UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science & Technology aspires to be a leader in Education, Training and Research in Engineering, Science, Technology and Management and to play a vital role in the Socio-Economic progress of the Country.

MISSION

- To blossom into an internationally renowned University
- To empower the youth through quality education and to provide professional leadership
- To achieve excellence in all its endeavors to face global challenges
- To provide excellent teaching and research ambience
- To network with global Institutions of Excellence, Business, Industry and Research Organizations
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation

VISION & MISSION STATEMENT OF THE DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To excel in providing quality education and training through Undergraduate and Postgraduate programs and carryout quality Research in the field of Mechanical Engineering

MISSION

- To provide a good learning experience through appropriate design of curriculum and syllabi that facilitate students to gain thorough understanding of the fundamental concepts and applications in Mechanical Engineering
- To equip students to solve challenging problems in Mechanical Engineering and related areas taking in to account their impact on the society
- To facilitate students to develop good communication, leadership and managerial skills through team approach in conducting experiments and projects
- To pursue academic and collaborative research activities with industry and other research institutions ensuring high quality in publications and other research outputs.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

B.TECH. - MECHANICAL ENGINEERING
(SEVEN SEMESTERS - PART TIME)

PROGRAMME EDUCATIONAL OBJECTIVES :

- To induce a sense of excitement in learning by adapting a holistic approach through well designed curriculum, pedagogy and evaluation for a successful professional career
- To provide a strong foundation in physical sciences and analytics to enable comprehensive understanding of the basic principles of Mechanical Engineering
- To develop knowledge and skill in applying engineering principles to conceive,design, analyze, manufacture, maintain and recycle engineering systems and components
- To equip the students with essential fundamental knowledge not only in the facets of Mechanical Engineering but also from other relevant disciplines to infuse a multi-disciplinary approach
- To enhance the spirit of inquiry through projects, internships leading to development of creativity, self confidence and team spirit
- To provide necessary ambience with scope for developing communication and life skills so as to meet the needs of the society in the globalized environment.

PROGRAMME LEARNING OUTCOME :

The Graduates in Mechanical Engineering will

- Possess self-learning capability involving any new concept or idea depending on the need
- Have a strong fundamental knowledge in Mathematics and Science with ability to apply them suitably
- Be able to demonstrate a clear understanding of the underlying principles in different aspects like thermal, mechanics, materials and manufacturing in Mechanical Engineering including related inter disciplinary aspects

- Demonstrate their capability in design and analysis of mechanical system, process and components taking into account social, economic and environmental impacts
- Be able to use the knowledge of materials and manufacturing process in product realization
- Adopt analytical approach in design and conduct of experiments, use of metrics, analysis and interpretation of results and draw appropriate conclusions

Be able to use soft skills acquired, exhibit professional approach in problem solving, work in multi-functional teams and adopt an ethical approach.

B.S.ABDUR RAHMAN
U N I V E R S I T Y
B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd.u/s 3 of the UGC Act, 1956)
(FORMERLY B.S.ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048.

REGULATIONS 2013
FOR
B.TECH. - PART TIME
DEGREE PROGRAMMES

(With amendments incorporated till June 2014)

REGULATIONS - 2013 FOR
B.TECH. PART TIME DEGREE PROGRAMMES

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.Tech. Degree Programme ii) "Branch" means specialization or discipline of B.Tech Degree Programme like Civil Engineering, Polymer Technology, etc.,

iii) "Course" means a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, Engineering Graphics, Computer Practice, etc.,

iv) "University" means B.S.Abdur Rahman University. v)'Dean (Academic Courses)' means Dean (Academic Courses) of B.S.Abdur Rahman University.

vi) 'Dean (Students)' means Dean(Students) of B.S.Abdur Rahman University

vii) "Controller of Exams" means the Controller of Examination of B.S.Abdur Rahman University, who is responsible for conduct of examinations and declaration of results.

2.0 ADMISSION

2.1 Candidates for admission to the first semester of the SEVEN semester Part-Time (Evening) B.Tech. degree programme shall be required to have passed the Diploma examination in Engineering / Technology/ of the Department of Technical Education, Tamilnadu or any other examination of any other authority accepted by the University as equivalent thereto.

2.2 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the University from time to time.

3.0 BRANCHES OF STUDY

3.1 Regulations are applicable to the following B.Tech. degree programmes in various branches of Engineering and Technology, each distributed over SEVEN semesters with two semesters per academic year.

B.TECH. DEGREE PROGRAMMES:

1. Aeronautical Engineering
2. Automobile Engineering
3. Civil Engineering
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Technology
9. Manufacturing Engineering
10. Mechanical Engineering
11. Polymer Engineering

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every Programme will have a curriculum with syllabi consisting of theory and practical courses such as,

i) Basic Sciences (BS)

ii) Humanities & Social Sciences (HS)

iii) Management Sciences (MS)

iv) Engineering Fundamental Courses (EF)

v) Engineering Core Courses (EC)

vi) Professional Electives (PE)

vii) General Electives (GE)

viii) Workshop practice, laboratory work, industrial training, seminar presentation, project work, etc.

4.2 Each course is normally assigned certain number of credits

one credit per lecture period per week

one credit per tutorial period per week

one credit for two to three periods and two credits for four periods of laboratory or practical courses,

one credit for two periods of seminar or project work per week

one credit for two weeks of industrial training

4.3 Each semester curriculum shall normally have a blend of lecture courses not exceeding SEVEN and practical courses not exceeding FOUR.

4.4 For the award of the degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. This minimum will lie between 130 and 140 credits, depending on the program.

4.5 The medium of instruction, examinations and project report will be English, except for courses on languages other than English.

5.0 DURATION OF THE PROGRAMME

5.1 A student is ordinarily expected to complete the B.Tech. programme In SEVEN semesters, but in any case not more than 14 semesters.

5.2 Each semester shall normally consist of around 90 working days or 270 working hours. End semester examination will normally follow immediately after the last working day of the semester.

6.0 CLASS ADVISOR AND FACULTY ADVISOR

6.1 CLASS ADVISOR

A faculty member will be nominated by the HOD as Class Advisor for the whole class (1st to 7th semester).

He/she is responsible for maintaining academic, curricular and co-curricular records of all students throughout their period of study.

6.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department of the student will attach a certain number of students to a faculty member of the department who shall function as Faculty Advisor for the students throughout their period of study. Such Faculty Advisor shall offer advice to the students on academic and personal matters, and guide the students in taking up courses for registration and enrolment every semester.

7.0 COURSE COMMITTEE

Common course offered to more than one discipline or group, shall have a "Course Committee", comprising all the faculty members teaching the common

course with one of them nominated as Course Coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs), depending on whether all the faculty members teaching the common course belong to the same department / different departments.

8.0 CLASS COMMITTEE

A class committee is constituted by the Head of the Department every semester to monitor and govern the teaching, learning and evaluation.

8.1 The first semester Class Committee composition will be as follows:

i) One senior faculty member preferably not teaching to the concerned class, appointed as Chairman by the Head of the Department

ii) Faculty members of individual courses

iii) Two students, (preferably one male and one female) of the class per group of 30 students or part thereof, to be nominated by the Head of the Department, in consultation with the faculty advisors.

iv) All faculty advisors and the class advisor of the class

v) Head of the Department

8.2 The class committee shall meet at least thrice during the semester. The first meeting will be held within two weeks from the date of class commencement, in which the type of assessments, like test, assignment, assignment based test etc., will be decided for the first, second and third assessments. The second meeting will be held within a week after the date of first assessment report, to review the students' performance and for follow up action. The third meeting will be held within a week after the second assessment report, to review the students' performance and for follow up action.

8.3 During these three meetings the student members representing the entire class, shall meaningfully interact and express opinions and suggestions of the class students to improve the effectiveness of the teaching- learning process.

8.4 The class committee, **excluding the student members and the invited members,** shall meet within 10 days from the last day of the end-semester examination to analyse the performance of the students in all the components of assessments and decide the grades secured by students in each course.

The grades in a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

9.0 REGISTRATION AND ENROLMENT

9.1 Except for the first semester, every student shall register for the ensuing semester during a specified week before the end semester examination of the current semester. Every student shall submit a completed Registration form indicating the list of courses intended to be credited during the ensuing semester. Late registration with the approval of Dean(AC) along with a late fee will be permitted up to the last working day of the current semester.

9.2 From the second semester onwards, all students shall pay the prescribed fees for the semester on a specific day at the beginning of the semester confirming the registered courses. Late enrolment, with the approval of Head of the Institution along with a late fee, will be permitted up to two weeks from the date of commencement of classes. If a student does not enroll, his/her name will be removed from rolls.

9.3 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees.

9.4 A student should have registered for all preceding semesters before registering for a particular semester.

10.0 CHANGE OF A COURSE

A student can change a course within a period of 15 days from the Commencement of the course, with the approval of the Dean(AC), on the recommendation of the Head of the Department of the student.

11.0 WITHDRAWAL FROM A COURSE

A student can withdraw from a course at any time before the second assessment for genuine reasons, with the approval of the Dean(AC), on the recommendation of the Head of the Department of the student.

12.0 TEMPORARY BREAK OF STUDY FROM A PROGRAMME

A student can take a one time temporary break of study covering the current semester and/or next semester period with the approval of the Head of the Institution at any time before the start of third assessment of current semester, within the maximum period of 14 semesters . If any students is debarred or

suspended for want of attendance or due to any act of indiscipline it will not be considered as break of study.

13.0 CREDIT LIMIT FOR ENROLMENT

13.1 A student can enroll for a maximum of 24 credits during a semester period including arrears courses.

13.2 Minimum credit requirement to move to the higher semester is

- Not less than a total of 18 credits, to move to the 3rd semester
- Not less than a total of 35 credits, to move to the 5th semester
- Not less than a total of 55 credits, to move to the 7th semester

13.3 However, a student who has secured "I" grade (due to shortage of attendance) in all the courses of a particular semester is not eligible to move to the next higher semester:

14.0 SUMMER TERM COURSES

14.1 A student can register for a maximum of two courses during summer term, if such courses are offered by the concerned department during the summer term.

14.2 The Head of the department, in consultation with the department consultative committee and with the approval of Head of the Institution may arrange for the conduct of a few courses during summer term, depending on the availability of teachers during summer and subject to certain minimum of students registering for such courses, which will be fixed from time to time by the Dean (AC).

14.3 The number of contact hours and the assessment procedure for any course during summer term will be the same as those during regular semesters except that there is no provision either for withdrawal from a summer term course or for substitute examination.

15.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

15.1 Every theory course shall have a total of four assessments during a semester as given below :

Assessment No.	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 4	1.5 hours	15%
Assessment 2	5 to 8	1.5 hours	15%
Assessment 3	9 to 12	1.5 hours	15%
Attendance #	-	-	5%
Semester End Exam	1 to 18 Full course	3 hours	50 %

\# 76-80% - 1 Mark ; 81-85 – 2 Marks ; 86-90 – 3 Marks ; 91-95 – 4 Marks and 96 – 100 – 5 Marks

15.2 Appearing for semester end examination for each course is mandatory and a student should secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

15.3 Every practical course will have 60% weightage for continuous assessment and 40% for semester end examination. However, a student should have secured a minimum of 50% marks in the semester end practical examination.

15.4 In the case of Industrial training, the student shall submit a report, which will be evaluated along with an oral examination by a committee of faculty members, constituted by the Head of the department. A progress report from the industry will also be taken into account for evaluation.

15.5 In the case of project work, a committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student(s), an oral examination (viva-voce) will be conducted as the semester end examination, for which one external examiner, approved by the Controller of Examinations, will be included. The weightage for periodic review will be 50% and remaining 50% for the project report and the Viva Voce examination.

15.6 Assessment of seminars and comprehension will be carried out by a committee of faculty members constituted by the Head of the Department.

15.7 The continuous assessment marks earned for a course during his/her first appearance will be used for grading along with the marks earned in the end-semester / arrear examination for that course until he/she completes.

16.0 SUBSTITUTE EXAMINATIONS

16.1 A student who has missed, for genuine reasons, a maximum of one of the four assessments of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident or admission to a hospital due to illness, etc. by a committee constituted by the Dean of School for that purpose.

16.2 A student who misses any assessment in a course shall apply in a prescribed form to the Dean (AC) through the Head of the department within a week from the date of missed assessment. However the substitute examination will be conducted within two weeks after the last day of the end-semester examination, with the approval of the Dean (AC).

17.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

17.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds or representing the University in approved events etc.) to become eligible to appear for the end-semester examination in that course, failing which the student shall be awarded "I" grade in that course. If the course is a core course, the candidate should register for and repeat the course when it is offered next.

17.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in that course to the class advisor. The class advisor will consolidate and furnish the list of students who have earned less that 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department. Thereupon, the Dean (Academic Affairs) shall announce, course-wise, the names of such students prevented from writing the semester end examination in each course.

17.3 A student should register to re-do a core course wherein "I" or "W" grade is awarded. If the student is awarded, "I" or "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken.

17.4 A student who is awarded "U" grade in a course will have the option of either to write semester end arrear exam at the end of the subsequent semesters, or to redo the course during summer term / regular semester. Marks earned during the redo period in the continuous assessment for the course, will be used for grading along with the marks earned in the end-semester (re-do) examination. If any student obtained "U" grade during summer term course, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

17.5 If a student with "U" grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing that course, then he/she will be awarded "I" grade in that course:

18.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

18.1 All assessments of a course will be made on absolute marks basis. However, the class committee without the student members and invited members will meet within 10 days after the end-semester examinations and analyze the performance of students in all assessments of a course and award letter grade. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	--
AB	--

"W" denotes withdrawal from the course

"I" denotes inadequate attendance in the course and hence prevention from writing semester end examination.

"U" denotes unsuccessful performance in the course.

"AB" denotes Absent for the semester end examination

18.2 A student who earns a minimum of five grade points in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student

18.3 The results, after awarding of grades, shall be signed by the Head of the Department and declared by the Controller of Examinations.

18.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her end semester examination answer paper in a course, on payment of a prescribed fee, through proper application to Dean (AC), who shallconstitute a revaluation committee consisting of the Head of the Department as convener, the teacher of the course and a senior member of faculty knowledgeable in that course. The committee shall meet within a week to revalue the answer paper and submit its report to the Controller of Examinations for consideration and decision

18.5 After results are declared, grade sheets shall be issued to each student, which will contain the following details. The list of courses enrolled during the semester including summer term courses, if any, and the grade scored, the Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards. GPA is the ratio of the sumof the products of the number of credits of courses registered and the points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester, including summer courses, if any.

If Ci, is the number of credits assigned by for i^{th} course and GPi is the Grade Point obtained in the i^{th} course

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i} C_i}$$

The Cumulative Grade Point Average CGPA shall be calculated in a similar manner, considering all the courses enrolled from first semester.

"I" and "W" grades will be excluded for calculating GPA.

"U", "I" AB" and "W" grades will be excluded for calculating CGPA

18.6 After successful completion of the programme, the Degree will be awarded with the following classifications based on CGPA

Classification	CGPA
First Class with Distinction	8.50 and above and passing all examinations in the first appearance and completing the programme within the normal 7 semesters
First Class	6.50 and above and completing the programme within a maximum of 9 semesters.
Second Class	All others

19.0 ELECTIVE CHOICE

19.1 Apart from the various elective courses listed in the curriculum for each branch of specialization, the student can choose a maximum of two electives from any other specialization under any department, during the entire period of study, with the approval of the Head of the parent department and the Head of the other department offering the course.

19.2 In the curriculum of SEVENth Semester, along with the project work, if two elective courses alone are listed, then the Head of the Institution may permit a student, as per approved guidelines, on the recommendation of the Head of the department, to do a full semester major industrial project work. In such a case, the above two elective courses or any other two elective courses in lieu thereof have to be enrolled during any semester including the summer, preceding or succeeding the project work, if offered.

20.0 DISICIPLINE

20.1 Every student is required to observe disciplined and decorous behaviour both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the institution.

20.2 Any act of indiscipline of a student, reported to the Dean (Students), will be referred to a Discipline and Welfare Committee, nominated by the Vice-Chancellor, for taking appropriate action.

21.0 ELIGIBILITY FOR THE AWARD OF DEGREE

21.1 A student shall be declared to be eligible for the award of the B.Tech. degree provided the student has:

i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 14 semesters from the date of admission, including break of study.

ii) no dues to the Institution, Library, Hostels

iii) no disciplinary action pending against him / her.

