:

1. Understand the C/H/N/O system, flame temperature, the different types of reaction occurring in an engine, while combustion.
2. Understand the simulation in an SI engine with fuel air as working medium.
3. Know about how the pressure is being getting developed in an engine.
4. Understand the simulation of a 2 stroke engine.
5. Understand the simulation in an CI engine with fuel air as working medium.

OUTCOME

The students should be able to:

1. Know about the heat of reaction in an engine.
2. Know about how the complete combustion occurring in an engine.
3. Know about the adiabatic flame temperature for constant volume and constant pressure process for combustion.
4. Know the deviation between an actual and an air standard cycle of an IC engine.
5. Know the concept of fuel vaporization and its effect in the performance of an engine during combustion.
6. Know the working of an engine during part-throttle and full throttle condition.
7. Know the concept of progressive combustion, gas exchange process during combustion.
8. Know how the computer coding is done to understand the concept of combustion in an IC engine.
9. Know about the simulation in a 2 stroke engine such as scavenging.
10. Know the main difference between an SI and CI engine, and to know about the heat transfer and gas exchange process.

UNIT I INTRODUCTION **9**

Simulation principles - Simulation exercises using computers. Validation of models.

UNIT II COMBUSTION PROCESS - GENERAL **9**

Heat of reaction - Adiabatic flame temperature - Temperature change due to fuel vaporization

UNIT III COMBUSTION AND HEAT TRANSFER IN ENGINES **9**

Combustion in diesel engines - Heat transfer in engines - Heat transfer correlations.

UNIT IV C.I. AND S.I. ENGINE SIMULATION **9**

Simulation of Otto cycles under full load and part load and supercharged conditions.

UNIT V TWO STROKE ENGINE SIMULATION **9**

Engine and Porting geometry, Gas flow, Scavenging.

TOTAL : 45

REFERENCES

1. Ashley S. Campbell, Thermodynamic Analysis of Combustion Engines, John Wiley and Sons, 1980.
2. V.Ganesan, Computer Simulation of Spark Ignition Engine Processes, Universities Press, 1995.
3. V.Ganesan, Computer Simulation of Compressed Ignition Engine Processes, Universities Press, 2002..

4. Gordon P. Blair, The Basic Design of two-Stroke engines, SAE Publications, 1990.

5. Horlock and Winterbone, The Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol. I & II, Clarendon Press, 1986.

6. J.I.Ramos, Internal Combustion Engine Modeling, Hemisphere Publishing Corporation, 1989.

7. J.N.Mattavi and C.A.Amann, Combustion Modeling in Reciprocating Engines, Plenum Press, 1980.

PIC708 SPECIALITY ENGINES

L	T	P	C
3	0	0	3

GOAL

To impart knowledge in development of engine technologies.

OBJECTIVES

The course should enables the students to:

1. Penetrate deep into engine classification, construction and operation of IC engines with latest technologies
2. Grasp the importance SI and CI engine application in automobiles
3. Understand the performance parameters and testing methodologies.
4. Understand the necessity of Ignition system SI engines
5. Understand the combustion process for both SI and CI engines, the concepts of Governors, Fuel pump, Fuel Injectors.
6. Understand the trends in power plants in military and combat vehicles, the Suspension brakes and safety of heavy vehicles, the vehicle operation and control of farm vehicles and the vehicle automated tracks.

OUTCOME

The students should be able to:

1. Describe SI and CI engine system application in automobiles.
2. Grasp the basic engine terminologies
3. Differentiate the fuel dynamics for SI and CI engines and define the key terms such as carburetion, stoichiometric ratio, etc.,
4. Design combustion chambers for diesel engines with reference to variable compression ratios
5. Analyze the air dynamics within the combustion chamber and determine the performance characteristics for both SI and CI engines theoretically.

6. Describe the working of drive line in combat vehicles and earth moving vehicles compared with commercial vehicles and describe the working of power trains in heavy vehicles and able to analyse the ride characteristics of tractors.

UNIT I INTRODUCTION **9**

The design features of Automotive, Locomotive, Marine, Stationary and Generator-set engines.

UNIT II S.I. ENGINE SYSTEMS **9**

Spark ignition engine system variants - Stoichiometric, Lean-burn, port injected/direct injected, Carburetted, Air assisted fuel injection engines, HEV Engines. Illustrations - Honda CVCC, Toyota Prius, Orbital Engine etc. Rotary Piston Engines, Dedicated alternative fueled engine systems - CNG, LPG, H_2, Alcohols, Stirling cycle.

