MECHANICAL ENGINEERING
PART-TIME B.E

CURRICULUMANDSYLLABUS

GOVERNMENT COLLEGE OF TECHNOLOGY
COIMBATORE - 641013

An Autonomous Institution - Anna University, chennai

Curriculum
&
Syllabus (I-VII Sem)

CANDIDATES ADMITTED DURING 2012 – 2013 AND ONWARDS

Regulations

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Regulations for Part Time candidates admitted during the academic year
2012 - 2013 and onwards

1. CONDITIONS FOR ADMISSION

Candidates for admission to the first year of the Part Time - Seven Semester B.E. Degree course shall be required to have passed,

    i.   the Diploma Examination in Engineering conducted by the State Board of Technical Education and Training, Tamil Nadu.

(or)

    ii.   an Examination of any University or Authority, accepted by the Syndicate of the Anna University as equivalent thereto.

(or)

    iii.   any other examination as notified by the Government of Tamil Nadu.

Any other conditions as notified by the Government of Tamil Nadu.

2. BRANCHES OF STUDY

Branches will be offered at the time of admission to the course. The following are the branches offered in this college.

1. B.E.   Civil Engineering
2. B.E.   Mechanical Engineering
3. B.E.   Electrical and Electronics Engineering
4. B.E.   Electronics and Communication Engineering

3. STRUCTURE OF PROGRAMMES

3.1 Every programme shall have a curriculum with well – defined syllabi comprising of both theory and practical courses such as :

    i.   General core subjects comprising Mathematics, Basic Sciences, Engineering Sciences, Humanities and Engineering arts.

    ii.   Core subjects of Engineering / Technology

    iii.   Elective subjects for specialization in related fields

    iv.   Workshop practice, computer practice, engineering graphics, laboratory work, industrial training, seminar presentation, project work, educational tours, camps etc.

3.2 The subjects of study shall be both theory and practical and shall be in accordance with the prescribed syllabus.

3.3 Each semester curriculum shall normally have a blend of lecture and practical subjects not exceeding 5.

3.4 A student who has passed all the subjects prescribed in the curriculum for the award of the

degree shall not be permitted to re-enroll to improve his/her **credits** in a subject or the aggregate **credits**.

3.5 The medium of instruction in examinations and project report shall be English.

4. DURATION OF THE PROGRAMME

The duration of the programme for the Degree of B.E. Programme shall be SEVEN (7) semesters with semester pattern. The number of working days will be **90** days (which includes **15** days for end semester examinations) or **450** Hours or **540** periods of each 50 minutes duration for semester pattern. The number of working days is to be calculated excluding study holidays, Government holidays and end - semester examination days. The Head of the Department shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught.

5. SYSTEM OF EXAMINATION

Performance in each subject of study shall be evaluated based on (i) continuous internal assessment through the semester and (ii) an end semester examination.

THEORY

End semester Examinations will be conducted in all the theory subjects of study at the end of each semester for all the subjects. The maximum marks of each subject shall be 100, out of which the continuous internal assessment will carry 25 marks, while the end semester Examination will carry 75 marks.

To arrive the internal mark the following guidelines are to be followed.

(i)	Test	(3 Nos.) { each test is to be conducted for 50 Marks}	: 60 Marks
(ii)	Assignment	(3 Nos.)	: 30 Marks
(iii)	Attendance*		: 10 Marks
			100 Marks

Total 100 Marks should be reduced to 25 Marks

* Attendance (10 Marks)

Percentage of attendance	Marks
75	0
76 - 80	2
81 - 84	4
85 - 89	6
90 - 94	8
95 and above	10

PRACTICAL

The Practical classes for all the Practical / Lab component subjects will be assessed continuously and marks will be entered in the prescribed proforma. The progress of Practical classes will be monitored by a committee formed by the concerned Head of the Departments / Professor in-charge of the Programme to ensure that the concerned staff conducts the laboratory experiments as specified in the syllabus. The proforma should be submitted at the end of the each month for Principal's / Chairman, Board of Examinations' approval. The maximum marks for the Practical / Lab component subjects shall be 100, out of which the continuous internal assessment

will carry 25 marks, while the end semester practical examination will carry 75 marks. If any practical subject contains Part A and Part B components, the maximum marks for each Part of the lab will be 50 marks, out of which the continuous internal assessment will carry 12.5 marks, while the end semester practical examination will carry 37.5 marks. The award of the end semester practical examination marks shall be conducted by both the Internal and External examiners. To arrive the internal mark the following guidelines are to be followed.

(i) Continuous Assessment   : 50 Marks

(ii) Test (minimum one)   : 40 Marks

(iii) Attendance*   : 10 Marks

Total 100 Marks should be reduced to 25 Marks

*Attendance (10 Marks)

Percentage of attendance	Marks
75	0
76 - 80	2
81 - 84	4
85 - 89	6
90 - 94	8
95 and above	10

PROJECT WORK AND VIVA - VOCE :

For the project work and viva-voce examination the maximum marks shall be 200 comprising of 50 marks for internal assessment and 150 for the end semester examination. The award of the end semester marks for 150 shall be evaluated by both the Internal and External examiners, out of which the project report shall carry a maximum of 50 marks (same mark must be awarded to every student of the project group) while the viva-voce examination shall carry 100 marks (awarded to each student of the project group based on the individual performance in the viva-voce examination).