20.2 The award of the degree must have been approved by the University.

22.0 POWER TO MODIFY

Notwithstanding all that has been stated above, the Academic Council has the right to modify the above regulations from time to time

CURRICULUM AND SYLLABI FOR B.TECH. PART TIME - MECHANICAL (Seven Semesters - Part Time)

CURRICULUM

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
Theory						
1	PTMA101	Mathematics I	3	1	0	4
2	PTPH101	Physics	3	0	0	3
3	PTCH101	Chemistry	3	0	0	3
4	PTGE101	Engineering Mechanics	3	1	0	4
5	PTEE101	Electrical Drives and Controls	4	0	0	4
Practical						
6	PTME101	Special Machines Lab	0	0	2	1
		Total	**16**	**2**	**2**	**19**

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
Theory						
1	PTMA102	Mathematics - II	3	1	0	4
2	PTME102	Fluid Mechanics and Machinery	3	1	0	4
3	PTEC101	Electronics for Mechanical Systems	3	0	0	3
4	PTME103	Thermal Engineering - I	3	1	0	4
5	PTME104	Engineering Materials and Metallurgy	3	0	0	3
Practical						
6	PTME105	Electronics and PLC lab	0	0	2	1
		Total	**15**	**3**	**2**	**19**

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
Theory						
1.	PTME201	Strength of Materials	3	1	0	4
2	PTME202	Manufacturing Technology	3	0	0	3
3	PTME203	Kinematics of Machinery	3	1	0	4
4	PTME204	Thermal Engineering - II	3	1	0	4
5	PTME205	Ecology and Environment	3	0	0	3
Practical						
6	PTME206	Strength of Materials and Metallurgy Lab	0	0	2	1
		Total	**15**	**3**	**2**	**19**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
Theory						
1.	PTME207	Heat and Mass Transfer	3	1	0	4
2.	PTME208	Design of Machine Elements	3	1	0	4
3.	PTME209	Dynamics of Machinery	3	1	0	4
4.	PTME210	Metrology and Measurements	3	0	0	3
5.	PTME211	Applied Hydraulics and Pneumatics	3	0	0	3
Practical						
6.	PTME212	Thermal Engineering Lab	0	0	2	1
		Total	**15**	**3**	**2**	**19**

SEMESTER V

Sl. No.	Course Code	Course Title	L	T	P	C
Theory						
1	PTME301	Mechatronics	3	0	0	3
2	PTME302	Design of Transmission Systems	3	1	0	4
3	PTME303	Computer Aided Design and Manufacturing	3	0	0	3
4	PTME304	Design & Manufacture of jigs, fixtures and tools	3	1	0	4
5	PTME305	Process Planning and cost Estimation	3	1	0	4
Practical						
6	PTME306	Metrology and CIM Lab	0	0	2	1
		Total	**15**	**3**	**2**	**19**

SEMESTER VI

Sl. No.	Course Code	Course Title	L	T	P	C
Theory						
1	PTME307	Industrial Engineering and management	4	0	0	4
2	PTME308	Operations Research	3	1	0	4
3	PTME309	Introduction to Finite Element Analysis	3	1	0	4
4		Elective - I	3	0	0	3
5		Elective - II	3	0	0	3
Practical						
6	PTME310	Computer Aided Modeling and Analysis Lab	0	0	2	1
		Total	**16**	**2**	**2**	**19**

SEMESTER VII

Sl. No.	Course Code	Course Title	L	T	P	C
Theory						
1	PTME401	Total Quality Management	3	0	0	3
2	PTME402	Robotics and Automation	3	0	0	3
3		Elective - III	3	0	0	3
4		Elective - IV	3	0	0	3
Practical						
5	PTME403	Project Work	0	0	6	6
		Total	**12**	**0**	**6**	**18**
		Cumulative Total				**132**

MINIMUM CREDITS TO BE EARNED FOR THE AWARD OF DEGREE = 132

LIST OF ELECTIVES

Sl.No	Course Code	Course Title	L	T	P	C
1	PTMEX01	Energy Conservation and Management	3	0	0	3
2	PTMEX02	Renewable Sources of Energy	3	0	0	3
3	PTMEX03	Refrigeration and Air Conditioning	3	0	0	3
4	PTMEX04	Gas Dynamics and Jet Propulsion	3	0	0	3
5	PTMEX05	Turbo Machines	3	0	0	3
6	PTMEX06	Computational Fluid Dynamics	3	0	0	3
7	PTMEX07	Modern Concepts in Engineering Design	3	0	0	3
8	PTMEX08	Theory of Metal Forming	3	0	0	3
9	PTMEX09	Modern Manufacturing Systems	3	0	0	3
10	PTMEX10	Engineering Economics and Cost Analysis	3	0	0	3
11	PTMEX11	Marketing Management	3	0	0	3
12	PTMEX12	Entrepreneurship Development	3	0	0	3
13	PTMEX13	Production Planning and Control	3	0	0	3
14	PTMEX14	Reliability Engineering and Maintenance	3	0	0	3
15	PTMEX15	Internal Combustion Engines	3	0	0	3
16	PTMEX16	Automobile Engineering	3	0	0	3
17	PTMEX17	Rubber Recycling and Waste Management	3	0	0	3
18	PTMEX18	Rubber Product Manufacturing Technology	3	0	0	3
19	PTMEX19	Tyre manufacture and testing	3	0	0	3
20	PTMEX20	Polymer Rheology	3	0	0	3
21	PTMEX21	Rubber Technology	3	0	0	3
22	PTMEX22	Numerical Methods	3	0	0	3
23	PTMEX23	Vibration and Noise Control	3	0	0	3
24	PTMEX24	Nano Technology	3	0	0	3
25	PTMEX25	Composite Materials for Manufacture	3	0	0	3
26	PTMEX26	Micro Electro Mechanical System	3	0	0	3

SEMESTER I

PTMA101	MATHEMATICS	L	T	P	C
		3	1	0	4

Objectives:

- To introduce matrices and functions of seven variables
- To acquaint with complex integration and analytical functions needed for Engineering Analyses
- To introduce the mathematical tools for the solutions of ordinary differential equations

Unit I MATRICES 12

Characteristic equation - Eigen values and Eigenvectors of a real matrix - Properties of eigenvalues and eigenvectors - Cayley - Hamilton Theorem - Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation - Nature of quadratic forms .

Unit II FUNCTIONS OF SEVERAL VARIABLES 12

Partial derivatives - Homogeneous functions and Euler's theorem - Total derivative - Differentiation of implicit functions - Change of variables - Jacobeans - Partial differentiation of implicit functions - Taylor's series for functions of two variables - Maxima and minima of functions of two variables.

Unit III ANALYTIC FUNCTION 12

Analytic functions - Necessary and sufficient conditions for analyticity - Properties - Harmonic conjugates - Construction of analytic function - Conformal Mapping - Mapping by functions w = a + z , az, 1/z, - Bilinear transformation.

Unit IV COMPLEX INTEGRATION 12

Line Integral - Cauchy's theorem and integral formula - Taylor's and Laurent's Series - Singularities - Residues - Residue theorem - Application of Residue theorem for evaluation of real integrals - Use of circular contour and semicircular contour with no pole on real axis.

Unit V ORDINARY DIFFERENTIAL EQUATIONS 12

Simultaneous first order linear equations with constant coefficients- Linear equations of second order with constant and variable coefficients- Homogeneous equation of Euler type- equations reducible to homogeneous form- method of variation of parameter.

L : 45, T : 15 Total Hours:60

TEXT BOOKS

1. Rajasekaran. S., A text book of Engineering , Dhanam Publishers, Chennai-42.
2. Grewal B.S., Higher Engineering Mathematics (40th Edition), Khanna Publishers, Delhi (2007).
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill Co. Ltd., New Delhi (2007).

REFERENCES

1. Glyn James, Advanced Modern Engineering Mathematics, Pearson Education (2007).
2. Veerarajan, T., Engineering Mathematics (For First Year), Tata McGraw-Hill Pub. Pvt Ltd., New Delhi (2006).

PTPH101	PHYSICS	L	T	P	C
		3	0	0	3

Objectives:

- To learn the different crystal structures and lattices of materials
- To understand the concepts of ultrasonic, non destructive testing and applications
- To study laser types& applications, fiber optics principle, types and applications
- To get exposed to different modern engineering materials

UNIT I CRYSTAL PHYSICS 9

Lattice - Unit cell - Bravais lattice - Lattice planes - Miller indices - 'd' spacing in cubic lattice - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - Packing factor for SC, BCC, FCC and HCP structures -- Crystal defects - point, line and surface defects- Burger vector.

UNIT II ULTRASONICS 9

Introduction - Production - magnetostriction effect - magnetostriction generator- piezoelectric effect - piezoelectric generator- Detection of ultrasonic waves properties - Cavitations - Velocity measurement - acoustic grating - Industrial applications - drilling, welding, soldering and cleaning - SONAR - Non Destructive Testing - pulse echo system through transmission and reflection modes - A, B and C -scan displays, Medical applications - Sonograms.

UNIT III LASERS 9

Introduction - Principle of Spontaneous emission and stimulated emission. Population inversion, pumping. Einstein's A and B coefficients - derivation. Types of lasers - He-Ne, CO2 , Nd-YAG, Semiconductor lasers - homojunction and heterojunction (Qualitative)- Industrial Applications - Lasers in welding, heat treatment and cutting - Medical applications - Holography (construction and reconstruction).

UNIT IV FIBER OPTICS 9

Principle and propagation of light in optical fibres - Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) - - Splicing, Loss in optical fibre - attenuation, dispersion, bending - Fibre optical communication system (Block diagram) - LED - PIN Diode - Fibre optic sensors - temperature and displacement sensors - Endoscope.

UNIT V MODERN ENGINEERING MATERIALS 9

Metallic glasses - preparation, properties and applications. Shape memory alloys(SMA) - Characteristics and applications. Nanomaterials - synthesis - plasma arcing - chemical vapour deposition - sol-gels - properties of nanoparticles and applications. Carbon nano tubes, fabrication - arc method - pulsed laser deposition - structure - properties and applications.

Total Hours:45

TEXT BOOKS:

1. Palanisamy, P.K., 'Engineering Physics' Scitech publications, Chennai, (2008).
2. Arumugam M. ' Engineering Physics', Anuradha Publications, Kumbakonam, (2007)
3. Sankar B.N and Pillai S.O. 'A text book of Engineering Physics', New Age International Publishers, New Delhi, 2007.

REFERENCES:

1. R. K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications, New Delhi (2003)
2. M.N. Avadhanulu and PG Kshirsagar, 'A Text book of Engineering Physics', S.Chand and company, Ltd., New Delhi, 2005.
3. Serway and Jewett, 'Physics for Scientists and Engineers with Modern Physics', 6th Edition, Thomson Brooks/Cole, Indian reprint (2007)

PTCH101	CHEMISTRY	L	T	P	C
		3	0	0	3

Objectives:

- To learn the technique of water treatment for domestic and industrial applications, pollution and control
- To acquire knowledge on fuels and their analyses, thermodynamic laws and surface chemistry
- To understand different types of cells, corrosion, surface coatings and catalysis

UNIT I WATER TREATMENT AND POLLUTION CONTROL 9

Treatment of water -impurities and disadvantages of hard water-Domestic and Industrial treatment - zeolite and ion exchange processes-Portable water-Boiler feed water -conditioning of boiler feed water. Scale and sludge formation -prevention -caustic embrittlement-boiler corrosion-priming and foaming Sewage treatment-Primary, secondary and tertiary treatment-significance of DO, BOD and COD-desalination -reverse osmosis. Control of water,air and land pollution.

UNIT II FUEL 9

Classification of fuels-Proximate and ultimate analysis of coal- coke manufacture-Otto Hoffman by product method-cracking-thermal and catalytic (fixed bed and fluidized bed)-petroleum-refining-factions-composition and uses synthetic petrol-fischer drops methods- Bergius process- knocking-octane number and cetane number-Preparation, composition and uses of producer gas , water gas and natural gas. Flue gas analysis- Orsat apparatus- gross and net calorific values- calculation of minimum requirement of air(simple calculations)- Explosive range -spontaneous ignition temperature

UNIT III THERMODYNAMICS AND SURFACE CHEMISTRY 9

Second law of thermodynamics-entropy and its significance- criteria for spontaneity- free energy-Gibbs, Helmholts and Gibbs-Helmholts equation-applications and problems - Adsorption -types of adsorption- adsorption of gases on solids- adsorption isotherm-Freundlich and Langmuir isotherms-adsorption of solutes from solutions- applications

UNIT IV ELECTROCHEMISTRY - CORROSION AND CATALYSIS 9

Reversible and irreversible cells-electrode potentials-types of electrodes-cell reactions-Nernst equations- electrochemical and galvanic series-fuel cells and solar cells-corrosion-chemical and electrochemical-factors affecting corrosion-sacrifical anode-impressed current cathodic protection-surface treatment and protective coating- Catalysis -classification-characteristics of catalysis - auto catalysis- enzyme catalysis

UNIT V POLYMERS-COMPOSITES AND NANOCHEMISTY 9

Polymers-definition-classification-thermoplastics and thermosetting plastics differences Preparation, properties and uses of polystyrene, bakelite, PET, polyurethane, Teflon, ureafromaldehyde, polycarbonates-Elastomers-Preparation, properties of Buna-S, nitrile, neoperene and butyl rubber, silicon rubber. Composites-FRP. Nanochemistry-introduction to nanochemistry-preparation and properties of nonmaterial-nano rods, nano wires-nanotubes-carbon nanotubes and their applications.

Total Hours : 45

TEXT BOOKS:

1. Dhara S S A text book of Engineering Chemistry, S.Chand & Co Ltd, New Delhi,2002
2. Jain. P.C and Monica Jain, Engineering Chemistry,Dhanpet Rai & Sons, New Delhi 2001

REFERENCES

1. Puri B R.,Sharma L R and Madhan S. Pathania, Principles of Physical Chemistry, Shoban Lal Nagin Chand & Co. Jalandar-2000.
2. G.B. Sergeev, Nanochemistry.Elsevier Science, New York,2006
3. V.R.Gowarikar, N.V.Viswanathan and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras (2006).

PTGE101 ENGINEERING MECHANICS L T P C

3 1 0 4

Objectives:

- To impart knowledge about the basic laws of statics and dynamics and their applications in problem solving
- To acquaint both with scalar and vector approaches for representing forces and moments acting on particles and rigid bodies and their equilibrium
- To give on exposure on inertial properties of surfaces and solids
- To provide an understanding on the concept of work energy principle, friction, kinematics of motion and their relationship

UNIT I BASICS & STATICS OF PARTICLES 12

Introduction - Units and Dimensions - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces - Vectors - Vectorial representation of forces and moments - Vector Algebra and its Physical relevance in Mechanics- Coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility - Single equivalent force

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram - Types of supports and their reactions - requirements of stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Equilibrium of Rigid bodies in two dimensions - Equilibrium of Rigid bodies in three dimensions - Examples

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Determination of Areas and Volumes - First moment of area and the Centroid of sections - Rectangle, circle, triangle from integration - T section, I section, Angle section, Hollow section by using standard formula - second and product moments of plane area - Physical relevance - Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow section by using standard formula - Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia - Mass moment of inertia - Derivation of mass moment of inertia for

rectangular section, prism, sphere from first principle - Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 12

Review of laws of motion - Newton's law - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies.

Introduction to vibrations - Single degree of freedom systems - with and without damping

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Frictional force - Laws of Coloumb friction - simple contact friction - Rolling resistance - Belt friction Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion.

L : 45, T : 15 Total Hours:60

TEXT BOOK:

1. Beer,F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers, Dynamics &Statics", Third SI Metric Edition, Tata McGraw-Hill International Edition, 2001.

REFERENCES :

1. Hibbeller, R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000
2. Irving H. Shames, Engineering Mechanics - Statics and Dynamics, IV Edition - Pearson Education Asia Pvt. Ltd., 2003

PTEE101 ELECTRICAL DRIVES AND CONTROLS L T P C
4 0 0 4

Objectives:

- To introduce basic circuit laws and use network reduction techniques for analyzing DC and AC circuits.
- To impart knowledge on operating principles and performance characteristics of DC and AC machines.
- To introduce special types of electric machines and their control for special applications.
- To derive the mathematical representation of physical systems and to study their state variable analysis

UNIT I ELECTRIC CIRCUITS 12

Introduction to DC circuits: ohm's law, kirchaff's laws, resistance connections, defining terms. Introduction to AC circuits: AC, representation techniques, defining terms, series and parallel circuits, 3 phase circuits. Simple problems.

UNIT II DC MACHINES 12

Construction -types- generator- characteristics- motors- characteristics- starting and speed control- testing- curves & efficiency.

UNIT III AC MACHINES 12

Transformers: construction, types, principle of operation, behavior of load, equivalent circuit, voltage regulation of load, equivalent circuit, voltage regulation, efficiency. Three phase Induction motor: construction, types, characteristics, speed control, starting methods. Simple problems.

UNIT IV INTRODUCTION TO CONTROL SYSTEMS 12

Differential equation of physical systems, time response of 1st and 2nd order systems, errors, state variable analysis- simple problems.

UNIT V CONTROL SYSTEM COMPONENTS 12

Components- servo motors- stepper motors- control of such motors- hydraulic & pneumatic systems- analysis- simple problems.