UNIT III C.I. ENGINE SYSTEMS **9**

Compression ignition engine system variants - Low, Medium and High speed system characteristics, High pressure fuel injection systems, Homogeneous Charge Compression Ignition systems, Dual and dedicated alternate fueled engine systems, Coal and producer gas fueled engine systems, Cogeneration system, Total engine systems.

UNIT IV SPECIAL PURPOSE ENGINE SYSTEMS **9**

Engines for special applications -Mining Defence, Off-highway - Tractor, Bulldozer etc. Submarines, Race car engine systems, Flexible fueled systems.

UNIT V LIFE CYCLE ANALYSES OF ENGINE SYSTEMS **9**

Life cycle cost.

TOTAL : 45

REFERENCES

1. The Warnkel Engine, Design, Development, Application,Jan P.Norbye, Chilton Book Company, USA,1971.
2. Introduction to Internal Combustion Engines, Richard Stone, Third Edition, Society of Automotive Engineers, Inc,USA, 1999.
3. Diesel Engine Reference Book, Bernard Challen and Rodica Baranescu (Editors) 2ns Edition, R - 183, SAE International , 1999.
4. Some Unusual Engines, L.J.K. Setright, Mechanical Engineering Publication Ltd., UK, 1975.
5. The Wankel R C Engine, R.F.Ansdale, A.S.Barnes & Co.,USA, 1969.
6. Bosch Technical Instruction Booklets, Robert Bosch GmbH, Germany, 1985.

PIC709 SUPERCHARGING AND SCAVENGING

L	T	P	C
3	0	0	3

GOAL

Enable the students to know about the effect and performance of engines

OBJECTIVES

The course enables the students to:

1. Understand the purpose of using supercharging.
2. Understand the various types in supercharger.
3. Understand the concept of scavenging in two stroke engines.
4. Understand the design concept of ports and mufflers
5. Understand the experimental methods for scavenging.

OUTCOME

The students should be able to:

1. Describe the effects on engine performance and engine modification.
2. Describe the various types of compressors and blowers
3. Know the classification of scavenging systems and charging processes in two stroke engines.
4. Design of intake and exhaust systems.
5. Analyze the experimental techniques for evaluating scavenging and port flow characteristics.

UNIT I SUPERCHARGING **9**

Objectives - Effects on engine performance - engine modification required Thermodynamics of Mechanical Supercharging and Turbocharging - Turbocharging methods - Engine exhaust manifolds arrangements.

UNIT II SUPERCHARGERS **9**

Types of compressors - Positive displacement blowers - Centrifugal compressors - Performance characteristic curves - Suitability for engine application - Surging - Matching of supercharger compressor and Engine - Matching of compressor, Turbine, Engine.

UNIT III SCAVENGING OF TWO STROKE ENGINES **9**

Peculiarities of two stroke cycle engines - Classification of scavenging systems - Mixture control through Reed valve induction - Charging Processes in two stroke cycle engine - Terminologies - Shankey diagram - Relation between scavenging terms - scavenging modeling - Perfect displacement, Perfect mixing - Complex scavenging models.

UNIT IV PORTS AND MUFFLER DESIGN **9**

Porting - Design considerations - Design of Intake and Exhaust Systems - Tuning.

UNIT V EXPERIMENTAL METHOD **9**

Experimental techniques for evaluating scavenging - Firing engine tests - Non firing engine tests - Port flow characteristics - Kadenacy system - Orbital engine combustion system.

TOTAL : 45

REFERENCES

1. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 1980.
2. Richard Stone, Internal Combustion Engines, SAE, 1992.
3. Vincent,E.T., Supercharging the I.C.Engines, McGraw-Hill. 1943
4. Watson, N. and Janota, M.S., Turbocharging the I.C.Engine, MacMillan Co., 1982.
5. Schweitzer, P.H., Scavenging of Two Stroke Cycle Diesel Engine, MacMillan Co., 1956
6. John B.Heywood, Two Stroke Cycle Engine, SAE Publications, 1997.

PIC710 MICROCONTROLLERS AND MICRO ELECTRONICS FOR I.C. ENGINE APPLICATIONS

L	T	P	C
3	0	0	3

GOAL

To make the students to understand the instruments involved in measurement of various automotive parameters and a basic knowledge on embedded systems.