For Internal Mark:

Work assessed by Guide / Supervisor   : 50 % weight

Work assessed by a Committee   : 50 % weight

6. REQUIREMENTS OF EXAMINATIONS AND ATTENDANCE

A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester.

6.1   A candidate will be permitted to appear for the Examination for any semester, only if

i.   he / she secures not less than 75% of attendance in the number of working days during that semester, provided that it shall be open to Chairman of the Academic Council or any authority delegated with such powers (by the governing body) to grant exemption (based on the recommendation of the Head of the Department) to a candidate who has failed to secure 75% of the attendance for valid reasons and has secured not less than 66% of the attendance. Such exemptions can be allowed only TWO times during his/ her entire period of study.

ii.   Candidates representing University in State / National / International / Inter University Sports events, Co & Extra - Curricular activities, paper or project presentation with prior permission from the Head of Institution are given exemption upto 10% of the required attendance and such candidates shall be permitted to appear for the current semester examination.

iii. his / her conduct has been certified to be satisfactory by the concerned Head of Department.

iv. **Condonation can be allowed only two times during his / her entire course of study.**

6.2 Candidates who do not complete the semester (as per clause 6.1), will not be permitted to write the end-semester examination and are not permitted to go to next semester. They are required to repeat the incomplete semester in the next academic year.

7. **PROCEDURES FOR AWARDING MARKS FOR INTERNAL ASSESSMENT**

i. Every teacher is required to maintain a 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each lecture or practical or project work class, the test marks and the record of class work (topic covered), separately for each course. This should be submitted to the Head of the Departments periodically (atleast three times in a semester) for checking the syllabus coverage and the records of test marks and attendance. The Head of the Departments will put his signature and date after due verification at the end of the semester, the record should be verified by the Head of the Institution who will keep this document in safe custody (for five years).

ii. **Theory subjects [25 marks]**

   (a). Unit Tests [60% weight] :
   Three tests each carrying fifty (50) marks shall be conducted by the Department / Institution. The total marks obtained in all the test put together out of 150, shall be reduced to 60 marks and rounded to nearest integer (this implies equal weight to all the three tests). However a retest at the discretion of the Head of the Department may be conducted for the deserving candidates.

   (b). Assignment [30% weight] :
   Three Assignments requiring work of average 5 to 6 hours of study and written work of average 5 to 6 hours, each carried out by a student in a separate assignment folder, duly indexed with headings, date of submission, marks, remarks and signature of faculty with date etc.

   (c). Attendance [10% weight] :
   A maximum 10 marks for attendance out of 100 marks shall be given to each student depending on his/her attendance percentage as per the distribution given below:

   Attendance (10 Marks)

Percentage of attendance	Marks
75	0
76 - 80	2
81 - 84	4
85 - 89	6
90 - 94	8
95 and above	10

   The Internal marks are valid for two more attempts in addition to the current attempt for the candidates admitted from the academic year 2009 - 2010 and onwards. If a candidate scores 50% of marks only in the end semester examination, after three attempts (First attempt + two more attempts), he / she would be declared as a passed candidate in that examination.

iii. **Practical Courses [25 marks]**

Every practical exercise / experiment shall be evaluated based on conduct of exercise / experiment and records maintained. There shall be atleast one test. The criteria for arriving the internal assessment marks are :

Experiment / Record / Average Practical classes performance: 50% weight

Practical Test   : 40% weight

Attendance   : 10% weight

Total 100 marks should be reduced to 25 marks

iv. **Theory Subjects with Laboratory Component**

    (a).   **Unit Tests [60% weight] :**

If there is a theory subject with Laboratory component, there shall be three tests; the first two tests (each 50 Marks) will be from theory portions and third test (maximum marks 50) will be for laboratory component. The total 150 marks should be reduced to 60 marks. However a retest at the discretion of the Head of the Department may be conducted for the deserving candidates.

    (b).   **Assignment [30% weight] :**

Three Assignments (at least 2 per term) requiring work of average 5 to 6 hours of study and written work of average 5 to 6 hours, each carried out by a student in a separate assignment folder, duly indexed with headings, date of submission, marks, remarks and signature of faculty with date etc.

    (c).   **Attendance [10% weight] :**

A maximum 10 marks for attendance out of 100 marks shall be given to each student depending on his/her attendance percentage as per the distribution given below:

Attendance (10) Marks

Percentage of attendance	Marks
75	0
76 - 80	2
81 - 84	4
85 - 89	6
90 - 94	8
95 and above	10

The internal marks are valid for two more attempts in addition to the current attempt for the candidates admitted from the academic year 2009 - 2010 and onwards. If a candidate scores 50% of marks only in the end semester examination, after three attempts (First attempt + two more attempts), he / she would be declared as a passed candidate in that examination.

v. **Project Work**

There shall be three assessments during the semester by a review committee. The students shall make presentation on the progress made before the committee. The Head of the Institution shall constitute the review committee for each branch of study. The criteria for arriving the internal assessment marks for the Project Work evaluated for 50 marks are :

Work assessed by the Project Guide	: 50%
Work Assessed by a committee	: 50%

The Internal marks are valid for two more attempts In addition to the current attempt for the candidates admitted from the academic year 2009 - 2010 and onwards. If a candidate scores 50% of marks only in the end semester examination, after three attempts (First attempt + two more attempts), he / she would be declared as a passed candidate in that examination.