Total Hours:60

REFERENCES:

1. Edward Hughes; electrical and Electronics Technology, Pearson India, 9th Edition, 2007.
2. Cotton.H; Electrical Technology, Pitman

PTME 101	SPECIAL MACHINES LAB	L	T	P	C
		0	0	2	1

Objectives:

- To study the various mechanisms and tools
- To practice the various operations of machine tools like lathe, Capstan and turret lathe, milling and grinding machines.
- To practice exercises in Electric discharge machine

Exercises in Milling Machines

Milling Polygon Surfaces

Keyway Milling

Exercises in Grinding / Polishing.

Surface Grinding

Cylindrical Grinding

Lapping

Exercises in Machining Components for Assembly of different fits.

Bush and Shaft

Bolt and Nut

Tongue and Groove

Exercise in Capstan or Turret Lathes

Step turning with drilling

Exercises in Gear Machining

Gear Milling

Gear Hobbing

Exercises in Electric Discharge Machine

SEMESTER – II

PTMA 102	MATHEMATICS II	L	T	P	C
		3	1	0	4

Objectives:

- To introduce Fourier Series analysis and Fourier transform techniques for Engineering applications
- To introduce the mathematical tools for the solutions of partial differential equations
- To develop Z transform techniques for the analysis of continuous time systems

UNIT I FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORM 12

Fourier integral theorem – Fourier transform pair-Sine and Cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Solution of linear equations of higher order with constant coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Method of separation of Variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT V Z - TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform – Elementary properties – Inverse Z-transform – Convolution

theorem – Initial and Final value theorems – Formation of difference equation – Solution of difference equation using Z-transform.

L:45, T:15 Total Hours:60

TEXT BOOKS

1. Rajasekaran.S., A text book of Engineering, Dhanam Publishers, Chennai-42.
2. Grewal, B.S. "Higher Engineering Mathematics", Khanna Publications (2007)

REFERENCES:

1. Glyn James, "Advanced Modern Engineering Mathematics, Pearson Education (2007)
2. Ramana, B.V. "Higher Engineering Mathematics" Tata McGraw Hill (2007).
3. Bali, N.P. and Manish Goyal, "A Text Book of Engineering 7th Edition (2007) Lakshmi Publications (P) Limited, New Delhi.

PTME102 FLUID MECHANICS AND MACHINERY L T P C
3 1 0 4

Objectives:

- To introduce the basic concepts of fluid mechanics and properties of the fluids
- To impart knowledge about the behavior of fluids under static and dynamic conditions
- To impart knowledge of design and analysis of fluid machineries such as turbines and pumps.

UNIT I BASIC CONCEPTS AND PROPERTIES 10

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

UNIT II FLIUD KINEMATICS AND FLUID DYNAMICS 15

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net – fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications – Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's ? theorem-applications - similarity laws and models.

UNIT III INCOMPRESSIBLE FLUID FLOW 15

Viscous flow - Navier-Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) - Hydraulic and energy gradient - flow through pipes - Darcy -weisback's equation - pipe roughness -friction factor- Moody's diagram-minor losses - flow through pipes in series and in parallel - power transmission - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

UNIT IV HYDRAULIC TURBINES 10

Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagrams - head and specific work - components of energy transfer - degree of reaction.

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies -performance curve for turbines.

UNIT V HYDRAULIC PUMPS 10

Pumps: definition and classifications - Centrifugal pump: classifications, working principle, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principle, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps - rotary pumps: working principles of gear and vane pumps.

L:45, T:15 Total Hours:60

TEXT BOOKS :

1. Streeter, V.L., and Wylie, E.B., “Fluid Mechanics”, McGraw-Hill, 1983.
2. Kumar, K.L., “Engineering Fluid Mechanics”, Eurasia Publishing House (P) Ltd, New Delhi (7th edition), 1995.
3. Vasandani, V.P., “Hydraulic Machines - Theory and Design”, Khanna Publishers.1992.

REFERENCES :

1. Bansal, R.K., “Fluid Mechanics and Hydraulics Machines”, (5th edition), Laxmi publications (P) Ltd, New Delhi, 1995
2. White, F.M., “Fluid Mechanics”, Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
3. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 1998.
4. Som, S.K., and Biswas, G., “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw-Hill, 2nd Edition, 2004.

PTEC101 ELECTRONICS FOR MECHANICAL SYSTEMS **L T P C**
3 0 0 3

Objectives:

- To study the characteristics of semiconductor devices such as diodes, transistors and their applications
- To study the fundamentals of digital logic circuits
- To study 8085 microprocessor and its interfacing with other peripheral devices

UNIT I SEMICONDUCTORS AND RECTIFIERS **9**

Classification of solids based on energy band theory-Intrinsic semiconductors-Extrinsic semiconductors-P type and N type-PN junction-Zenor effect-Zenor diode characteristics-Half wave and full wave rectifiers -Voltage regulation.

UNIT II TRANSISTORS AND AMPLIFIERS **9**

Bipolar junction transistor- CB, CE, CC configuration and characteristics-Comparision-Field effect transistor-Configuration and characteristic-SCR, Diac, Triac, UJT-Characteristics and simple applications-MOSFET: PMOS. NMOS-Structure and characteristics.

UNIT III DIGITAL ELECTRONICS **10**

Number system: Binary, Octal and Hexadecimal – Binary Arithmetic Operations-Boolean Algebra-Logic gates-Implementation of combinational circuits using logic gates-Half and full adders-Flip Flops: SR, JK, and D FF-Truth tables and circuits-Shift Registers-Ripple Counters.

UNIT IV 8085 MICROPROCESSOR **9**

Block diagram of microcomputer-Architecture of 8085-Pin configuration-Instruction set-Addressing modes-Simple programs using arithmetic and logical operations.

UNIT V INTERFACING AND APPLICATIONS OF MICROPROCESSOR **8**

Interfacing of Input and Output devices-Applications of microprocessor Temperature control, Stepper motor control, traffic light control- Memory

Interfacing-memory mapping-I/O Interfacing: I/O mapped I/O and Memory mapped I/O-The intel 8255 PPI.

Total Hours:45

TEXT BOOKS :

1. Milman and Halkias, “Integrated Electronics”, Tata McGraw-Hill publishers, 1995.
2. Ramesh Goankar, “Microprocessor Architecture”, Programming and Applications with 8085, Wiley Eastern, 1998.

REFERENCES :

1. Malvino and Leach, “Digital Principles and Applications”, Tata McGraw-Hill, 1996
2. Mehta V.K, “Principles of Electronics”, S. Chand and Company Ltd, 1994
3. Dougles V.Hall, “Microprocessor and Interfacing”, Programming and Hardware, Tata McGraw-Hill, 1999.
4. Salivahanan S, Suresh Kumar N, Vallavaraj A, “Electronic Devices and Circuits” First Edition, Tata McGraw-Hill, 1999.

PTME103 THERMAL ENGINEERING - I **L T P C**
3 1 0 4

Objectives:

- To refresh basics of thermodynamics and analyse the various air standard cycles
- To impart knowledge on working and performance of IC engines and air compressors.
- To analyse the working of gas turbines and Brayton cycle.

UNIT I THERMODYNAMIC BASICS AND GAS POWER CYCLES 12

System concept –thermodynamic processes- internal energy, enthalpy, specific heats-first law of thermodynamics - non flow and steady flow energy equations – second law of thermodynamics- heat engines, heat pumps and refrigerators Otto, Diesel, Dual, Brayton cycles - Calculation of mean effective pressure and air standard efficiency.

UNIT II AIR COMPRESSOR 12

Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling – work of multistage air compressor., Problems in single and two stage air compressors. Various types of compressors.

UNIT III INTERNAL COMBUSTION ENGINES AND ITS SYSTEMS 12

Classification of IC engine - components and functions. Actual and theoretical Valve timing diagram, port timing diagram and p-V diagrams. Comparison of two stroke & four stroke engines and SI and CI engines.

UNIT IV INTERNAL COMBUSTION ENGINE FUELS, COMBUSTION & PERFORMANCE 12

Comparison of petrol and diesel engine Fuels. Air-fuel ratio calculation, Knocking and Detonation, Lubrication system and cooling system Performance calculation. Exhaust gas analysis, pollution control norms.

UNIT V GAS TURBINES 12

Open and closed Gas turbine cycles –Methods of Cycle improvement - Regeneration – Intercooling - Reheating and their combinations –Performance- Materials.

L:45, T:15 Total Hours:60

TEXT BOOKS:

1. Rajput, R.K., Thermal Engineering, 6th Edition, Laxmi Publications, 2007
2. Ballaney, P.L., "Thermal Engineering" , Khanna Publishers, 24th Edition, 2003.

REFERENCES:

1. Holman, J.P." Thermodynamics", McGraw Hill, 1965.
2. Rudramoorthy, R., Thermal Engineering, 4th Edition, Tata McGraw Hill, New Delhi, 2006.
3. Domkundwar, Kothandaraman, and Domkundwar, A Course in Thermal Engineering, Dhanpat Raj & Sons, Fifth edition, 2002.

PTME104 ENGINEERING MATERIALS AND METALLURGY **L T P C**
3 0 0 3

Objective:

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and its alloys.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, substitutional and interstitials – Phase diagrams and microstructure development: Isomorphous, eutectic, peritectic, eutectoid and alloy systems. Iron-Iron carbide equilibrium diagram, peritecoid.

UNIT II HEAT TREATMENT 9

Full annealing-stress relief, Recrystalisation- Spheroidizing, Normalising, Hardening and tempering of steel. Isothermal transformation diagrams- Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburizing, nitriding, cyaniding, carbonotriding –flame and induction hardening – vacuum and plasma hardening – current trends- thermo-mechanical treatments- elementary ideas on sintering.

UNIT III FERROUS AND NON FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W)- classification of steels (tool steel, stainless)– cast irons – alloy cast irons- Copper and Copper alloys –Aluminum and its alloys- Magnesium and its alloys– Titanium and its alloys- Nickel and Cobalt alloys, properties and applications of these materials.

UNIT IV NON-METALLIC AND NEWER MATERIALS 9

Types, properties and applications: Polymers, Ceramics and Composites– Super conductors- nanomaterials and their properties.

UNIT V MECHANICAL PROPERTIES AND TESTING 9

Crystal imperfections- Dislocations- Strengthening mechanisms- Elastic, anelastic and viscoelastic behaviour – modulus of elasticity- plastic deformation- Mechancial tests- tension, compression, impact, hardness- effect of temperature, grain size, solutes and precipitates on dislocation dynamics – Mechanism of Fracture - mechanism of creep-creep resistant materials- creep

tests- fracture toughness- ductile-brittle transition –deformation mechanism maps- fatigue fracture-fatigue test.

Total Hours:45

TEXT BOOKS:

1. Raghavan. V. Materials Science and Engineering", Prentice Hall of India Pvt. Ltd, 5th edition, 2007.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2007.

REFERENCES:

1. George E. Dieter, Mechanical Metallurgy, McGraw Hill, 2007.
2. Sydney H Avner, "Introduction to Physical Metallurgy", 2/E Tata McGraw Hill Book, Company, 2007.
3. Kenneth G. Budinski and Michael K. Budinski "Engineering Materials", PHI / Pearson Educations, 8th Edition, 2007.
4. G.S. Upadhay and Anish Upadhay, "Materials Science and Engineering", Viva Books Pvt. Ltd, 2006.
5. James F. Shackelford and Madanpalli K. Muralidhara, Introduction to Materials Science for Engineers, Pearson Education, 6th edition, 2007.
6. Donald R. Askeland and Pradeep P. Phule, The Science and Engineering of Materials, Thomson 5th edition, 2007.

PTME 105	ELECTRONICS AND PLC LAB	L	T	P	C
		0	0	3	1

Objectives:

- To design and test various fluid power circuits
- To simulate hydraulic , pneumatic and electric circuits using LAB VIEW
- To impart knowledge on data acquisition system

LIST OF EXPERIMENTS

1. Design and testing of fluid power circuits to control
   (i) velocity (ii) direction and (iii) force of single and double acting actuators
2. Design of circuits with logic sequence using Electro pneumatic trainer kits.
3. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software.
4. Circuits with multiple cylinder sequences in Electro pneumatic using PLC.
5. Servo controller interfacing for open loop
6. Servo controller interfacing for closed loop
7. PID controller interfacing
8. Stepper motor interfacing with 8051 Micro controller
   (i) full step resolution (ii) half step resolution
   a. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LAB VIEW
   b. Computerized data logging system with control for process variables like pressure flow and temperature.

SEMESTER – III

PTME201	**STRENGTH OF MATERIALS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Objectives:

- To understand the stresses developed in beams under transverse load
- To understand the shear stress developed due to tensional load
- To understand the stresses induced in cylinders and spheres due to internal
- Pressure

UNIT I STRESS STRAIN AND DEFORMATION OF SOLIDS 12

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT II BEAMS - LOADS AND STRESSES 12

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

UNIT III TORSION 12

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads.

UNIT IV BEAM DEFLECTION 12

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope : Double integration method, Macaulay Method, and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS 12

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

L: 45, T: 15 Total Hours:60

TEXT BOOKS:

1. Popov E.P, Engineering Mechanics of Solids, Prentice-Hall of India, New Delhi, 1997.
2. Beer F. P. and Johnston R, Mechanics of Materials, McGraw-Hill Book Co, Third Edition, 2002.

REFERENCES:

1. Nash W.A, Theory and problems in Strength of Materials, Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.
2. Kazimi S.M.A, Solid Mechanics, Tata McGraw-Hill Publishing Co, New Delhi, 1981.
3. Ryder G.H, Strength of Materials, Macmillan India Ltd., Third Edition, 2002.
4. Ray Hulse, Keith Sherwin & Jack Cain,"Solid Mechanics", Palgrave ANE Books, 2004.
5. Singh D.K "Mechanics of Solids" Pearson Education 2002.
6. Timoshenko S.P, Elements of Strength of Materials, Tata McGraw-Hill, New Delhi 1997.

PTME202 MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

Objectives:

- To introduce the concepts of basic manufacturing processes such as metal casting and forming
- To introduce the fabrication techniques like welding
- To introduce the concept of metal cutting, gear manufacturing and surface finishing techniques
- To learn the mechanisms involved in the working of lathe, shaper, planer, milling, drilling, grinding and broaching machines.

UNIT I CASTING AND WELDING

Introduction to casting, Patterns, Types, Pattern materials, Allowances - Moulding - types - Moulding sand, Gating and Risering, Cores & Core making. Special Casting Process - Shell, Investment, Die casting, Centrifugal Casting.
Special welding - Laser, Electron Beam, Ultrasonic, Electro slag, Friction welding, electrical resistance welding.

UNIT II MECHANICAL WORKING OF METALS

Hot and Cold Working: Rolling, Forging, Wire Drawing, Extrusion - types - Forward, backward and tube extrusion.

Sheet Metal Operations: Blanking - blank size calculation, draw ratio, drawing force, Piercing, Punching, Trimming, Stretch forming, Shearing, Bending - simple problems - Bending force calculation, Tube forming - Embossing and coining, Types of dies: Progressive, compound and combination dies.

UNIT III THEORY OF METAL CUTTING

Orthogonal and oblique cutting - Classification of cutting tools: single, multipoint - Tool signature for single point cutting tool - Mechanics of orthogonal cutting - Shear angle and its significance - Chip formation-Cutting tool materials - Tool wear and tool life - Machinability - Cutting Fluids - Simple problems.

UNIT IV GEAR MANUFACTURING AND SURFACE FINISHING PROCESS

Gear manufacturing processes: Extrusion, Stamping, and Powder Metallurgy. Gear Machining: Forming. Gear generating process - Gear shaping, Gear hobbing.

Grinding process, various types of grinding machine, Grinding Wheel - types - Selection of Cutting speed and work speed, dressing and truing. Fine Finishing - Lapping, Buffing, Honing, and Super finishing.

UNIT V MACHINE TOOLS

Milling Machine - specification, Types, Types of cutters, operations, Indexing methods - simple problems. Shaping, Planning and Slotting Machine - description, Operations, Work and tool holding Devices. Boring machine - Specification, operations, Jig boring machine. Broaching machine - operations, Specification, Types, Tool nomenclature.

Total Hours:45

TEXT BOOKS:

1. Sharma, P.C., A textbook of Production Technology - Vol I and II, S. Chand & Company Ltd., New Delhi, 1996.
2. Rao, P.N., Manufacturing Technology, Vol I & II, Tata McGraw Hill Publishing Co., New Delhi, 1998.

REFERENCE BOOKS:

1. Chapman W. A. J., Workshop Technology Vol. I and II, Arnold Publisher, New Delhi, 1998.
2. Hajra Choudhary, S. K. and Hajra Choudhary, A. K., Elements of Manufacturing Technology, Vol II, Media Publishers, Bombay, 1988.
3. Jain. R. K., Production Technology, Khanna Publishers, New Delhi, 1988.
4. Kalpakjian, Manufacturing Engineering and Technology, Addision Wesley Congmen Pvt. Ltd., Singapore, 2000.