OBJECTIVES

The course should enable the student to:

1 Understand measurement characteristics.
2. Understand the working of automotive instruments.
3. Know about the measurement analysis.
4. Understand the working of embedded systems.
5. Understand the working of real time operating system(RTOS)

OUTCOME

The students should be able to:

1. Describe the classification of instrument and characteristics of instruments and the static and dynamic analysis, experimental error analysis, and statistical analysis.
2. Describe the working of modern automotive instrumentation and computerized instrumentation system.

3. Describe the measurements of fuel quantity, coolant temperature, oil pressure, vehicle speed and the working of display devices and information system and the operation of onboard and off board diagnostics , occupant protection system and warning system

4. Describe the working of gas analyzers, smoke tester, gas chromatography and spectrometry and the measurement of pH and review of basic measurement techniques.

5. Describe the working of serial communication using i2c,CAN,USB buses and parallel communication using ISA,PCI and the basics of basic concepts of RTOS, basics of real time and embedded system operating systems.

UNIT I OVERVIEW OF AUTOMOTIVE EMBEDDED SYSTEM 9

Introduction to automotive embedded system, Architecture of embedded systems, Methods and tools for automotive embedded systems, Applications related to automotive embedded system.

UNIT II ARCHITECTURE OF 8-BIT EMBEDDED MICRO-CONTROLLERS 9

History & features, Architecture & assembly language programming, Branch, Call, Time delay, Arithmetic, Logic instructions, Programs, Bank switching, Table processing, Macros and Modules of 8051.

UNIT III PERIPHERAL INTERFACING WITH 8-BIT MICRO-CONTROLLER 9

Timer, Stepper motors, LCD, Keyboard, Serial Port, ADC, DAC, & Sensor Interfacing, Interrupt handling, PWM generation, DC motor control, Automotive embedded system application development using IO and related programming.

UNIT IV SERIAL COMMUNICATION PROTOCOL ON HCS12 9

UART, SPI, I2C, Various ways to use the CAN module in HCS12, interfacing using LIN, Micro-controller based system development using IO and related programming.

UNIT V MICROELECTRONIC FUNDAMENTALS 11 9

Semi Conductor devices - diodes - Rectifier circuit - Transistors - Transistor model - Transistor amplifiers - operational amplifiers - Digital Circuits - Binary number system - Logic circuits (combinatorial) Logic circuits with memory (Sequential) - Integrated circuits.

TOTAL : 45

TEXT BOOKS

1. Ronald K. Jurgen ,Automotive Electronics Handbook, McGraw-Hill, 1999

2. Hall, Douglas V, Microprocessors and Interfacing: Programming and Hardware, 2nd edition, Tata McGraw Hill, 1999

3. Frank Vahid and Tony Givargis, Embedded System Design: A Unified Hardware/Software Introduction, John Wiley & Sons, 2002

4. John B Peatman, Design with PIC Microcontrollers, Pearson Education, 2002

5. David E. Simon, An Embedded Software Primer, Pearson Education, 1999

6. Gordon Doughman, Programming the Motorola M68HC12 Family, Annabooks/Rtc, 2000

7. Douglas V. Hall, Microprocessors and interfacing: programming and hardware, 2nd edition, Tata McGraw -Hill, 1999

8. Fredrick M. Cady and James M. Sibigtroth, Software and Hardware Engineering: Motorola M68Hc12, Oxford University Press, 2000

9. Muhammad Ali Mazidi, DeVry University, Danny Causey and Janice Mazidi, HCS12 Microcontrollers and Embedded Systems, Prentice Hall, 2008

10. Understanding automotive Electronics, William B. Ribbens Ph.D., Fifth edition, SAE inc. USA, 2005.

12. Robert N.Brady, Automotive Computers and Digital Instrumentation, Prentice Hall, 1988.

13. Bosch Technical Instruction Booklets.

REFERENCES

1. Gasoline Engine Management, Second Edition, Robert Bosch GmbH, 2004.

2. Engine Management, Second Edition, Robert Bosch GmbH, 1999.

3. Eric Chowaniety, Automobile Electronics, SAE Publications 1995.

4. William B. Ribbews, Understanding Automotive Electronics, Fifth Edition, SAE Publications 1998.