8. PROCEDURE FOR COMPLETING THE PROGRAMME

i. A candidate who has for some reason discontinued the course can join the course of study of any semester only at the time of its normal commencement in the Institution for regular students upon satisfying all the following conditions

   a) he / she should have completed the course of study of the previous semesters.
   b) he / she should be eligible to register for the examinations and satisfy rule 8 (iii)
   c) he / she should have registered for all the examinations of the previous semesters.

ii. A candidate will be permitted to proceed from one semester to the next higher semester only if he / she has satisfied the regulation for eligibility to appear for the End-Semester examination in the concerned semester, subject to the condition that the candidate should register for all the arrear subjects of lower semesters along with the current (higher) semester subjects.

iii. A candidate should have completed the B.E. Degree Programme within a period of SEVEN consecutive academic years (14 semesters) from the date of admission to the course, even if the candidate discontinues and rejoins subsequently, to be eligible for the award of the degree. The minimum and maximum period for completion of the U.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
B.E. (Part Time)	7	14

9. REQUIREMENTS FOR APPEARING FOR SEMESTER EXAMINATION

A candidate shall normally be permitted to appear for the semester examination of the current semester if he/she has satisfied the semester completion requirements (Subject to Clause 6.1) and has registered for examination in all subjects of that semester. Registration is mandatory for current semester examinations as well as arrears examinations failing which the candidate will not be permitted to move to the higher semester.

10. PASSING MINIMUM AND CLASSIFICATION OF SUCCESSFULL CANDIDATES

i. For each subject the examination will be conducted for 100 marks. A candidate who secures not less than 50% of the total marks in the End Semester examination and Internal Assessment put together in both theory and Practical courses, including Project work, subject to securing a minimum of 50% in the End - Semester examination,

wherever applicable, shall be declared to have passed the examination in that subject. When the mark secured for 100 is converted to 75, minimum 37 marks must be secured for pass. Any Programme, during any semester, conducts the lab in two parts, say A and B, it is mandatory that the student must appear for both the parts of the lab in the end semester practical examination. The candidate is declared as pass in both the parts A and B lab, only if he / she secures a minimum **of 50% put together,** and the student must compulsorily appear for both the parts of the lab in the end semester practical examination. If the candidate is absent for any one part of the lab, the candidate is declared as fail in both the parts A and B of the lab [marked as Absent in External Examinations] and he / she should appear in both, part A and B in the Subsequent semesters.

ii. A candidate who successfully completes the course requirements and has passed all the prescribed examinations in all the Seven Semesters within a maximum period of Seven years(14 semesters) reckoned from the commencement of the first semester to which the candidate was admitted is eligible to get the degree.

iii. A candidate who qualifies for the Degree by passing the examination in all subjects of the entire Programme in first attempt within a period of Seven Semesters from the date of admission to the Programme and secures a **CGPA of not less than 8.00** for the entire Programme shall be declared to have passed the examination for the degree in **FIRST CLASS WITH DISTINCTION**. For this purpose the withdrawal from examination will not be construed as an appearance. Further, the authorized break of study will not be counted for the purpose of classification.

iv. A candidate transferred from other Institution, who qualifies for the Degree by passing the examination in all subjects of the entire Programme in first attempt within a period of Seven Semesters from the date of admission to the Programme and secures a **CGPA of not less than 8.00** for the entire Programme shall be declared to have passed the examination for the degree in **FIRST CLASS WITH DISTINCTION**. For this purpose the withdrawal from examination will not be construed as an appearance. Further, the authorized break of study will not be counted for the purpose of classification.

v. A candidate who qualifies for the award of the Degree having passed the examinations in all the subjects of the Programme in the semesters first to seven within a maximum period of Nine consecutive semesters after his/her commencement of study in the first semester and secures a **CGPA of not less than 6.50** for the entire Programme shall be declared to have passed the examination for the degree in **FIRST CLASS**. For this purpose, the authorized break of study will not be counted for the purpose of classification.

vi. All other successful candidates shall be declared to have passed the examination for the Degree in **SECOND CLASS**.

vii. A candidate who is absent in semester examination in a subject / project work after having registered for the same shall be considered to have appeared in that examination for the purpose of classification.

11. ISSUE OF GRADE SHEETS

Individual grade sheet for each semester will be issued, containing the following information through the Head of the Department concerned, after the publication of the results.

i) The **credits** obtained in each subject in internal assessment and end semester examination and total **credits** obtained for each course.

ii) Whether the candidate has passed / failed in the courses concerned.

12. MALPRACTICE

If a student indulges in malpractice in any of the end semester examinations, he / she shall be liable for punitive action as and when prescribed by the **Anna University, chennai.**

13. REVALUATION

i. Copies of answer script for theory subjects can be obtained from the Office of the Controller of Examinations on payment of a prescribed fee specified for this purpose through proper application.

ii. A candidate can apply for revaluation of his / her semester examination answer paper in a theory subject, on payment of a prescribed fee through proper application to the Office of the Controller of Examinations, as per the norms given by the Chairman, Academic Council. Revaluation is not permitted for Practical subjects and for Project work.

iii. Retotalling is permissible for all arrear and current theory subjects.

iv. Challenging the revaluation is permitted ,for those students who have applied for photocopy of the answer script. The Copy of answer Script is to be valued by a competent authority and the valued script should be submitted to COE's office along with the prescribed fee for challenging revaluation.

14. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the B.E Degree provided the candidate has

i) Successfully completed the course requirements and has passed all the prescribed examinations in all **the 7 semesters within a maximum period of 7 years** from the commencement of first semester to which the candidate was admitted.

ii) The award of degree must have been approved by the Syndicate of the University.

iii) The Minimum credit to be earned to get -PTBE degree is 90 .

15. CLASS COMMITTEE

15.1 A class committee consists of teachers of the concerned class, student representatives and a chairperson who is not teaching the class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching-learning process. The functions of the class committee include

- Solving problems experienced by students in the class room and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein.
- Informing the student representatives the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- Informing the student representatives the details of Regulations regarding weightage used for each assessment. In the case of practical courses (laboratory/drawing/ project work/ seminar etc.) the breakup of marks for each experiment / exercise/ module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional help or guidance or coaching to such weak students.

15.2   The class committee for a class under a particular branch is normally constituted by the Head of the Department. However, if the students of different branches are mixed in each class of the first semester (generally common to all branches), the class committee is to be constituted by the Head of the Institution.

15.3   The class committee shall be constituted on the first working day of any semester or earlier.

15.4   Atleast 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.

15.5   The chairperson of the class committee may invite the Faculty Adviser(s) and the Head of the Department to the meeting of the class committee.

15.6   The Head of the Institution may participate in any class committee of the institution.

15.7   The chairperson is required to prepare the minutes of every meeting, submit the same to the Head of the Institution within two days of the meeting and arrange to circulate among the concerned students and teachers. If there are some points in the minutes requiring action by the management, the same shall be brought to the notice of the management by the Head of the Institution.

15.8   The first meeting of the class committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weight of assessments within the framework of the Regulations. Two or three subsequent meetings may be held at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express the opinions and suggestions of the class students to improve the effectiveness of the teaching-learning process.

16. FACULTY ADVISER

To help the students in planning their courses of study and for general advise on the academic programme, the Head of the Department of the student will attach a certain number of students to a teacher of the Department who shall function as Faculty Adviser for those students throughout their period of study. Such Faculty Adviser shall advise the students and monitor the courses taken by the students, check the attendance and progress of the students attached to him / her and counsel them periodically. If necessary, the faculty adviser may also discuss with or inform the   parents about the progress of the students.

17. COURSE COMMITTEE FOR COMMON SUBJECTS

Each common theory subjects offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers teaching the common subject with one of them nominated as Course Coordinator. The nomination of the course Coordinator shall be made by the Head of the Department / Head of the institution depending upon whether all the teachers teaching the common subject belong to a single department or to several departments. The 'Course committee' shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Where it is feasible, the course committee may also prepare a common question paper for the test(s).

18. PROVISION FOR WITHDRAWAL FROM EXAMINATION

i.   A candidate may, for valid reasons, be granted permission to withdraw from appearing for the examination in any subject or subjects of only one semester examination during the entire duration of the degree programme. Also only one application for withdrawal is permitted for that semester examination in which withdrawal is sought.

ii.   Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination and if it is made prior to the commencement of the last examination in that semester and duly recommended by the Head of the Department and approved by the Head of the Institution.

iii. Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction.

iv.   Withdrawal is possible only if the candidate satisfies the attendance requirements [as per Clause 6.1]

19. TEMPORARY BREAK OF STUDY FROM A PROGRAMME

i.   A candidate is not normally permitted to temporarily break the study. However if a candidate intends to temporarily discontinue the programme in the middle for valid reasons (such as accident or hospitalization due to prolonged ill health) and to rejoin the programme in a later semester he/she shall apply to the Head of the Institution in advance, in any case, not later than the last date for registering for the semester examinations of the semester in question, through the Head of the Department stating the reasons thereof.

ii.   The candidate permitted to rejoin the programme after the break shall be governed by the rules and regulations in force at the time of rejoining.

iii. The duration specified for passing all the subjects for the purpose of classification vide Clause 10(iii), 10(iv) and 10(v) shall be increased by the period of such permitted break of study.

iv.   The total period for completion of the programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 8(iii) irrespective of the period of break of study in order that he/she may be eligible for the award of the degree (vide clause 14).

v.   If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Break of Study' and Clause 19(iii) is not applicable for this case.

20. RANK OF A STUDENT

A candidate who qualifies for the Degree by passing the examination in all subjects of the entire Programme in first attempt within a period of Seven Semesters from the date of admission to the Programme can be given his position in the class as rank. The Rank is determined from I Semester to VII Semester end semester examination CGPA . Students transferred from other institutions to GCT are not eligible for rank.

21. PROCEDURE FOR USING SCRIBER

If a candidate is physically handicapped (in case of accidents / ill health) at the time of examination, then he / she may be permitted to use a scriber to write the examination. In such case 30 minutes extra time will be permitted. The Scriber shall be a non-engineering student / graduate.

22. DISCIPLINE

Every student is required to observe disciplined and decorous behaviour both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the College. In the event an act of indiscipline being reported, the Principal shall constitute a disciplinary committee consisting of three Heads of Department of which one should be from the faculty of the student, to enquire into acts of indiscipline. The disciplinary action is subject to review by the University in case the student represents to the University. Any expulsion of the student from the college shall be with prior concurrence from Director of Technical Education / University.