PTME203 KINEMATICS OF MACHINERY L T P C
3 1 0 4

Objectives:

- To understand the layout of linkages in the assembly of a system/machine.
- To study the principles involved in assessing the displacement, velocity and acceleration at any point in a link of a mechanism.
- To analyze the motion resulting from a specified set of linkages in a mechanism.
- To understand the basic concepts of toothed gearing and kinematics of gear trains.

UNIT I BASICS OF MECHANISMS 10

Terminology and Definitions-Degree of Freedom Mobility-Grubler's criterion-Grashoff's law-Kinematic Inversions of 4-bar chain and slider crank chains-Mechanical Advantage-Transmission angle-Description of common Mechanisms-Single, double and offset slider mechanisms - Quick return mechanisms - Ratchets and escapements - Indexing Mechanisms - Rocking Mechanisms - Straight line generators-Design of Crank-rocker Mechanisms.

UNIT II KINEMATICS 15

Displacement, velocity and acceleration - analysis in simple mechanisms - Graphical Method velocity and acceleration polygons - Kinematic analysis by Complex Algebra methods-Vector Approach, Computer applications in the kinematic analysis of simple mechanisms-Coincident points- Coriolis Acceleration.

UNIT III KINEMATICS OF CAM 10

Classifications - Displacement diagrams-parabolic, Simple harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion - Pressure angle and undercutting.

UNIT IV GEARS 13

Spur gear Terminology and definitions-Fundamental Law of toothed gearing and involute gearing-Inter changeable gears-gear tooth action – Terminology - Interference and undercutting-Non standard gear teeth- Helical, Bevel, Worm,

Rack and Pinion gears (Basics only)-Gear trains-Parallel axis gear trains-Epicyclic gear trains-Differentials.

UNIT V FRICTION 12

Surface contacts-Sliding and Rolling friction - Friction drives – Friction in screw threads - Friction clutches - Belt and rope drives, Friction aspects in Brakes – Friction in vehicle propulsion and braking

L: 45, T: 15 Total Hours:60

TEXT BOOKS:

1. Rattan S.S, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.
2. Shigley J.E and.Uicker J.J, “Theory of Machines and Mechanisms”, McGraw-Hill, Inc. 1995.

REFERENCES:

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.
2. Ghosh A and A.K.Mallick, “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao J.S and Dukkipati R.V, “Mechanism and Machine Theory”, Wiley-Eastern Ltd., New Delhi, 1992.
4. John Hannah and Stephens R.C, “Mechanics of Machines”, Viva Low-Prices Student Edition, 1999.

STANDARDS:

1. IS 2458 : 2001, Vocabulary of Gear Terms – Definitions Related to Geometry
2. IS 3756: 2002, Method of Gear correction – Addendum modification for External Cylindrical Gears with Parallel Axes.
3. IS 5267: 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.
4. IS 12328: Part 1: 1988 Bevel Gear Systems Part – 1 Straight Bevel Gears.
5. IS 12328: Part 2: 1988 Bevel Gear Systems Part – 2 Spiral Bevel Gears.

PTME204 THERMAL ENGINEERING – II

L	T	P	C
3	1	0	4

Objectives:

- To learn the working of high pressure boilers and analyse Rankine cycle
- To impart knowledge on working and performance of Steam Nozzles and turbines
- To understand the importance of cogeneration and waste heat recovery principles
- To analyse the cycles and systems of refrigeration and air conditioning

UNIT I BOILERS **12**

Types, Rankine cycle – Analysis – thermal calculations – Heat balance – Accessories – Types of boilers – Boiler code.

UNIT II STEAM NOZZLE **12**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ration, supersaturated flow.

UNIT III STEAM TURBINES **12**

Types – Impulse and reaction principles, compounding, velocity diagrams for simple and multistage turbines, speed regulations – governors.

UNIT IV COGENERATION AND WASTE HEAT RECOVERY **12**

Cogeneration Principles – Cycle analysis – Applications – source and Utilization of waste heat – systems – Heat exchangers – Economic analysis.

UNIT V REFRIGERATION AND AIR – CONDITIONING **12**

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption, Air cycle, Ejector, Steam, Thermoelectric refrigeration systems, Psychormetric, Psychormetric chart, Instrumentation, Cooling load calculations and air circulating systems, Concept of RSHF, GSHF, ESHF – Air conditioning systems.

L: 45, T: 15 Total Hours:60

TEXT BOOKS:

1. Rajput, “Thermal Engineering”, S. chand Puclishers, 2000.
2. Rudramoorthy R, “Thermal Engineering”, Tata MC Graw Hill, New Delhi, 2003.

REFERENCES:

1. Kothandaraman, C.P., Domkundwar.S and A.v. Domkundwar”, a course in thermal Engineering”, Dhanpal Rai & sons, fifth edition, 2002.
2. Holman .J.P., “Thermodynamics”, McGraw Hill, 1985.
3. Arora .C.P., “Refrigeration and Air Conditioning”, TMH, 1994.
4. Charles H Butler : Cogeneration” McGraw Hill, 1984.
5. Sydney Reiter “Industrial and commercial heat recovery systems“ Van Nostrand Reinhols, 1985.
6. David Gunn, Robert Horton, Industrial Boilers – Longman Scientific and Technical Publication, 1986.

PTME205 ECOLOGY AND ENVIRONMENT L T P C
3 0 0 3

Objectives :

- To create awareness about the importance of environment and its conservation.
- To understand the influence of various technologies on environment and ecological balance.
- To learn about the importance of sustainability in all technologies.

UNIT I ECOSYSTEMS AND BIODIVERSITY 12

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – biodiversity – definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity - biodiversity at global, national and local levels – conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT II INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9

Definition, scope and importance – need for public awareness – forest resources – mineral resources – water resources – food resources – energy resources – land resources – role of an individual in conservation of natural resources – equitable use of resources for sustainable lifestyles.

UNIT III ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards – solid waste management: causes, effects and control measures of urban and industrial wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8

From unsustainable to sustainable development – urban problems related to energy – water conservation – resettlement and rehabilitation of people –

environmental ethics – wasteland reclamation – consumerism and waste products – environment protection acts – issues involved in enforcement of environmental legislation – public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 7

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health.

Total Hours:45

TEXT BOOKS:

1. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, 2004.
2. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co.
3. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science.
4. Trivedi R.K. And P.K. Goel, Introduction to Air Pollution, Techno-Science Publications.

REFERENCES:

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, India,
2. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media.
3. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
4. Wager K.D., Environmental Management, W.B. Saunders Co., Philadelphia, USA, 1998.
5. Erach Bharucha, Text book for Environmental Studies, University Grants Commission, WWW.ugc.ac.in/policy/modelcurrr.html.

PTME206	STRENGTH OF MATERIALS AND METALLURGY LAB	L	T	P	C
		0	0	2	1

Objectives:

- To study and analyse the microstructure of various metals
- To study the properties of materials through various testing

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
    i. Unhardened specimen
    ii. Quenched Specimen and
    iii. Quenched and tempered specimen.
11. Microscopic Examination of
    i. Hardened samples and
    ii. Hardened and tempered samples.

SEMESTER – IV

PTME207 HEAT AND MASS TRANSFER **L T P C**
3 1 0 4

(Use of standard heat and mass transfer data book is permitted in the University examination)

Objectives:

- To study the different modes of heat transfer and their application in engineering
- To study and design various types of heat exchangers
- To learn the basic concepts of mass transfer.

UNIT I CONDUCTION **15**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart.

UNIT II CONVECTION **13**

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **12**

Nusselts theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – LMTD Method of heat Exchanger Analysis – Effectiveness – NTU method of Heat Exchanger Analysis – Overall Heat Transfer Coefficient – Fouling Factors.

UNIT IV RADIATION 10

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoff Law – Black Body Radiation –Grey body radiation Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation.

UNIT V MASS TRANSFER 10

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

L: 45, T: 15 Total Hours:60

TEXT BOOKS:

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 1995.
2. Yadav R "Heat and Mass Transfer" Central Publishing House, 1995.
3. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co., 1994.

REFERENCES:

1. Nag P.K, " Heat Transfer", Tata McGraw-Hill, New Delhi, 2002
2. Holman J.P "Heat and Mass Transfer" Tata McGraw-Hill, 2000.
3. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 1998
4. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, 1998.

PTME208 DESIGN OF MACHINE ELEMENTS **L T P C**
3 1 0 4

Note: (Use of P S G Design Data Book is permitted in the University examination)

Objectives:

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data's required for design.

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS **12**

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

UNIT II DESIGN OF SHAFTS AND COUPLINGS **12**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways - Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings - design of knuckle joints.

UNIT III DESIGN OF FASTNERS AND WELDED JOINTS **12**

Threaded fastners - Design of bolted joints including eccentric loading – Design of welded joints for pressure vessels and structures - theory of bonded joints.

UNIT IV DESIGN OF SPRINGS AND LEVERS **12**

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs - Belleville springs – Design of Levers.

UNIT V DESIGN OF BEARINGS AND FLYWHEELS 12

Design of bearings – sliding contact and rolling contact types. – Cubic mean load – Design of journal bearings – Mckees equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of flywheels involving stresses in rim and arm.

L: 45, T: 15 Total Hours:60

TEXT BOOKS:

1. Juvinall R.C, and Marshek K.M, "Fundamentals of Machine Component Design", John Wiley & Sons, Third Edition, 2002.
2. Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Book Co, 2003.

REFERENCES:

1. Norton R.L, "Design of Machinery", Tata McGraw-Hill Book Co, 2004.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Ugural A.C, "Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2004.
4. Spotts M.F., Shoup T.E "Design and Machine Elements" Pearson Education, 2004.

STANDARDS:

1. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 1 Construction.
2. IS 10260: Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 2 : Friction and Wear.
3. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 3 : Lubrication.

PTME209 DYNAMICS OF MACHINERY L T P C
3 1 0 4

Objectives:

- To understand the force-motion relationship in components subjected to external forces and standard mechanisms.
- To understand the importance of balancing in various machineries.
- To understand the effect of dynamics due to undesirable vibrations.
- To understand the principles in control mechanisms.

UNIT I FORCE ANALYSIS 14

Rigid Body dynamics in general plane motion – Equations of motion.-Dynamic force analysis - Inertia force and Inertia torque - D.Alemberts principle - The principle of superposition - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams - Fly wheels –Engine shaking Forces - Cam dynamics - Unbalance, Spring, Surge and Windup.

UNIT II BALANCING 12

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines.

UNIT III FREE VIBRATION 12

Basic features of vibratory systems - idealized models Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Types of Damping - Damped vibration critical speeds of simple shaft - Torsional systems; Natural frequency of two and three rotor systems.

UNIT IV FORCED VIBRATION 10

Response to periodic forcing - Harmonic Forcing - Forcing caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility Vibration isolation.

UNIT V MECHANISM FOR CONTROL 12

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction - Controlling Force other Governor mechanisms.

Gyroscopes - Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes.

L: 45, T: 15 Total Hours:60

TEXT BOOK:

1. Rattan S.S., “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1994.

REFERENCES :

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.
2. Ghosh A. and Mallick A.K., “Theory of Mechanisms and Machines”, Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
3. Shigley J.E. and Uicker J.J., “Theory of Machines and Mechanisms”, McGraw-Hill, Inc., 1995.
4. Rao J.S. and Dukkipati R.V., “Mechanism and Machine Theory”, Wiley-Eastern Limited, New Delhi, 1992.
5. John Hannah and Stephens R.C., “Mechanics of Machines”, Viva low-Priced Student Edition, 1999.
6. Sadhu Singh “Theory of Machines”, Pearson Education, 2002.

PTME210 METROLOGY AND MEASUREMENTS **L T P C**
3 0 0 3

Objectives:

- To transfer knowledge about metrology and its practical application which play an important role in the modern competitive industrial environment.
- To provide knowledge on the basic principles of measuring instruments and the precision measurement techniques.

UNIT I MEASUREMENT CONCEPT **10**

Definition of metrology, General Concepts of measurement system-Units and standards-measuring instruments- sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration, interchangeability, traceability. Stastistical concepts: Mean, Range, Variance and Standard deviation.

UNIT II LINEAR, ANGULAR AND FORM MEASUREMENT **11**

Linear measuring instruments: Slip gauges, Tool Maker's microscope, limit gauges. Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements: -Sine bar, bevel protractor-Taper angle measurements- Form measurement- Measurement of screw threads- floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method- straightness, flatness and roundness measurements- surface finish-surface roughness tester.

UNIT III LASER AND ADVANCES IN METROLOGY **8**

Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications.- computer aided inspection. Machine Vision systems - principle and functions.

UNIT IV FORCE, TORQUE AND TEMPERATURE MEASUREMENT **8**

Response of Measuring System: Amplitude, Frequency and Phase - Force, torque measurement- mechanical, pneumatic, hydraulic and electrical type-Flow measurement-Temperature measurement- bimetallic strip, pressure thermometers, thermocouples, electrical resistance thermister.

UNIT V VIBRATION AND ACOUSTIC MEASUREMENT 8

Vibration measurement – Vibrometers and accelerometers, test methods and calibration- Acoustic Measurement- AE Parameters, principles of acoustic emission techniques ,– Advantages, limitations and applications.

Total Hours:45

TEXT BOOKS :

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, 1994
2. Alan S. Morris, “The Essence of Measurement”, Prentice Hall of India, 1997

REFERENCES :

1. Gupta S.C, “Engineering Metrology”, Dhanpat rai Publications, 1984
2. Beckwith T.G, and R.D.Marangoni, “Mechanical Measurements”, Addison Wesley, 1999
3. Donald D Eckman, “Industrial Instrumentation”, Wiley Eastern, 1985.
4. ASTME, “hand book of industrial metrology” Prentice Hall of India, 1988
5. ASNT, “Nondestructive testing handbook Emission” Volme.5- Acoustic emission testing,1994

PTME211 APPLIED HYDRAULICS AND PNEUMATICS **L T P C**
3 0 0 3

Objectives:

- To learn the advantages and applications of fluid power engineering and power transmission system.
- To learn the applications of fluid power system in automation of machine tools and others equipments.

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols.

Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

UNIT II HYDRAULIC SYSTEM & COMPONENTS 9

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps.

Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tandem, Rod less, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

Construction of Control Components : Director control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram.

UNIT III DESIGN OF HYDRAULIC CIRCUITS 9

Reciprocation, Quick return, Sequencing, Synchronizing Circuits , simple industrial circuits, Press circuits, Earth movers, grinding machine, Safety and Emergency modules.

Accumulators and Intensifiers : Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS 9

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators.

Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Penumo hydraulic circuit, Sequential circuit design for simple industrial applications using cascade method.

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves.

Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

Total Hours:45

TEXT BOOKS :

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2000.
2. Majumdar S.R., “Oil Hydraulics”, Tata McGraw-Hill, 2000.

REFERENCES :

1. Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw Hill, 1995
2. Anthony Lal, “Oil hydraulics in the service of industry”, Allied publishers, 1982.
3. Harry L. Stevart D.B, “Practical guide to fluid power”, Taraoeala sons and Port Ltd. Broadey, 1976.
4. Michael J, Prinches and Ashby J. G, “Power Hydraulics”, Prentice Hall, 1989.
5. Dudely A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.

PTME212	THERMAL ENGINEERING LAB	L	T	P	C
		0	0	2	1

Objectives:

- To conduct performance and heat balance tests on various I.C. engines
- To estimate liquid fuel properties
- To conduct performance and heat balance tests on steam generators and steam turbines

I.C ENGINE LAB AND FUELS LAB

1. Valve Timing and Port Timing Diagrams.
2. Performance Test on 4-stroke Diesel Engine.
3. Heat Balance Test on 4-stroke Diesel Engine.
4. Morse Test on Multicylinder Petrol Engine.
5. Retardation Test to find Frictional Power of a Diesel Engine.
6. Determination of Viscosity – Red Wood Viscometer.
7. Determination of Flash Point and Fire Point.

STEAM LAB

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

SEMESTER – V

PTME301	MECHATRONICS	L	T	P	C
		3	0	0	3

Objective:

- To create knowledge about the source of concepts and techniques involved in mechatronic systems which are widely used in various industries.

UNIT I MECHATRONICS, SENSORS AND TRANSDUCERS 9

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers.

Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors.

UNIT II ACTUATION SYSTEMS 9

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – D.C Motors – A.C Motors – Stepper Motors.

UNIT III SYSTEM MODELS AND CONTROLLERS 9

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

UNIT IV PROGRAMMING LOGIC CONTROLLERS 9

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC Problem.

UNIT V DESIGN OF MECHATRONICS SYSTEM 9

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions, Case Studies of Mechatronics Systems, Pick and place robot – automatic Car Park Systems – Engine Management Systems.