23. CREDIT SYSTEM

The letter grade and the grade point are awarded based on percentage of marks secured by a candidate in individual course as detailed below:

Range of Total Marks	Letter Grade	Grade Points (GP)
90 to 100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
55 to 59	D	6
50 to 54	E	5
0 to 49	U	0
Incomplete	I	0
Withdrawal	W	0

"U"   denotes failure in the subject.

"I"   denotes incomplete as per clause 6.1 and hence prevention from writing End Semester Examination.

"W"   denotes withdrawal from the subject.

After results are declared, Grade sheets will be issued to each student which will contain the following details :

The list of subjects enrolled during the semester and the grades 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 sum of the products of the number of credits of subjects registered and the points corresponding to the grades scored in those subjects, taken for all the subjects, to the sum of the number of credits of all the subjects in the semester.

$$GPA = \frac{\text{Sum of } [\, C \times GP \,]}{\text{Sum of } C}$$

where   C   - credit of a particular subject

     GP   - grade point obtained by the student in the respective subject.

CGPA will be calculated in a similar manner, considering all the subjects enrolled from first semester. "U", "I" and "W" grades will be excluded for calculating GPA and CGPA.

Each subject is normally assigned certain number of credits with 1 credit per lecture period per week, 1 credit per tutorial period per week, 1 credit for 2 periods of laboratory or practical or seminar or project work per week (2 credits for 3 or 4 periods of practical).

However, the performance of a student is evaluated only based on the credit system.

24. REVISION OF REGULATION AND CURRICULUM

The college may from time to time revise, amend or change the regulations, scheme of examinations and syllabus, if found necessary.

END OF REGULATIONS ...

CURRICULUM FOR CANDIDATES (B.E., MECHANICAL ENGINEERING -PART TIME) ADMITTED DURING 2012-2013 AND ONWARDS

S.N	Subject Code	Subject Name	Sessional marks	Exam final Marks	Total Marks	L	T	P	C
I SEMESTER									
1	12M1Z2	ENGINEERING MATHEMATICS I	25	75	100	3	1	0	4
2	12M105	ENGINEERING MECHANICS	25	75	100	3	1	0	4
3	12M106	PROGRAMMING WITH C and C++	25	75	100	3	0	0	3
4	12M302	ENVIRONMENTAL SCIENCE AND ENGINEERING	25	75	100	3	0	0	3
5	12M303	FLUID MECHANICS AND MACHINERY	25	75	100	3	1	0	4
		TOTAL			500				18
II SEMESTER									
1	12M2Z2	ENGINEERING MATHEMATICS II	25	75	100	3	1	0	4
2	12M304	ENGINEERING METALLURGY	25	75	100	3	0	0	3
3	12M305	MANUFACTURING TECHNOLOGY II	25	75	100	3	0	0	3
4	12M306	STRENGTH OF MATERIALS	25	75	100	3	1	0	4
5	12M403	APPLIED ELECTRONICS AND MICROPROCESSORS	25	75	100	3	0	0	3
		TOTAL			500				17
III SEMESTER									
1	12M401	PROBABILITY AND STATISTICS	25	75	100	3	1	0	4
2	12M402	METROLOGY AND MEASUREMENTS	25	75	100	3	0	0	3
3	12M404	ELECTRICAL MACHINES AND DRIVES	25	75	100	3	0	0	3
4	12M405	KINEMATICS OF MACHINES	25	75	100	3	1	0	4
5	12M406	ENGINEERING THERMODYNAMICS	25	75	100	3	1	0	4
		TOTAL			500				18
IV SEMESTER									
1	12M501	ENGINEERING ECONOMICS AND MANAGEMENT	25	75	100	3	0	0	3
2	12M502	DESIGN OF MACHINE ELEMENTS	25	75	100	3	1	0	4
3	12M503	THERMAL ENGINEERING	25	75	100	3	1	0	4
4	12M504	DYNAMICS OF MACHINES	25	75	100	3	1	0	4
5	12M607	THERMAL ENGINEERING LABORATORY II	25	75	100	0	0	3	2
		TOTAL			500				17
V SEMESTER									
1	12M506	HYDRAULIC AND PNEUMATIC CONTROLS	25	75	100	3	0	0	3
2	12M601	OPERATIONS RESEARCH	25	75	100	3	1	0	4

3	12M603	DESIGN OF TRANSMISSION SYSTEMS	25	75	100	3	1	0	4
4	12M604	COMPUTER AIDED DESIGN AND MANUFACTURING	25	75	100	3	0	0	3
5	E-I	ELECTIVE:I	25	75	100	3	0	0	3
		TOTAL			500				17

		VI SEMESTER							
1	12M605	HEAT AND MASS TRANSFER	25	75	100	3	1	0	4
2	12M701	AUTOMOBILE ENGINEERING	25	75	100	3	0	0	3
3	12M702	INDUSTRIAL ROBOTICS	25	75	100	3	0	0	3
4	E-II	ELECTIVE:II	25	75	100	3	0	0	3
5	E-III	ELECTIVE:III	25	75	100	3	0	0	3
		TOTAL			500				16