Total Hours:45

TEXT BOOK:

1. W. Bolton, “Mechatronics”, Pearson Education, Second Edition, 1999.

REFERENCES :

1. Michael B. Histand and David G. Alciatore, “ Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 2000.
2. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, “Mechatronics”, Chapman and all, 1993.
3. Dan Necsulesu, “Mechatronics”, Pearson Education Asia, 2002 (Indian Reprint).
4. Lawrence J. Kamm, “Understanding Electro – Mechanical Engineering”, an Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.
5. Nitaigour Premchand Mahadik, “Mechatronics”, Tata McGraw-Hill publishing Company Ltd, 2003

PTME302 DESIGN OF TRANSMISSION SYSTEMS **L T P C**
3 1 0 4

Note: (Usage of P.S.G Design Data Book is permitted in the University examination)

Objectives:

- To gain knowledge on the principles and procedure for the design of power transmission components.
- To understand the standard procedure available for Design of Transmission systems
- To learn to use standard data and catalogues

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS **12**

Selection of V belts and pulleys – selection of Flat belts and pulleys - Wire ropes and pulleys – Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS **12**

Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS **12**

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears.

Worm Gear: Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.

Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT IV DESIGN OF GEAR BOXES 12

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box.

UNIT V DESIGN OF CAM, CLUTCHES AND BRAKES 12

Cam Design: Types-pressure angle and under cutting base circle determination - forces and surface stresses.

Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-internal and external shoe brakes.

L : 45, T : 15 Total Hours:60

TEXT BOOKS :

1. Juvinall R. C., Marshek K.M., “Fundamentals of Machine component Design”, – John Wiley & Sons Third Edition, 2002.
2. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd., 1994.

REFERENCES :

1. Maitra G.M., Prasad L.V., “Hand book of Mechanical Design”, II Edition, Tata McGraw- Hill, 1985.
2. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, McGraw-Hill, International Editions, 1989.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000, Norton R.L, “Design of Machinery”, McGraw-Hill Book co, 2004.
4. Hamrock B.J., Jacobson B., Schmid S.R., “Fundamentals of Machine Elements”,McGraw-Hill Book Co., 1999.

STANDARDS :

1. 1.IS 4460: Parts 1 to 3 : 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity.
2. IS 7443 : 2002, Methods of Load Rating of Worm Gears
3. IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, Pl and PM Profiles : Dimensions

4. IS 2122: Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 1 Flat Belt Drives.

5. IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission : Part 2 V-Belt Drives.

PTME303	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

Objectives:

- To provide an overview of how computers are being used in design, development of manufacturing plans and manufacturing
- To understand the need for integration of CAD and CAM
- To gain knowledge on how computers are integrated at various levels of planning and manufacturing understand computer aided planning and control and computer monitoring.

UNIT I INTRODUCTION 9

Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices.

Computer Graphics: Raster scans graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

UNIT II GEOMETRIC MODELING 9

Geometric modeling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

Drafting and Modeling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling, constraint based modeling.

UNIT III COMPUTER AIDED MANUFACTURING 9

Numerical control: NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming.

UNIT IV COMPUTER AIDED PRODUCTION PLANNING GROUP TECHNOLOGY 9

Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type. Material requirement planning, manufacturing resources planning.

UNIT V FLEXIBLE MANUFACTURING SYSTEMS 9

DNC, AGV, ASRS, Flexible manufacturing systems – FMS equipment, system layouts, FMS control.CIM: Integration, CIM implementation, major functions in CIM, Benefits of CIM, Lean manufacturing, Just-in-time.

Total Hours:45

TEXT BOOK :

1. CAD / CAM Principles and Applications – 2nd edition, P.N. Rao, Tata Mc. Graw Hill.

REFERENCES:

1. CAD / CAM Theory and Practice / Ibrahim Zeid / TMH
2. CAD / CAM / CIM / Radhakrishnan and Subramanian / New Age
3. Principles of Computer Aided Design and Manufacturing / Farid Amirouche/ Pearson
4. Computer Numerical Control Concepts and programming / Warren S Seames/ Thomson.

PTME304 DESIGN AND MANUFACTURE OF JIGS, FIXTURES AND TOOLS **L T P C 3 1 0 4**

Objectives:

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

UNIT I LOCATING AND CLAMPING PRINCIPLES 10

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT II JIGS AND FIXTURES 12

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT III PRESS WORKING TERMINOLOGIES & ELEMENTS OF CUTTING DIES 13

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT IV BENDING FORMING AND DRAWING DIES 13

Difference between bending, forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing –

Design and development of bending, forming, drawing reverse re-drawing and combination dies – Blank development for ax- symmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V MOULD MAKING 12

Die sinking (copy milling), Pentograph, Profile grinding, Electrical discharge machining – Characteristics, physical processes, special technological features, types of EDM, design consideration & functions and technological planning. Applications of wire cut EDM in mold making.

Electroforming for mold manufacturing – discussion of the process, materials for electroforming, design & materials for models, machining for electroformed blanks, mold cavities, economy & service life.

L : 45, T : 15 Total Hours:60

TEXT BOOKS:

1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Donaldson, Lecain and Goold “Tool Design”, IIIrd Edition Tata McGraw Hill, 2000.

REFERENCES:

1. K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton – Third Edition 1974.
2. Joshi, P.H. “Press Tools” – Design and Construction”, Wheels publishing, 1996.
3. Hoffman “Jigs and Fixture Design” – Thomson Delmar Learning, Singapore, 2004.
4. ASTME Fundamentals of Tool Design Prentice Hall of India.
5. Design Data Hand Book, PSG College of Technology, Coimbatore.

PTME305	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	1	0	4

Objectives:

- To impart knowledge in process planning, cost estimation and budgeting.
- To understand traditional and computer aided process planning and costing.
- To make cost estimation for various products after process planning.

UNIT I PROCESS PLANNING 10

Definition – Objective – Scope – approaches to process planning- Process planning activities – Finished part requirements- operating sequences- machine selection – material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes – CAPP – Retrieval and generative type.

UNIT II COMPUTER AIDED PROCESS PLANNING 10

Computer Aided Process Planning - Variant process planning - Generative process planning - Forward and backward planning, Logical Design of Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP

UNIT III INTRODUCTION TO COST ESTIMATION 10

Objective of cost estimation- costing – cost accounting- classification of cost- Elements of cost- Material cost-Determination of material cost-Labour cost-Determination of labour cost - Expenses-Ladder of cost - Analysis of overhead expenses-Factory expenses – Depreciation - causes of deprecation – Methods of depreciation – Administrative Expenses – Selling Price Calculation.

UNIT IV PRODUCTION COST ESTIMATION 15

Estimation in Forging shop – Losses in Forging – Forging cost – Estimation in welding shop – Gas cutting – Electric arc welding – Estimation in Foundry shop – Estimation of pattern cost and casting cost.

UNIT V ESTIMATION OF MACHINE TIME AND COST 15

Estimation of machining time for lathe operation – estimation machining time for drilling, boring, shaping, planning milling and grinding operations.

L : 45, T : 15 Total Hours:60

TEXT BOOK:

1. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 1995.

REFERENCES:

2. Phillip. F Ostwalal and Jairo Munez, "Manufacturing Processes and systems", John Wiley, 9th Edition, 1998.

3. Russell.R.S and Tailor, B.W, "Operations Management", PHI, 4th Edition, 2003.

4. Chitale.A.V. and Gupta.R.C., "Product Design and Manufacturing", PHI, 2nd Edition, 2002.

PTME306	METROLOGY AND CIM LAB	L	T	P	C
		0	0	2	1

Objectives:

- To measure experimentally various specifications of engineering components
- To use modern techniques for acquiring data in the measurements parameters such as temperature, vibration, displacement, force, torque etc.
- To train on moderns measuring equipments such as CMM, Machine Vision system and surface roughness tester.
- To practice the part programming of CNC lathe and milling
- To familiarize generation of NC code using software

LIST OF EXPERIMENTS:

1. Complete measurement of the given component using standard equipments
2. Measurements of Gear Tooth Dimensions
3. Measurement of Angle using Sine bar / Sin Center /Tool makers microscope / Slip-gauge
4. Measurement of straightness and flatness
5. Measurement of thread parameters
6. Measurement of surface roughness
7. Modeling a free form surface using Coordinate Measuring Machine (CMM)
8. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical)
9. MANUAL PART PROGRAMMING (Using G and M Codes) in CNC lathe
10. MANUAL PART PROGRAMMING (using G and M codes) in CNC milling

SEMESTER – VI

PTME307	INDUSTRIAL ENGINEERING AND MANAGEMENT	L T P C 4 0 0 4

Objectives:

- To learn the important aspects of Industrial engineering such as work study, method study, work measurement, job evaluation and merit rating
- To become familiarize with the needy management concepts such as planning, organizing, staffing, directing and controlling.

UNIT I INTRODUCTION AND WORK STUDY 12

Definition, History and development of Industrial Engineering, Industrial Engineering approach, Objectives of Industrial Engineering, Functions of Industrial Engineer.

Work Study: Need, Aim, and scope of Work-study, Techniques of work-study, Work-study procedure, Advantages of work-study, Human factors in work-study work-study and productivity working conditions.

UNIT II METHOD STUDY 12

Objectives of work-study, Scope of method study, Steps involved in method study, Selection of job for method study, Recording techniques, Micro & memo motion study, Development and selection of new method, Principles of motion Economy, Installation of the proposed method, Maintain the proposed method, Ergonomics.

UNIT III WORK MEASUREMENT 10

Objectives of work measurement, Techniques of work measurement, Time study equipments, Performance rating, Allowances, Computation of Standard time, Comparison of various techniques, Work sampling Synthetic Data, Predetermined Motion Time Analysis.

UNIT IV JOB EVALUATION AND MERIT RATING / WAGES AND INCENTIVES 10

Objectives of job evaluation, job evaluation-procedure, Analysis description, specification, evaluation, Merit rating.

Wage policy, factors influencing wage system, characteristics of wage system, types of wage payment, incentive schemes and plan.

UNIT V MANAGEMENT CONCEPTS 16

Nature and process of management- functions and levels of management Planning –Types, process- Management by Objectives- Management by Exception Organizing – Purpose- Types of organizations-Departmentation-Centralization Vs Decentralization Staffing – Recruitment-Selection-Placement-Training- Directing and controlling.

Total Hours: 60

TEXT BOOK :

1. Martand Telsang, Industrial Engineering and Production Management, S.Chand & Company Ltd.

REFERENCES :

1. P K.C Jain, L.N. Aggarwal roduction planning control and Industrial management, Khanna publishers.
2. Prasad L.M, “Principles of Management”. Sultan Chand & Sons, 2005

PTME308 OPERATIONS RESEARCH **L T P C**
3 1 0 3

Objectives:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.
- To create awareness about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations.
- To introduce the advanced OR models and to apply them for Engineering problems.

UNIT I LINEAR PROGRAMMING PROBLEM 12

Linear programming- formulation of the problem- Simplex method, graphical method, Big M method, Dual simplex method, two phase method.

UNIT II TRANSPORTATION PROBLEM & ASSIGNMENT PROBLEM 12

Transportation models- Initial Basic feasible solutions, MODI method, Unbalance in transportation, Degeneracy in transportation models

Assignment Problem - Minimization and Maximizations type of problems by Hungarian method.

UNIT III NETWORK ANALYSIS AND SEQUENCING PROBLEMS 12

PERT and CPM – Network diagram- Probability of achieving completion date - Crash time – Cost analysis.

Sequencing N jobs through 2 machines and 3 machines

UNIT IV QUEUING THEORY & INVENTORY CONTROL 12

Queuing theory- Poisson arrivals and exponential service times – characteristics of Queuing models- single channel and multi channel models.

Inventory Control- Deterministic Inventory models & Probabilistic demand models.

UNIT V REPLACEMENT MODELS, SYSTEM ANALYSIS & SIMULATION 12

Replacement models- Replacement of items that deteriorate with time- value of money changing with time- not changing with time- Individual and group replacement policy

System Analysis & Simulation- Types of system, elements of system, system analysis, steps involved in system analysis and system design.- simulation basic concepts , advantages and dis advantages- random number generation- Monte carlo simulation.

L : 45, T : 15 TOTAL : 60

TEXT BOOK :

1. Taha H.A. Operations Research,Pearson Education, 6th Edition, 2003.

REFERENCES :

1. Hira and Gupta, Problems in Operations Research, S.Chand and co.2002
2. Panneerselvam, Operations Research Prentice Hall of India, 2003

PTME309 INTRODUCTION TO FINITE ELEMENT ANALYSIS L T P C
3 1 0 4

Objectives:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT I INTRODUCTION 11

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems – Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II ONE-DIMENSIONAL PROBLEMS 15

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors. Assembly of Matrices - solution of problems from solid mechanics and heat transfer- Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 13

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts – Quadrilateral elements – Higher Order Elements.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 10

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION AND MISCELLANEOUS TOPICS 11

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems –

L : 45, T : 15 Total Hours:60

TEXT BOOKS:

1. Seshu. P. “Text book of Finite Element Analysis” Prentice Hall of India, 2003.
2. J.N. Reddy, “Finite Element Method” Tata McGraw Hill, 2003.

REFERENCES:

1. Chandrupatla and Belegundu, “Introduction to Finite Elements in Engineering” PHI / Pearson Education, 2003.
2. Logan. D.L. “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002.
3. Cook R.D., Malkus. D.S. Plesha, ME., “Concepts and Applications of Finite Element Analysis”, John – Wiley Sons 2003.
4. S.S. Rao, “The Finite Element Method in Engineering “Butter worth Heinemann, 2001.

PTME310	COMPUTER AIDED MODELING AND ANALYSIS LAB	L	T	P	C
		0	0	2	1

Objectives:

- To practice the various modeling and drafting software
- To analyse stress distribution and stress concentration of various components under structural and thermal loads.

A) COMPUTER AIDED MODELING

3D Part modeling – protrusion, cut, sweep, draft, loft, blend, rib Editing – Move, Pattern, Mirror, Round, Chamfer Assembly – creating assembly from parts – assembly constraints Conversion of 3D solid model to 2D drawing - different views, sections, isometric view and dimensioning Introduction to Surface Modeling Introduction to File Import, Export – DXF, IGES, STL, STEP 3D modeling of machine elements like flanged coupling, screw jack etc.

Note: Any one of the 3D MODELING softwares like Pro/E, IDEAS, CATIA, UNIGRAPHICS, AutoCAD to be used.

B) ANALYSIS LAB

Stress analysis of a plate with a circular hole.

Stress analysis of rectangular L bracket

Stress analysis of an axi-symmetric component

Stress analysis of beams (Cantilever, Simply supported, Fixed ends)

SEMESTER – VII

PTME401	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Objective:

- To understand the basic concepts and principles of TQM.
- To learn the fundamentals of statistical process control.
- To acquire the knowledge about various tools used for TQM.
- To understand the principle and implementation of quality systems.

UNIT I INTRODUCTION 9

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II TQM PRINCIPLES 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III STATISTICAL PROCESS CONTROL (SPC) 9

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV TQM TOOLS 9

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits,

Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Total Hours:45

TEXT BOOK :

1. Dale H.Besterfiled, et al., Total Quality Management, Pearson Education, Inc. 2003. (Indian reprint 2004). ISBN 81-297-0260-6.

REFERENCE BOOKS :

1. James R.Evans & William M.Lidsay, 'The Management and Control of Quality', (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. 'Total Quality Management', McGraw Hill, 1991.
3. Oakland.J.S. 'Total Quality Management' Butterworth – Hcinemann Ltd., Oxford. 1989.
4. Narayana V. and Sreenivasan, N.S. 'Quality Management – Concepts and Tasks', New Age International 1996.
5. Zeiri. 'Total Quality Management for Engineers' Wood Head Publishers, 1991.

PTME402 ROBOTICS AND AUTOMATION L T P C
3 0 0 3

Objectives:

- To understand the basic concepts associated with the design and functioning and applications of robots.
- To study about the drives and sensors used in robots.
- To learn about analyzing robot kinematics and robot programming.

UNIT I FUNDAMENTALS OF ROBOT 7

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Their Functions – Need for Robots – Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 10

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives.

End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 10

Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms. Applications – Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 10

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems.

Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 8

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

Total Hours:45

TEXT BOOK :

1. M.P.Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw-Hill, 2001.

REFERENCES :

1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill Book Co., 1987.
2. Yoram Koren, “Robotics for Engineers”, McGraw-Hill Book Co., 1992.
3. Janakiraman.P.A., “Robotics and Image Processing”, Tata McGraw-Hill, 1995.

ELECTIVES

PTMEX01 ENERGY CONSERVATION AND MANAGEMENT **L T P C**
3 0 0 3

Objectives:

- To acquire knowledge on energy audit, energy economy and energy management
- To understand the importance of energy efficiency and conservation in Electrical and Mechanical systems
- To understand contemporary issues related to the environment.