		VII SEMESTER							
1	12M703	TOTAL QUALITY MANAGEMENT	25	75	100	3	0	0	3
2	12M704	REFRIGERATION AND AIR CONDITIONING	25	75	100	3	1	0	4
3	E-IV	ELECTIVE IV	25	75	100	3	0	0	3
4	E-V	ELECTIVE: V	25	75	100	3	0	0	3
5	12M801	PROJECT WORK	50	150	200	0	0	12	6
		TOTAL			600				19

		LIST OF ELECTIVE SUBJECTS FOR V SEMESTER							
1	12M6E0	POWER PLANT ENGINEERING	25	75	100	3	0	0	3
2	12M6E1	DESIGN OF JIGS,FIXTURES AND PRESS TOOLS	25	75	100	3	0	0	3
3	12M6E2	COMPUTATIONAL FLUID DYNAMICS	25	75	100	3	0	0	3
4	12M6E3	MACHINE TOOL DESIGN	25	75	100	3	0	0	3
5	12M6E4	DESIGN FOR MANUFACTURE	25	75	100	3	0	0	3

		LIST OF ELECTIVE SUBJECTS FOR VI SEMESTER							
1	12M7E0	MANAGEMENT ACCOUNTING	25	75	100	3	0	0	3
2	12M7E1	BASIC FRENCH AND INITIATIVE TO GERMAN LANGUAGE	25	75	100	3	0	0	3
3	12M7E2	INTERNAL COMBUSTION ENGINES	25	75	100	3	0	0	3
4	12M7E3	ENTREPRENEURSHIP AND PRODUCT DEVELOPMENT STRATEGIES	25	75	100	3	0	0	3
5	12M7E4	MANUFACTURING,PLANNING AND CONTROL	25	75	100	3	0	0	3
6	12M7E5	COMPOSITE MATERIALS	25	75	100	3	0	0	3
7	12M7E6	HUMAN VALUES AND PROFESSIONAL ETHICS	25	75	100	3	0	0	3
8	12M7E7	MECHATRONICS	25	75	100	3	0	0	3
9	12M7E8	WELDING TECHNOLOGY	25	75	100	3	0	0	3

10	12M7E9	PLANT LAYOUT AND MATERIAL HANDLING	25	75	100	3	0	0	3
LIST OF ELECTIVE SUBJECTS FOR VII SEMESTER									
1	12M8E0	PROCESS PLANNING AND COST ESTIMATION	25	75	100	3	0	0	3
2	12M8E1	NANO TECHNOLOGY	25	75	100	3	0	0	3
3	12M8E2	KNOWLEDGE BASED SYSTEMS IN MANUFACTURING	25	75	100	3	0	0	3
4	12M8E3	NEWER PRODUCTION PROCESSES	25	75	100	3	0	0	3
5	12M8E4	SUPPLY CHAIN MANAGEMENT	25	75	100	3	0	0	3
6	12M8E5	INDUSTRIAL TRIBOLOGY	25	75	100	3	0	0	3
7	12M8E6	LEAN MANUFACTURING	25	75	100	3	0	0	3
8	12M8E7	PRECISION ENGINEERING	25	75	100	3	0	0	3
9	12M8E8	RELIABILTY AND TOTAL PRODUCTIVE MAINTENANCE	25	75	100	3	0	0	3
10	12M8E9	NUMERICAL METHODS	25	75	100	3	0	0	3

12M1Z2 ENGINEERING MATHEMATICS I
(Common to all branches)

L	T	P	C
3	1	0	4

MATRICES (09)
Characteristic equation – Eigen values and Eigen vectors of a real matrix - Properties of Eigen values - Cayley-Hamilton Theorem(statement only) and applications- Diagonalisation by similarity transformation - Reduction of quadratic form to canonical form.

HYPERBOLIC FUNCTIONS AND SOLID GEOMETRY (09)
Hyperbolic functions and Inverse Hyperbolic functions -Identities-Real and imaginary parts- solving problems using hyperbolic functions.
Sphere – tangent plane – Orthogonal spheres - Cone- right circular cone – Cylinder – right circular cylinder.

APPLICATIONS OF DIFFERENTIAL CALCULUS (09)
Curvature - cartesian and polar coordinates – centre and radius of curvature - circle of curvature -Evolutes - Envelopes - Evolutes as envelope of normal.

FUNCTION OF SEVERAL VARIABLES (09)
Function of two variables - Taylor's theorem (statement only) and expansions - maxima and minima - constrained maxima and minima by Lagrangian multiplier method - Jacobians - differentiation under integral sign.

INTEGRAL CALCULUS (09)
Gamma and Beta functions - Double integration - Cartesian and Polar Coordinates – change of order of integration - Area as double integral – Triple integration –Volume as a triple integral - Transformation to Cylindrical and Spherical co-ordinates.

LECTURE: 45 TUTORIAL:15 TOTAL : 60

Text Books
1. Veerarajan.T., **"Engineering Mathematics"**, for Semesters I and II , Tata McGraw Hill Publishing Co., New Delhi., 2010.
2.Dr.Kandasamy.P., Dr.Thilagavathy.K and Dr.Gunavathy.K., **"Engineering Mathematics"**, for First Year B.E/B.Tech, S. Chand & Co., Ram Nagar, New Delhi, 2010.