UNIT I IMPORTANCE OF ENERGY CONSERVATION AND MANAGEMENT **8**

World, national Energy consumption – environmental aspects – Energy prices, policies – Energy auditing : methodology, analysis, energy accounting – Measurements – Thermal and Electrical.

UNIT II ELECTRICAL SYSTEMS **12**

AC / DC current systems, Demand control, power factor correction, load management, Motor drives : motor efficiency testing, energy efficient motors, motor speed control – Lighting : lighting levels, efficient options, daylighting, timers, Energy efficient windows – electrical distribution systems – Transformers – Power quality – harmonic distortion.

UNIT III THERMAL SYSTEMS **10**

Boiler – efficiency testing, excess air control, Steam distribution & use – steam traps, condensate recovery, flash steam utilization, Thermal Insulation. Heat exchanger networking – concept of pinch, target settling, problem table approach.

UNIT IV ENERGY CONSERVATION **8**

Energy conservation in Pumps, Fans (flow control) and blowers, Compressed Air Systems, Refrigeration and air conditioning systems – Waste heat recovery recuperators, heat sheets, heat pipes, heat pumps.

UNIT V ENERGY MANAGEMENT, ECONOMICS 7

Energy resource management – Energy Management information systems – Computerized energy management – Energy economics – discount rate, payback period, internal rate of Return, life cycle costing – Financing energy conservation Projects.

Total Hours:45

TEXT BOOKS:

1. L.C. Witte, P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
2. O. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.

REFERENCES:

1. I.G.C. Dryden, “The Efficient Use of Energy” Butterworths, London, 1982
2. W.C. turner, “Energy Management Hand book” Wiley, New York, 1982.
3. W.R. Murphy and G. Mc KAY “Energy Management” Butterworths, London 1987.

PTMEX02 RENEWABLE SOURCES OF ENERGY

L	T	P	C
3	0	0	3

Objectives :

- To understand contemporary issues related to the environment.
- To understand the basic forms of renewable energy sources.
- To expose future energy systems and energy use scenarios with a focus on promoting the use of renewable energy resources and technologies.

UNIT I ENERGY AND ENVIRONMENT 9

Primary energy sources - world energy resources-Indian energy scenario-energy cycle of the earth –environmental aspects of energy utilisation, CO2 emissions and Global warming, Global dimming–renewable energy resources and their importance. Potential impacts of harnessing the different renewable energy resources.

UNIT II SOLAR ENERGY 9

Principles of solar energy collection -.solar radiation - measurements - instruments - data and estimation- types of collectors - characteristics and design principles of different type of collectors - performance of collectors - testing of collectors. Solar thermal applications - water heaters and air heaters - performance and applications - simple calculations - solar cooling - solar drying - solar ponds - solar tower concept - solar furnace.

UNIT III WIND, TIDAL AND GEO THERMAL ENERGY 9

Energy from the wind - general theory of windmills - types of windmills - design aspects of horizontal axis windmills - applications. Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants - power from geothermal energy - principle of working of geothermal power plants.

UNIT IV BIO ENERGY 9

Energy from bio mass & bio gas plants -various types - design principles of biogas plants - applications. Energy from wastes – Waste Collection, Reduction and Transfer, waste burning power plants - utilization of industrial and municipal wastes - energy from the agricultural wastes.

UNIT V OTHER RENEWABLE ENERGY SOURCES 9

Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) - thermoelectric generators – thermionic generators - fuel cells - solar cells - types, Emf generated, power output, losses and efficiency and applications. Hydrogen conversion and storage systems.

Total Hours:45

TEXT BOOK :

1. Rai G.D, “Non conventional Energy sources” (1999) Khanna Publishers, New Delhi.

REFERENCES :

1. Sukhatme, S.P., Solar Energy, 2nd edition, TMH, 2003
2. Sulton, “Direct Energy Conversion”, McGraw-Hill, 1966.
3. Duffie and Beckmann, “Solar Energy Thermal Processes, John Wiley, 1974.
4. Garg. H. P and Prakash. J., “Solar Energy - Fundamentals and applications”, TMH, New Delhi, 1997.

PTMEX03 REFRIGERATION AND AIR CONDITIONING **L T P C**
3 0 0 3

(Use of standard steam tables, Psychometric chart and Refrigerant property tables are permitted)

Objectives:

- To understand the underlying principles of operation in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning Systems.

UNIT I REFRIGERATION CYCLE **9**

Review of thermodynamic principles of refrigeration. Concept of Aircraft refrigeration system. Vapour compression refrigeration cycle - use of P-H charts - multistage and multiple evaporator systems - cascade system - COP comparison. Vapor absorption refrigeration system. Ammonia water and Lithium Bromide water systems. Steam jet refrigeration system.

UNIT II REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING **9**

Compressors - reciprocating & rotary (elementary treatment.) - condensers - evaporators - cooling towers. Refrigerants - properties - selection of refrigerants, Alternate Refrigerants, Refrigeration plant controls - testing and charging of refrigeration units. Balancing of system components. Applications to refrigeration systems - ice plant - food storage plants - milk -chilling plants – refrigerated cargo ships.

UNIT III PSYCHROMETRY **9**

Psychrometric processes- use of psychrometric charts - Grand and Room Sensible Heat Factors - bypass factor - requirements of comfort air conditioning - comfort charts - factors governing optimum effective temperature, recommended design conditions and ventilation standards.

UNIT IV COOLING LOAD CALCULATIONS **9**

Types of load - design of space cooling load - heat transmission through building. Solar radiation - infiltration - internal heat sources (sensible and latent)

- outside air and fresh air load - estimation of total load - Domestic, commercial and industrial systems - central air conditioning systems.

UNIT V AIRCONDITIONING 9

Air conditioning equipments – air cleaning and air filters - humidifiers - dehumidifiers - air washers - condenser – cooling tower and spray ponds - elementary treatment of duct design - air distribution system. Thermal insulation of air conditioning systems. - applications: car, industry, stores, and public buildings.

Total Hours:45

TEXT BOOKS :

1. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., 1983.
2. Arora. C.P., "Refrigeration and Air Conditioning", Tata McGraw-Hill New Delhi, 1988.

REFERENCES :

1. Roy.J Dossat, “Principles of Refrigeration”, Pearson Education 1997.
2. Jordon and Prister, “Refrigeration and Air Conditioning”, Prentice Hall of India PVT Ltd., New Delhi, 1985.
3. Stoecker N.F and Jones, "Refrigeration and Air Conditioning", TMH, New Delhi,1981.

PTMEX04 GAS DYNAMICS AND JET PROPULSION

L	T	P	C
3	0	0	3

Objectives:

- To understand the basic difference between incompressible and compressible flow.
- To impart knowledge on compressible flow through ducts, jet propulsion and space propulsion.
- To understand the phenomenon of shock waves and its effect.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 6

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers – Use of Gas tables.

UNIT II FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalised gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS 10

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.

UNIT IV JET PROPULSION 10

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V SPACE PROPULSION 10

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

Total Hours:45

TEXT BOOKS :

1. Anderson, J.D., Modern Compressible flow, McGraw Hill, 3rd Edition, 2003.
2. H. Cohen, G.E.C. Rogers & Saravanamutto, Gas Turbine Theory, Longman Group Ltd., 1980.
3. S.M. Yahya, fundamentals of Compressible Flow, New Age International (P)Limited, New Delhi, 1996.

REFERENCES :

1. P. Hill and C. Peterson, Mechanics and Thermodynamics of Propulsion, Addison – Wesley Publishing Company, 1992.
2. N.J. Zucrow, Aircraft and Missile Propulsion, vol.1 & II, John Wiley, 1975.
3. N.J. Zucrow, Principles of Jet Propulsion and Gas Turbines, John Wiley, New York, 1970
4. G.P. Sutton, Rocket Propulsion Elements, John wiley, 1986, New York.
5. A.H. Shapiro, Dynamics and Thermodynamics of Compressible fluid Flow, Johnwiley, 1953, New York.
6. V. Ganesan, Gas Turbines, Tata McGraw Hill Publishing Co., New Delhi, 1999.
7. PR.S.L. Somasundaram, Gas Dynamics and Jet Propulsions, New Age International Publishers, 1996.
8. V. Babu, Fundamentals of Gas Dynamics, ANE Books India, 2008.

PTMEX05	TURBO MACHINES	L	T	P	C
		3	0	0	3

Objective:

- To understand the various systems, principles, operations and applications of different types of turbo machinery components.

UNIT I INTRODUCTION TO TURBO MACHINES 9

Turbines, Pumps, Compressors, Fans and Blowers – Stages of Turbo machines – Energy transfer between fluid and rotor – Stage velocity triangles.

Thermal Turbo machines – Classification – General energy equation – Modified to turbo machines – compression and expansion process – Velocity triangles – Work – T-S and H-S diagram, Total – to – Total and Total – to – Static efficiencies.

Dimensional analysis – Non dimensional parameters of compressible flow Turbo machines – Similarity laws, applications and limitations.

UNIT II CENTRIFUGAL FANS AND BLOWERS 9

Definition, selection and classifications –Types of blading design-velocity triangles - Stage Parameters – Flow analysis in impeller blades –Design parameter- Volute and Diffusers – Efficiencies and Losses – Fan noises – Causes and remedial measures.

Centrifugal Compressors: - Constructional details – Stage velocity triangles – – Stage work – Stage pressure rise – Stage efficiency – Degree of reaction – Slip factor – H-S diagram – Efficiencies – Performance characteristics.

UNIT III AXIAL FANS AND PROPELLERS 9

Definition and classifications – Stage parameters – Types of fan stages-performance characteristics.

Cascade of blades – Cascade tunnel - Blade geometry-Cascade variables-Energy transfer and loss in terms of lift and drag - Axial Flow Compressors: definition and classifications – Constructional details – Stage velocity triangles – Stage work – Stage pressure rise – H-S diagram – Stage efficiencies and losses- Degree of reaction – Radial equilibrium-Surging and Stalling – Performance characteristics.

UNIT IV AXIAL FLOW TURBINES 9

Construction details –90^0 IFR turbine- Stage work – Stage Velocity triangles – Stage pressure rise – Impulse and reaction stage – Effect of degree of reaction – H-S diagram – Efficiencies and Losses –Performance characteristics.

UNIT V RADIAL FLOW TURBINES AND WIND TURBINES 9

Constructional details –– Stage velocity triangles – H-S diagram – Stage efficiencies and losses –Performance characteristics.

Wind turbines: definition and classifications – Constructional details –Horizontal axis wind turbine- Power developed – Axial thrust – Efficiency.

Total Hours:45

TEXT BOOKS :

1. Yahya, S.H., “Turbines, Compressors and Fans”, Tata McGraw-Hill Publishing Company, 1996.
2. Dixon S.L “Fluid Mechanics, Thermodynamics of turbomachines”-2nd Edition, Pergamon press 1990.

REFERENCES :

1. Kadambi V and Manohar Prasad- “An Introduction to energy conversion - Vol. III”, Turbomachines- Wiley Eastern India Ltd, 1977.
2. Shepherd D.H. – “Principles of Turbomachinery”- The Macmillan Company, 1969.

PTMEX06 COMPUTATIONAL FLUID DYNAMICS **L T P C**
3 0 0 3

Objective:

- To gain an overview of CFD and the use of commercial CFD codes to analyze flow and heat transfer in problems of practical engineering interest.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8

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 – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE METHOD 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

UNIT III FINITE VOLUME METHOD (FVM) FOR DIFFUSION 9

Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

UNIT IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 10

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes-properties of discretization schemes – Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT V CALCULATION FLOW FIELD BY FVM 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-ε) models – High and low Reynolds number models

Total Hours:45

TEXT BOOKS:

1. T.J. Chung, Computational Fluid Dynamics, Cambridge University, Press, 2002.
2. Versteeg, H.K., and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The finite volume Method, Longman, 1998.
3. 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, Hemisphere Publishing Corporation, 2004.
2. Muralidhar, K., and Sundararajan, T., computationsl Fluid Flow and Heat Transfer, Narosa Publishing House, NewDelhi, 1995.
3. Ghoshdastidar P.S., Heat Transfer, Oxford Unversity Press, 2005.
4. Prodip Niyogi, Chakrabarty S.K.,Laha .M.K.Introduction to Computational Fluid Dynamics, Pearson Education, 2005.
5. Introduction to Computational Fluid Dynamics Anil W. Date Cambridge University Press, 2005.

PTMEX07	MODERN CONCEPTS OF ENGINEERING DESIGN	L	T	P	C
		3	0	0	3

Objectives:

- To understand the importance of product design
- To understand the conceptual design and design selection
- To make students familiar with legal issues such as liability and intellectual property.

UNIT I PRODUCT DESIGN PROCESS 9

Importance of product design-Design process - Design considerations-Morphology of design - Marketing Organisation for design - Computer aided engineering-Codes and standards-Design review-Technological innovation and design process-Product and process cycles-Societal considerations in design.

UNIT II PRODUCT PLANNING AND SPECIFICATION 9

Opportunities identification-evaluation-resource allocation-preproject planning-customer need identification -establishing target specification-setting the final specification.

UNIT III CONCEPT GENERATION, SELECTION AND TESTING 9

Activity of concept generation, Clarification of problem-External and internal searches-Concept exploration-Result analysis-Overview of selection methodologies-Concept screening-Concept scoring-Concept testing-Choice of survey population-Survey formats-measurement of customer response-Interpretation and analysis of results.

UNIT IV PRODUCT ARCHITECTURE, INDUSTRIAL DESIGN, DESIGN FOR MANUFACTURE AND PROTOTYPING 9

Product architecture-implications-establishment-platform planning-system level design-Need for industrial design and its impact-The Industrial design process and its management-Assessment of quality-Overview of Design for Manufacture process-Steps in DFM-Basics principles of prototyping-Prototyping technologies-Planning for prototypes.

UNIT V ROBUST DESIGN AND PRODUCT DEVELOPMENT ECONOMICS AND INTELLECTUAL PROPERTY RIGHTS 9

Design of experiments-Steps in the robust design process-Elements of economic analysis-Steps in economic analysis process-Overview of patents-Utility patents-Steps in preparing disclosure.

Total Hours:45

TEXT BOOKS :

1. Ulrich KT., and Eppinger S. D, “Product Design and Development”, McGraw-Hill Book Company, International Edition 2003. ISBN 007 123 273 7.

REFERENCES :

1. Dieter G. E., “Engineering Design”, McGraw-Hill Book Company, International Edition, 2000. ISBN 007 116 204 6 (Unit – I)
2. Ullman D.G, “The Mechanical Design Process”, McGraw-Hill Book Co, Third Edition, 2003. ISBN 007 112281 8
3. Otto, K.N., and Wood, K.L., “Product Design-Techniques in Reverse Engineering and New product Development”, Pearson Education, First Indian Reprint, 2004. ISBN 81 2970271 1
4. Yousef Haik, “Engineering Design Process” Vikas Publishing House, 1999.

PTMEX08 THEORY OF METAL FORMING

L	T	P	C
3	0	0	3

Objectives:

- To understand the behaviour of materiels during forming
- To understand the varius metal forming processes and their analyses
- To study the varius special metal forming processes

UNIT I THEORY OF PLASTICITY 9

Theory of plastic deformation – Engineering stress and strain relationship – Strees tensor – Strain tensor – Yield criteria – Plastic stress strain relationship – Plastic work.

UNIT II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY 7

Uniaxial tension test – Mechanical properties – Work hardening, Compression test, bulge test, plane strain compression stress, plastic instability in uniaxial tension stress, plastic instability in biaxial tension stress.

UNIT III ANALYSIS OF METAL FORMING 12

Slab analysis – Slip line method, upper bound solutions, numerical methods, contact problems, effect of friction, thermo elastic- Elasto plasticity, elasto visco plasticity – analysis of forging, rolling, extrusion and wire drawing processes- Cold and Hot Forging.

UNIT IV SHEET METAL FORMING 8

Sheet Metal Forming methods – Bending – Drawing – Deep Drawing – Stretch Forming – Tooling and applications – Analysis of Sheet Metal Forming – HERF Techniques – Principles and Process Parameters – Superplastic Forming.

UNIT V SPECIAL METAL FORMING PROCESSES 9

Orbital forging, Isothermal forging, Warm forging, Hot and Cold isotrophical pressing, high speed extrusion, rubber pad forming, micro blanking – Overview of Powder Metal Techniques – Powder rolling.

Total Hours:45

TEXT BOOKS:

1. Dieter G.E , “Mechanical Metallurgy” Mc Graw – Hill Co. S1. Edition 1995
2. Nagpal G.R “Metal Forming Process”, Kanna Pub, New Delhi – 2000.

REFFERENCES:

1. Wagoner, R.H and Chenot, JJ Metal Forming Analysis, Cambridge University Press, 2002.
2. Slater, R.A.C., Engineering Plasticity – Theory and Applications to Metal Forming, JohnWiely and Sons, 1987.
3. Shiro Kobayshi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1989.
4. Hosford, W.F and Caddell, R.M., Metal Forming Mechanics and Metallurgy, Prentice Hall Eaglewood Cliffs, 1993.
5. Narayanaswamy. R,Theory of Metal Forming and Plasticity Narosa Publishers, 1999.

PTMEX09 MODERN MANUFACTURING SYSTEMS **L T P C**
3 0 0 3

Objectives

- To understand how the material removal by using various Energy.
- To know how the new materials and complex parts are produced with high accuracy by using new technology.

UNIT I COMPONENTS OF CIM **12**

CIM as a concept and a technology, CASA/Sme model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods – seriel, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM – point to point (PTP), star and multiplexing. Computer networking in CIM – the seven layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM.

UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING **9**

History of Group Technology – role of G.T in CAD/CAM Integration – part families- classification and coding – DCLASS and MCLASS and OPTIZ coding systems – facility design using G.T – benefits of G.T – cellular manufacturing.Process planning - role of process planning in CAD/CAM Integration – approaches to computer aided process planning – variant approach and generative approaches – CAPP and CMPP systems.

UNIT III UNCONVENTIONAL MACHINING **9**

Principles, Mechanism, process parameters and Applications of Ultrasonic machining, Electro Discharge Machining, Electro Chemical Machining, Electron and Laser Beam Machining, Plasma Arc Machining and Water Jet Machining.

UNIT IV RAPID PROTOTYPING **6**

Stereo lithography - Laminated object manufacturing - selective laser sintering - Vacuum process casting – Resin injection - Applications of RPT - Micro finishing process.

UNIT V ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 9

Introduction - Pattern recognition - Control strategies - Heuristic search, Forward and Backward reasoning - Search algorithms - Game playing - Knowledge representation - structural representation of knowledge – Expert systems in manufacturing.

Total Hours:45

REFERENCES :

1. Mikell. P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education 2001.
2. HMT Manual, "Non-traditional machining methods", 1975.
3. Amitabha Ghosh and Asok kumar Mallik, “Manufacturning science”, Ellis Horwood publisher
4. Rich E. and Knight K., "Artificial Intelligence", McGraw Hill Inc, 1991.
5. Pham D.T., "Expert Systems in Engineering", IFS Publishers, Springer-Verlag, 1988.
5. Durvent W.R., "The Lithographic hand book", Narosa Publishers, 1995.
6. Pandey P.S. and Shah N. "Modern Manufacturing Processes", 1980.
6. Sadasivan T.A. and Sarathy D. "Cutting tools for Productive Machining", Widia (India) Limited, 1999.

PTMEX10	ENGINEERING ECONOMICS AND COST ANALYSIS	L	T	P	C
		3	0	0	3

Objectives:

- To study the importance of economics in engineering.
- To impart knowledge on value engineering, interest formulae, cash flow analysis.
- To impart knowledge on replacement and maintenance analysis, depreciation types and methods to find depreciation amount.

UNIT I INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II VALUE ENGINEERING 10

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT III CASH FLOW 9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement

of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION 9

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

Total Hours:45

TEXT BOOKS:

1. 1.Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2001.

REFERENCES:

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 1984
4. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, “Principles of Engineering Economy”, Ronald Press, New York,1976.
5. Smith, G.W., “Engineering Economy”, Lowa State Press, Iowa, 1973.

PTMEX11	MARKETING MANAGEMENT	L	T	P	C
		3	0	0	3

Objective:

- To learn the concepts of marketing principles like strategic marketing concepts, segment ation, pricing, advertisement and strategic formulation.

UNIT I MARKETING AND STRATEGIES 10

Marketing philosophies and concepts, Marketing Management Process, Analysis of marketing opportunities, Analysis of micro and macro environment. Market segmentation, Targeting and positioning, Marketing Mix, Competetive Marketing Strategies.

UNIT II PRODUCT POLICIES 13

Product planning and development – product life cycle – brand management, New product Development, pricing strategis, Distribution channel design and management – Promotion Mix-Personal selling, Advertisement, Sales promotion and Publicity public relations.

UNIT III CONSUMER BEHAVIOUR 7

Understanding Industrial and individual buyer behavior – influencing factors – responding to buyer behaviour – Building customer satisfaction, Relationship – marketing to organization - marketing of services.

UNIT IV MARKETING RESEARCH 10

Types, process – tools and techniques – application of marketing research – product launching, demand estimation, advertising, brand preferences, customer satisfaction, retail stores image, customer perception, distribution, competitor analysis and related aspects – preparation of marketing research report – sample case studies.

UNIT V INFORMATION TECHNOLOGY IMPACT ON MARKETING DECISIONS 5

Online marketing – web based marketing programmes – emerging new trends and challenges to marketers.

Total Hours:45

TEXT BOOKS :

1. Phlip Kortler: Marketing management (Millenium edidtion), prentice hall of India P (ltd), New Delhi 2001.
2. Zikmand d'Amico, Marketing South western, Thomson Learning, 2000.
3. Sherlekar S.A., Marketing Management, Himalaya publishing, New Delhi.

REFERENCES:

1. Micheal R.Czinkota & Masaaki Kotabe, Marketing management, Vikas Thomson learning 2000.
2. Douglas, J.Darymple marketing management John Wiley & Sons, 2000
3. NAG, marketing successfully A professional perceptive, macmilan 2001.
4. Boyd Walker, Marketing Management, McGraw Hill, 2002
5. Aakar Day, Kumar, Essential of Marketing Research
6. Keith Flether, Marketing Management and Information Technology Prentice Hall, 1998.
7. R.L.Varshney, S.L.Gupta, marketing management Indian perspective, Sultan Chand 2000.

PTMEX12 ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

Objective:

- To develop confidence on financial assistance by the institutions, methods of taxation and tax benefits, etc., and to initiate the entrepreneurship skills among the student community.

UNIT I ENTREPRENEURSHIP **9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION **9**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Entrepreneurial skills - Self Rating, Business Game, Thematic Appreciation Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS **9**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING **9**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT / CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS **9**

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale

Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

Total Hours : 45

TEXT BOOKS:

1. S.S.Khanka "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
2. Kurahko & Hodgetts, "Enterprenuership – Theory, process and practices", Thomson learning 6th edition.

REFERENCES:

1. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002.
2. Mathew J Manimala," Enterprenuership theory at cross roads: paradigms and praxis" Dream tech 2nd edition 2006.
3. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs" Publishers: Entrepreneurship Development" Institute of India, Ahmedabad, 1986.

PTMEX13 PRODUCTION PLANNING AND CONTROL **L T P C**
3 0 0 3

Objectives:

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).The course provides basic concepts of production planning and control, its bottlenecks, material requirement planning, shop floor control and different approaches to computer aided process planning in manufacturing sector.

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect-aesthetic aspect. Profit consideration-Standardization, Simplification & specialization-Break even analysis-Economics of a new design. Sales Forecasting - Sales Trend Analysis, Forecasting in seasonal demand, use of indicators and correlation analysis.

UNIT II WORK STUDY AND ERGONOMICS **9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards. Ergonomics principles and applications.

UNIT III RODUCT PLANNING AND PROCESS PLANNING **9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling-Batch production scheduling-Product sequencing - Production Control systems-Periodic batch control-Material requirement planning kanban –Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures.Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

Total Hours:45

TEXT BOOK :

1. Martand Telsang, “Industrial Engineering and Production Management”, S. Chand and Company, First edition, 2000.

REFERENCES :

1. Samson Eilon, “Elements of production planning and control”, Universal Book Corpn.1984
2. Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, 8th Edition. John Wiley and Sons, 2000.
3. K.C.Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers, 1990.
4. N.G. Nair, “Production and Operations Management”, Tata McGraw-Hill, 1996.
5. S.N.Chary, “Theory and Problems in Production & Operations Management”, Tata McGraw Hill, 1995.
6. S.K. Hajra Choudhury, Nirjhar Roy and A.K. Hajra Choudhury, “Production Management”, Media Promoters and Publishers Pvt. Ltd., 1998.

PTMEX14	RELIABILITY ENGINEERING AND MAINTENANCE	L	T	P	C
		3	0	0	3

Objectives:

- To introduce the concept of reliability and maintenance.
- To understand the process control, sampling procedures and their application.
- To learn the methods of failure analysis.

UNIT I RELIABILITY 9

Definition, mean fracture rate, mean time to failure, mean time between failures, hazard rate, hazard models, constant hazard, linearly increasing hazard, Weibull model.

UNIT II FAILURE DATA ANALYSIS 9

Repair time distributions - exponential, normal, log normal, gamma - Graphical evaluation.

UNIT III RELIABILITY SYSTEM 9

System reliability, series, parallel and mixed configuration, Simple problems - Standby reliability.

UNIT IV RELIABILITY TESTING 9

Reliability demonstration and testing - Reliability growth testing - Duane curve - Risk assessment - FMEA, Fault tree.

UNIT V TOTAL PRODUCTIVE MAINTENANCE 9

Causes of Machine Failures - Downtime - Maintenance policies - Restorability predictions - Replacement models - Spares provisioning -Maintenance management - Cleanliness and House Keeping.

Total Hours:45

REFERENCES:

1. Paul Kales, Reliability for technology, "Engineering and Management", Prentice Hall, New Jersey, 1998.
2. Modarres, "Reliability and Risk Analysis", Meral Dekker Inc., 1993.

3. Gopalakrishnan.P, and Banerji A.K., "Maintenance and Spare Parts Management", Prentice Hall of India, New Delhi, 1996.

4. Ebeling, “An Introduction to Reliability and Maintainability Engineering”, Tata Mc Graw Hill, 2004.

PTMEX15 INTERNAL COMBUSTION ENGINES **L T P C**
3 0 0 3

Objective :

- To understand the underlying principles of operation in different IC Engines and components.
- To provide knowledge on pollutant formation, control, alternate fuel etc.,

UNIT I SPARK IGNITION ENGINES **9**

Spark ignition engine, Mixture requirements – Feedback Control Carburettors _ Petrol injection systems – Normal and abnormal Combustion – Factors affecting knock – Shape of combustion chambers in SI engine.

UNIT II COMPRESSION IGNITION ENGINES **9**

Normal and abnormal Combustion in CI engines, direct and indirect ignition systems, combustion chambers – air movements in CI engines – Fuel spray behaviour – Spray structure, spray generation and evaporation _ turbo charging in CI engines.

UNIT III ALTERNATIVE FUELS **9**

Alternate fuels – Ethanol and Bio Diesel - Hydrogen – Natural gas – Liquefied Petroleum Gas- Suitability, engine modifications, merits and demerits of I.C. Engine fuels.

UNIV IV ENGINE EMISSIONS AND THEIR CONTROL **9**

Pollutants from I.C. engines – Formation of NOx, SOx, CO, CO2 and Hydro carbon, emission mechanism, particulate emission- Methods of controlling emissions – Catalytic converters and particulate traps- Methods of measurement of emission and driving cycles.

UNIT V RECENT TRENDS IN IC ENGINES **9**

Stratified charge spark ignition engine – learn burn engines, dual fuel engine- Multi point fuel injection gasoline engines- Homogenous charge compression ignition engines- Plasma ignition, electric / hybrid vehicles.

Total Hours:45

REFERENCES :

1. Mathur R.B. and Sharma R.P, Internal Combustion Engines- Dhanpat Rai & Sons.1994.
2. Domkundwar V.M., Internal Combustion Engines- Dhanpat Rai & Co., 1999.
3. John B. Heywood, Internal Combustion Engine Fundamentals – McGraw Hill., 1988.
4. Gill, Smith and Zurich, Fundamentals of IC engines.
5. Ganesan V., internal Combustion Engines - Tata McGraw Hill,1996

PTMEX16 AUTOMOBILE ENGINEERING **L T P C**
3 0 0 3

Objective :

- To provide a comprehensive view of automobile engineering to the students.

UNIT I VEHICLE STRUCTURE AND ENGINES 10

Types of Automobiles - Vehicle Construction – Chassis – Frame and Body – aerodynamics. Components of Engine – Their forms, Functions and Materials - Review of Cooling and Lubrication systems in Engine – Turbo Chargers – Engine Emission Control by 3–Way

Catalytic Controller – Electronic Engine Management System.

UNIT II ENGINE AUXILIARY SYSTEMS 10

Carburettor–working principle- Electronic fuel injection system – Mono-point and Multi - Point Injection Systems – Construction, Operation and Maintenance of Lead Acid Battery - Electrical systems – Battery generator – Starting Motor and Drives – Lighting and Ignition (Battery, Magneto Coil and Electronic Type)- Regulators-cut outs.

UNIT III TRANSMISSION SYSTEMS 10

Clutch – Types and Construction – Gear Boxes, Manual and Automatic – Simple Floor Mounted Shift Mechanism – Over Drives – Transfer Box Fluid flywheel- Torque convertors– Propeller shaft – Slip Joint – Universal Joints – Differential and Rear Axle – Hotchkiss Drive and Torque Tube Drive.

UNIT IV STEERING, BRAKES AND SUSPENSION 10

Wheels and Tyres – Wheel Alignment Parameters - Steering Geometry and Types of steering gear box– Power Steering – Types of Front Axle – Suspension systems – Braking Systems – Types and Construction – Diagonal Braking System – Antilock Braking System.

UNIT V ALTERNATIVE ENERGY SOURCES 5

Use of Natural Gas, LPG, Biodiesel, Gasohol and Hydrogen in Automobiles - Electric and Hybrid Vehicles, Fuel Cells.

Note:Practical training in dismantling and assembling of Engine parts Transmission System should be given to the students

Total Hours:45

TEXT BOOKS :

1. Sethi H.M, “Automobile Technology”, Tata McGraw-Hill-2003
2. Kirpal Singh “Automobile Engineering Vol. 1& 2”, Standard Publishers, New Delhi.

REFERENCES :

1. Crouse and Anglin “Automotive Mechanism”, 9th Edition. Tata McGraw-Hill, 2003.
2. Newton, Steeds and Garet, “Motor vehicles”, Butterworth Publishers, 1989.
3. Srinivasan.S , “ Automotive Mechanics” 2nd edition, 2003, Tata McGraw-Hill.
4. Joseph Heitner, “Automotive Mechanics”, 2nd edition, East-West Press, 1999.

PTMEX17	POLYMER RECYCLING AND WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Objectives:

- To study the concept of various types of plastic waste identification, separation and method of recycling.

UNIT I IDENTIFICATION AND SEPERATION 9

Plastics production and consumption- Plastic wastes generation source and types – Plastic waste composition, quantities - Plastics identification methods physical , chemical and instrumental –sorting and separation technologies-disposal alternatives – Recycling methods – Primary, Secondary and tertiary recycling of plastics.

UNIT II METHODS OF RECYCLING 9

Size reduction of recycled plastics – cutting / shredding, densification, pulverization and chemical size reduction processes - municipal solid waste and composition – recycling of plastics from urban solid wastes- household waste – industrial sector – rheology, density and mechanical properties of recyclable plastics and need for compatibilization – Processing of commingled / mixed plastic waste – super wood, plastic lumber.

UNIT III RECYCLING OF PACKAGING WASTES 9

Recycling of polyolefins – polyethylene films – Polypropylene battery recyling-Recycling of HDPE fuel tanks - PET recycling methods – PET film recycling - Applications of polyolefin and PET recyclate – PVC recycling

UNIT IV RECYCLING OF ENGINEERING PLASTICS 9

Engineering thermoplastics and their major areas where engineering polymers are recycled – major recyclers of engineering plastics – GE/ Bayer/ MRC Polymers – PC, PBT, Nylon, PPO, ABS and polyacetals and their blends.

UNIT V RECYCLING OF THERMOSETS 9

Recycling of Polymer thermoset composites – regrind processes - SMC scrap – pyrolysis and energy recovery –Types of rubber products – rubber grinding methods – tyre grinding – rubber crumb applications – Reclaiming and de-

vulcanization processes – tyre derived fuel and energy recovery – Pyrolysis of scrap tyres.

Total Hours:45

REFERENCES :

1. Polymer recycling, Science, technology and applications, John Scheirs, John Wiley & Sons, England 1988.
2. Recycling of plastic materials (Ed) Francesco Paolo La Mantia, Chem Tec Publishing.
3. Degradeable polymers, recycling and plastic waste management (Eds) Ann – Christine Albertson and Samuel J.Huang, Marcel Dekker, New York.
4. Plastics waste Management (Ed) Nabil Mustafa, Marcel Dekker, New York.

PTMEX18	RUBBER PRODUCT MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

Objectives:

- To understand the manufacturing of products from natural and synthetic rubbers.
- To learn the manufacture of different parts of various types of tyres.
- To acquire the basic knowledge in designing and formulation of rubber products.