Reference Books
1. N.P.Bali., Dr. Manish Goyal., **"A text book of Engineering Mathematics"**, vol. I , University science Press, New Delhi, 2010.
2.H.C.Taneja., **"Advanced Engineering Mathematics"** ,vol. I, I.K.International Pub.House Pvt.Ltd., New Delhi, 2007.
3. Baburam., **"Engineering Mathematics"**, vol. I, Pearson, New Delhi, 2010.
4. B.V.Ramana., **"Higher Engineering Mathematics"** ,Tata McGraw Hill Publishing Co., New Delhi, 2007.
5. Grewal B.S., **"Higher Engineering Mathematics"** ,(40th Edition) Khanna Publishers, New Delhi., 2007

12M105 ENGINEERING MECHANICS
(Common to Civil, Prod, EEE and EIE)

L	T	P	C
3	1	0	4

INTRODUCTION TO MECHANICS AND FORCE CONCEPTS (09)
Definition of mechanics – characteristics – system of forces – parallelogram, triangle and polygon law of forces – resultant of a force system – resultant of a concurrent, coplanar and parallel force system – resolution and composition of forces – Lami's theorem – moment of a force – physical significance of moment-Varignon's theorem – resolution of a force into force and couple – force in space –addition of concurrent forces in space – equilibrium of a particle in space.

FRICTION (09)
Frictional resistance – classification of friction- laws of friction –coefficient of friction-angle of friction – angle of repose — cone of friction – free body diagram-advantages-equilibrium of a body on a rough inclined plane – non-concurrent force system - ladder friction – rope friction – wedge friction. Simple machines-concept of lifting machines-law of lifting machine – efficiency– mechanical advantages – velocity ratio and their relationship.

GEOMETRICAL PROPERTIES OF SECTION (09)
Introduction – concept of first moment – definition of centroid – centroid of an area – centroid of simple figures - composite sections – bodies with cutparts-moment of inertia – theorem of moment of inertia – moment of inertia of composite sections – principal moment of inertia of plane areas- radius of gyration.

BASICS OF DYNAMICS (09)
Definition – kinematics and kinetics – displacements, velocity and acceleration- Equations of motion - Types of motion – Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration – motion curves – motion under gravity – relative motion – curvilinear motion of a particle – projectiles – angle of projection – range – time of flight and maximum height.
Newton's second law of motion – linear momentum – D'Alembert's principle, Dynamics equilibrium — work energy equation of particles– law of conservation of energy – principle of work and energy.

IMPULSE MOMENTUM AND IMPACT OF ELASTIC BODIES (09)
Impulsive force – Impulse – linear impulse and momentum – Equations of momentum – principle impulse and momentum – impulsive motion – conservation of momentum.
Definition – Time of compression, restitution, collision – law of conservation of momentum – Co-efficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – loss of kinetic energy.

LECTURE:45 TUTORIAL: 15   TOTAL :60

Text Books
1. S.S. Bhavikatti and K.G. Rajasekarappa, **"Engineering Mechanics"**, New Age International (P) Ltd. 1999.
2. S.C. Natesan, **"Engineering Mechanics"**, Umesh Publications, 5-B north market, Naisarak, Delhi , 2002.

Reference Books
1. F.B. Beer and E.R. Johnson, **"Mechanics for Engineers"**, Tata Mc.Graw Hill publishing   Ltd, 1996.
2. S. Timoshenko and Young, **"Engineering Mechanics"**, Mc.Graw Hill, 4th Edition, 1995.
3. Irving shames, **"Engineering Mechanics"**, Prentice Hall of India Ltd, Delhi, 1980.
4. Domkundwar V.M and Anand V. Domkundwar, **"Engineering Mechanics (Statics and Dynamics)"**, Dhanpat Rai & Co. Ltd, 1st Edition, 2006.
5. Suhas Nitsure,**"Engineering Mechanics"**, Technical Publications, Pune, 1st edition, 2006.

12M106 PROGRAMMING WITH C AND C++

(Common to Production)

L	T	P	C
3	0	0	3

C FUNDAMENTALS (10)

Introduction – character set – identifiers and keywords – data types – variables – operators – input/output statements. Control statements – branching – looping – nested control structures.

FUNCTIONS, POINTERS, STRUCTURES AND UNION (10)

Function definition – accessing function – function prototypes, 1D array, multi dimensional arrays - passing arrays to functions. Declaration of pointers – passing pointers. Structures and Unions.

OUTLINE OF C++ AND CLASSES AND OBJECTS (9)

Preprocessor – header files – input/output statements. Classes –declaration of classes – member functions – objects – nested classes – constructors - destructors – inline member function – friend functions.

INHERITANCE AND OVERLOADING (9)

Single inheritance – direct base classes – indirect base classes – types of derivation: public inheritance, private inheritance, protected inheritance – Accessing public, private and protected data. Function overloading – scoping rules for function overloading- overloading assignment operator.

POLYMORPHISM AND DATA FILE OPERATION (7)

Polymorphism –early binding – late binding – virtual functions. Opening and closing of files – reading / writing a character from a file.

TOTAL:45

Text Books
1. E.Balagurusamy *"Programming in ANSI C"* TMH publications,2010.
2. D.Ravichandran *"Programming with C++"* TMH publications,2010.