UNIT I **9**

Introduction-Various Types of Tyre-Bias-Bias-Belted-Radial-Tubeless Tyre-Different Components and it's Geometric Basic Functions-Function of Pneumatic Tyre-Load Carrying Capacity - Vibration and Noise reduction. Tyre Function as a Spring-Contribution to Driving Control, Road Adhesion-Steering Control and Self-Aligning torque. Tyre Sizing.

UNIT II **9**

Cord Rubber Composite and its Properties, Failure Mechanism of Cord Reinforced Rubbers. Mechanics of Tyre Pavment interaction.Tractive Force on Dry, Wet, Ice, Snow and Irregular Pavements Breaking and Friction of Tyres. Tyre Wear Friction, Tyre Noise Mechanism of Noise Generation. Effect of Tread Pattern - Vehicle Speed-Rolling Resistance-Flat Spoting- Water Planning.

UNIT III **9**

Manufacturing Technique of Various Tyre & Tube (Two Wheelers, Car Tyre, Truck Tyre, Scooter Tyre, Air Craft tyre) Principle of Designing -Formulations for Various Tyre Components. Green Tyre-Curing Methods-Post Curing inflation. Quality Control Tests.

UNIT IV **9**

Latex Product Manufacturing-Gloves-Experimental Gloves-Surgical Gloves. Foams-Latex Thread - Latex toys - Coir Foam - Carpet Packings.

UNIT V **9**

Dry Rubber Products - Manufacturing of Foot Wear-Inner Tube - Tennis Balls-Golf Balls-Solid Tyre-Hollow Articles (Rubber Balls).

Total Hours:45

REFERENCES :

1. A.K. Bhowmick, M.M. Hall and H.A. Benaney, Rubber Products Manufacturing Technology, Marcel Dekker Inc, New York, 1994.
2. A.S. Craig, Rubber Technology, Oliver and Boyd, Edinburgh, 1982.
3. C.W. Evans, Hose Technology, Elsevier Applied Science Publishers, 1979.
4. D.C. Blackley, High Polymer Latices, Vol I & II, Applied Science Publishers, London, 1966.

PTMEX19 TYRE MANUFACTURE AND TESTING

L	T	P	C
3	0	0	3

Objectives:

- To gain knowledge about functions of various parts of tyres.
- To understand the principle and process of tyre manufacturing.
- To understand the failure mechanism of different parts of tyres.
- To acquire the knowledge in property testing and performance evaluation of tyres.

UNIT I INTRODUCTION **9**

A historical introduction on the design and development of tyres of various kinds and types. The current status of tyre industry in India and its future prospectus. Tyre sizing and marking on the tyres. Different types of tyres – bias, bias belted radial, tube type and tubeless tyres their basic features and performance comparison. Different components of a tyre, its geometry, basic functions. Functions of a pneumatic tyre – load carrying, vibration and noise reduction, the tyre function as a spring, contribution to driving control and road adhesion, the tyre friction contribution to driving control, steering control and self aligning torque.

UNIT II CORD – RUBBER COMPOSITES **6**

Types of tyre cords, its properties, testing and application in different types of tyres. Properties and failure mechanism of cord reinforced rubber and its application in tyres.

UNIT III TYRE MECHANICS AND WEAR **9**

Mechanics of tyre pavement interaction. Tyre forces on dry and wet road surface. Traction forces on dry, wet, ice, snow and irregular pavements, Breaking and traction of tyres. Rubber friction and sliding mechanism, various factors affecting friction and sliding. Tyre stresses and deformation, tyre noise, mechanism of noise generation, effect of tread pattern, vehicle speed etc., on noise level, Tyre in plane dynamics. High frequency properties, basic yaw and camber analysis.

UNIT IV MANUFACTURING TECHNIQUES 12

Tyre manufacturing machinery, basic design and features. Two wheeler and car tyres, truck tyres, OTR, Farm tyres, aircraft tyres. Principles of designing, formulations for various rubber components. Tyre reinforcement materials (Textile, steel, glass etc.). Criteria of selection, different styles and construction, textile treatment. Tyre mould design, green tyre design principles, methods of building green tyres for bias, bias belted, radial and tube-less tyres, green tyre treatments. Tyre curing methods, post cure inflation, quality control tests, Tyre related products, their design and manufacturing techniques, tubes, valves, flaps and bladders. Different types, their feature and operation of tyre building machines, bead winding machine, wire/glass processing machines, bias cutters, curing presses.

UNIT V TYRE TESTS AND FIELD EVALUATION 9

Measurement of tyre properties, dimension and size-static and loaded, Tyre construction analysis, Endurance test wheel and plunger tests, traction, noise measurements. Force and moment characteristics, cornering coefficient aligning torque coefficient, load sensitivity and load transfer sensitivity, Rolling resistance, non uniformity dimensional variations, force variations- radial force variation, lateral force variation concentricity and ply steer. Type balance, mileage, evaluations, tyre flaws and separations, X-ray holography etc., Foot print pressure distribution. BIS standards for tyres, tubes and flaps.

Total Hours:45

REFERENCES:

1. Samuel K. Clark, Mechanics of pneumatic Tires, National Bureau of standards, Monograph, US Govt. printing office, 1971.
2. Tom French, Tyre Technology, Adam Hilger, New York, 1989.
3. F.J. Kovac, Tire Technology, 4th edition, Good year Tire and Rubber company, Akron, 1978.
4. E. Robecchi, L.Amiki, Mechanics of Tire, 2 Vols, Pirelli, Milano, 1970

PTMEX20	POLYMER RHEOLOGY	L	T	P	C
		3	0	0	3

Objectives:

- Acquire knowledge of basic terminology and principles of polymer rheology
- Demonstrate ability to solve problems in rheology.
- To understand the methodology and experimental techniques of rheological characterization of polymers
- Gain familiarity with key polymer fabrication processes (e.g., coating, extrusion and injection molding).
- To understand and derive basic mechanical models for several fabrication processes.
- Demonstrate ability to apply rheological and engineering principles to solve processing problems.

UNIT I MECHANICAL BEHAVIOUR OF POLYMERIC MATERIALS 9

Introduction to Rheology – types of mechanical deformation – Elastic materials – Vicous materials – Viscoelasticity – effect of rate of strain, temperature and time on mechanical behaviour of polymeric materials – creep – stress relaxation – Boltzman principle – time temperature super position principle – WLF equation.

UNIT II MECHANICAL MODELS –VISCOELASTIC BEHAVIOUR 9

Mechanical models – stress strain response of spring and dashpot – viscoelstic models – Maxwell element – Voigt kelvin element – response to creep and stress relaxation – four-parameter model – dynamic mechanical properties – behavior of Maxwell element and relaxation spectra.

UNIT III FLOW PROPERTIES OF POLYMER MELT 9

Fluid flow – types of fluid flow – time dependant fluids, shear rate dependant fluids, Newtonian and Non Newtonian fluids – viscosity of polymer melts – shear thinning and shear thickening – zero-shear rate viscosity – laminar flow of Newtonian fluids – power law – general treatment of isothermal viscous flow in tubes – entrance and exit effects - elastic effects in polymer melt flow - die- swell and melt fracture – Weissenberg effect – normal stress difference – Elongational viscosity.

UNIT IV MEASUREMENT OF RHEOLOGICAL PROPERTIES 9

Measurements of rheological properties – capillary rheometers – melt flow index – cone and plate viscometrer – torque rheometers – Mooney viscometer – curemeters – Rheo-optical methods – birefringence.

UNIT V APPLICATION OF POLYMER RHEOLOGY TO PROCESSING 9

Rheological behaviour of important thermoplastics (PE, PVC, PS, PP, nylons and PC)- Applications of rheology to polymer processing (injection moulding, extrusion and blow moulding)

Total Hours:45

REFERENCES:

1. Paul C. Painter and M. Michael Coleman, Fundamentals of Polymer Science, Technomic Publishing Co. Inc., Lancaster, USA 1994.
2. Richard C. Progelhof and James L. Throne, Polymer Engineering Principles, Hanser Publishers, Munnich Vienna New York, 1993.

PTMEX21 RUBBER TECHNOLOGY L T P C
3 0 0 3

Objectives:

- To understand the manufacturing process of elastomers.
- To acquire the knowledge of general principle and design of rubber compounding.
- To understand the mechanism and process of vulcanization of rubbers.

UNIT I COMPOUNDING TECHNOLOGY 9

General classification of elastomers as general purpose and special purpose elastomers - General principles of rubber compounding - Various compounding ingredients.

UNIT II GENERAL PURPOSE ELASTOMERS 9

General methods of manufacture, properties, compounding processing, vulcanization and applications of natural rubber, SBR, Polybutadine and Isoprene rubber.

UNIT III SPECIALITY ELASTOMERS – I 9

Manufacture - properties, compounding, processing, vulcanization and applications of EPDM, Butyl rubber, Neoprene rubber and Nitrile rubber.

UNIT IV SPECIALITY ELASTOMERS – II 9

Manufacture, properties, compounding, processing, vulcanization and applications of hypalon rubber, silicone rubber, EVA, acrylates, polyurethanes, fluorocarbons.

UNIT V THERMOPLASTIC ELASTOMERS 9

Thermoplastic elastomers and Ionomers - a general introduction- different methods for the preparation of the thermoplastic elastomers. Classification of the thermoplastic elastomers as block copolymers, blends, etc. Different methods of preparation of thermoplastic elastomers and Ionomers.

Total Hours:45

REFERENCES :

1. Rubber Technology - Maurice Morton, 3rd edition, Van Nostrand, Reinhold Co., New York.
2. Rubber Technology and Manufacture - (C.M.Blow and Hepburn, Butterworths, London)
3. Rubber Materials and their compounds - J.A.Brydson, Elsivier Applied Science, 1988.

PTMEX22 NUMERICAL METHODS L T P C
3 0 0 3

Objectives:

- To intrduce mathematical tools for solution of linear systems and engen value problems
- To acquaint with numerical differentiation and integration
- To solve initial and boundry value problem.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9

Linear interpolation methods (method of false position) – Newton's method – Statement of Fixed Point Theorem – Fixed point iteration: x=g(x) method – Solution of linear system by Gaussian elimination and Gauss-Jordon methods- Iterative methods: Gauss Jacobi and Gauss-Seidel methods- Inverse of a matrix by Gauss Jordon method – Eigenvalue of a matrix by power method.

UNIT II INTERPOLATION AND APPROXIMATION 9

Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline – Newton's forward and backward difference formulas.- Relations between operators (E,)

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9

Derivatives from difference tables – Divided differences and finite differences –Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and Three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9

Single step methods: Taylor series method – Euler and modified Euler methods – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

Total Hours:45

REFERENCES :

1. Gerald, C.F, and Wheatley, P.O, “Applied Numerical Analysis”, Sixth Edition, Pearson Education Asia, New Delhi, 2002.
2. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., “Numerical Methods”, S.Chand Co. Ltd., New Delhi, 2003.
3. Burden, R.L and Faires, T.D., “Numerical Analysis”, Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.
4. M.K.Venkataraman “Numerical Methods” The National Publishing Co. Chennai.
5. S.S.Sastry “Introductory Methods of Numerical Analysis”, PHI of India (p) Ltd. New Delhi.

PTMEX23 VIBRATION AND NOISE CONTROL

L	T	P	C
3	0	0	3

Objectives:

- To understand the Fundamentals of Vibration and Noise and its practical applications.
- To understand the working principle and operations of various vibrations and noise measuring instruments.
- To understand the various Vibration and Noise control strategies.

UNIT I BASICS OF VIBRATION **9**

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II BASICS OF NOISE **9**

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III AUTOMOTIVE NOISE SOURCES **9**

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

UNIT IV CONTROL TECHNIQUES **9**

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V SOURCE OF NOISE AND CONTROL 9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

Total Hours:45

TEXT BOOKS :

1. Singiresu S.Rao - "Mechanical Vibrations"-Pearson Education, ISBM –81-297-0179-0 - 2004.
2. Kewal Pujara "Vibrations and Noise for Engineers, Dhanpat Rai & Sons, 1992.

REFERENCES :

1. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book" - Second edition - SAE International - ISBN 0-7680-0403-9 – 1999.
2. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth Heinemann, ISBN 0750-5044-3 - 2004
3. John Fenton - "Handbook of Automotive body Construction and Design Analysis – Professional Engineering Publishing, ISBN 1-86058-073- 1998.

PTMEX24	NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

Objectives:

- Study the basic nano technology and nano science.
- Understand interdisciplinary nature of this field.
- Understand the important role of physics, chemistry ,biology.
- Recognize that the rules of nano science are fundamentally different than those we experience.
- Study the basic fabrication strategies of nano science.

UNIT I INTRODUCTION TO NANOMATERIALS 7

Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials- historical Development of nano materials-problems in fabrication and characterization of nano materials.

UNIT II PRODUCTION OF NANOMATERIALS 10

Methods of production of nanomaterials, Sol-gel synthesis, Inert gas condensation, Mechanical alloying or high-energy ball milling, Plasma synthesis, and Electrodeposition.

UNIT III APPLICATION OF NANO MATERIALS 10

Applications in Electronics, Chemical, Mechanical engineering industries-Use of nanomaterials in automobiles, aerospace, defence and medical applications – Metallic, polymeric, organic and ceramic nanomaterials.

UNIT IV NANOFABRICATION AND MACHINING 8

LIGA, Ion Beam Etching, Molecular Manufacturing Techniques - Nano Machining Techniques, Top down and Bottom up Nano fabrication Techniques, Quantum Materials.

UNIT V INSPECTION OF NANOMATERIALS 10

Scanning Probe Microscopy (SPM)- Contact Mode, Tapping Mode, Scanning Tunnelling Mode (STM). Advanced Scanning Probe Microscopy – Electrostatic force Mode (EFM)- Magnetic Force Mode (MFM)- Scanning Thermal Mode

(SthM), Piezo Force Mode (PFM). Scanning Capacitance Mode (SCM), Nanoidentation.

TOTAL: 45

REFERENCE :

1. Mark Ratner and Daniel Ratner, “Nano Technology”, Pearson Education, New Delhi, 2003.

PTMEX25 COMPOSITE MATERIALS FOR MANUFACTURE **L T P C**
3 0 0 3

Objective:

- To understand the fundamentals of mechanics and manufacturing methods of composites

UNIT I INTRODUCTION TO COMPOSITES **8**

Fundamentals of composites - need for composites – Enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – Particle reinforced composites, Fibre reinforced composites. Applications of various types of composites.

UNIT II POLYMER MATRIX COMPOSITES **12**

Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Rovings – Woven fabrics – Non woven random mats – various types of fibres. PMC processes - Hand lay up processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GRP).

UNIT III METAL MATRIX COMPOSITES **9**

Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements – particles – fibres. Effect of reinforcement - Volume fraction – Rule of mixtures. Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze casting.

UNIT IV CERAMIC MATRIX COMPOSITES **9**

Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix -Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing).

UNIT V ADVANCES IN COMPOSITES 7

Carbon /carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications.

Total Hours:45

TEXT BOOKS :

1. Mathews F.L. and Rawlings R.D., "Composite materials: Engineering and Science", Chapman and Hall, London, England, 1st edition, 1994.
2. Chawla K.K., "Composite materials", Springer – Verlag, 1987.

REFERENCES :

1. T.W. Clyne and P.J. Withers, "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.
2. A.B. Strong, "Fundamentals of Composite Manufacturing", SME, 1989.
3. S.C. Sharma, "Composite materials", Narosa Publications, 2000.
4. "Short Term Course on Advances in Composite Materials", Composite Technology Centre, Department of Metallurgy, IIT- Madras, December 2001.

PTMEX26	MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)	L	T	P	C
		3	0	0	3

Objective:

- To impart knowledge to the students about the design and fabrication of Micro Electro Mechanical Systems (MEMS).

UNIT I INTRODUCTION TO MEMS 9

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Microaccelorometers and Micro fluidics, MEMS materials, Micro fabrication.

UNIT II MECHANICS FOR MEMS DESIGN 9

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

UNIT III ELECTRO STATIC DESIGN 9

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inchworms, Electromagnetic actuators, Bistable actuators.

UNIT IV CIRCUIT AND SYSTEM ISSUES 9

Electronic Interfaces, Feed back systems, Noise, Circuit and system issues, Case studies – Capacitive accelerometer, Peizo electric pressure sensor, Modeling of MEMS systems, CAD for MEMS.

UNIT V INTRODUCTION TO OPTICAL AND RF MEMS 9

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF MEMS – design basics, case study – Capacitive RF MEMS switch, performance issues.

Total Hours: 45

TEXTBOOK:

1. Stephen Santeria," Microsystems Design", Kluwer publishers, 2000.

REFERENCES :

1. Nadim Maluf," An introduction to Micro electro mechanical system design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor," The MEMS Handbook", CRC press Baco Raton, 2000.
3. Tai Ran Hsu," MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.