Reference Books
1. *Pradeep Dey and Manas Ghosh*, *"Programming in C"* , *Oxford University Press, New Delhi, 2011.*
2. *Byron Gottfried* *"Programming with C"* *TMH publications,2010.*
3. *Robert Lafore* " *Object Oriented Programming in TURBO C++"* *Galgotia Publication Pvt Ltd, 2001.*
4. *E.Balagurusamy* *"Programming with C++"* *TMH publications,2010.*
5. *D.Ravichandran* *"Programming with C"* *TMH publications,2010.*
6. *Amitava Nag, Uday Mandal* *"Numerical Methods and Programming"* *TMH publications,2011.*

12M302 ENVIRONMENTAL SCIENCE AND ENGINEERING
(Common to all branches)

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L   T   P   C
3   0   0   3
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ENVIRONMENTAL RESOURCES   (09)
Earth structure, Internal and external earth processes, plate tectonics, erosion, weathering, deforestation, anomalous properties of water, hydrological cycle, effect of modern agriculture, fertilizers, pesticides, eutrophication, biomagnifications, land degradation, minerals, rocks, rock cycle, mining, types of mining, desertification, soil erosion, methods of conservation of soil erosion, renewable energy resources, wind, solar, geothermal, tidal, OTEC.

ECO SYSTEM AND BIODIVERSITY   (09)
Weather and climate, ocean current, upwelling, EL Nino, Ecology, ecosystem, biomes, physical and chemical components of ecosystem, biological components of ecosystem, forest ecosystem, desert ecosystem and pond ecosystem, Energy flow in ecosystem, nitrogen cycle, carbon dioxide cycle, phosphorous cycle, food pyramid, Ecological succession, types, biodiversity, need for biodiversity, values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity insitu-exitu conservation.

ENVIRONMENTAL POLLUTION   (09)
Air pollution, classification of air pollutants gaseous, particulates, sources effects and control of gaseous pollutants SO_2, NO_2, H_2S, CO, CO_2 and particulates, control methods, cyclone separator, electrostatic precipitator, catalytic combustion- water pollution-classification of water pollutants, inorganic pollutants, sources, effects and control of heavy metals, organic pollutants, oxygen demanding wastes, aerobic and anaerobic decomposition, soil pollution, Noise pollution, sources, effects, decibel scale.

ENVIRONMENTAL THREATS   (09)
Acid rain, green house effect, global warming, disaster management, flood, drought, earthquake, tsunami, threats to biodiversity, destruction of habitat, habit fragmentation- hunting, over exploitation – man-wildlife conflicts, The IUCN red list categories, status of threatened species.

SOCIAL ISSUES AND ENVIRONMENT   (09)
Sustainable development- sustainable technologies, need for energy and water conservation, rain water harvesting, water shed management, waste land reclamation, Air act, Wild life protection act, forest conservation act, population growth, exponential and logistic growth, variation in population among nations, population policy, women and child welfare programs, Role of information technology in human and health, HIV/AIDS, effects and preventive measures.

TOTAL: 45

Text Books
1. Sharma J.P., 'Environmental Studies', 3rd Edn, University Science Press, New Delhi (2009)
2. Anubha Kaushik and C.P.Kaushik, '**Environmental Science and Engineering**', 3rd Edn New age International Publishers, New Delhi (2008)

Reference Books
1. R.K.Trivedi, '**Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards**', Vol.1 &II, Environ Media.(2006)
2. G.Tyler Miller,Jr, '**Environmental Science**', Tenth Edition, Thomson BROOKS/COLE (2004)
3. Gilbert M.Masters, '**Introduction to Environmental Engineering and Science**', 2nd Edition Pearson Education (2004).

12M303 FLUID MECHANICS AND MACHINERY

(Common to Production)

L	T	P	C
3	1	0	4

FLUID PROPERTIES (09)

Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension, capillarity, compressibility and bulk modulus – Pascal's Law – pressure measurements – manometers- Fluid statics - Total pressure and centre of pressure on submerged surfaces.

FLUID KINEMATICS AND DYNAMICS (09)

Types of fluid flow – Types of flow line – control volume – continuity equation – one-dimensional and three dimensional – velocity potential and stream function- Energy equation – Euler and Bernoulli's equations –Applications-Orifice meter, venturimeter and pitot tube.

FLOW THROUGH PIPES AND BOUNDARY LAYER CONCEPT (09)

Laminar flow through circular pipes and parallel plates-Hagen Poisullie equation-Turbulent flow-Darcy Weisbach equation-Boundary layer- Definition- Boundary layer on a flat plate-Thickness and classification- Displacement, energy and momentum thickness.

MOMENTUM PRINCIPLE (09)

Impulse momentum principle-Application of momentum principle-Impact of Jet - Force exerted by a jet on normal, inclined and curved surfaces for stationary and moving cases-Angular momentum principle-construction of velocity vector diagrams.

HYDRAULIC TURBINES AND PUMPS (09)

Classification – construction, working principles and design of Pelton wheel and Francis Turbines-head, losses, work done and efficiency - specific speed - operating characteristics - Governing of Turbines-Classification of pumps- centrifugal pump-working principle - discharge, work done and efficiencies.

LECTURE: 45 TUTORIAL:15 TOTAL :60

Text Books
1.Rajput.R.K., *"A text Book of Fluid Mechanics"*, S.Chand and Company, New Delhi , 2002.
2.Ramamrutham.S and Narayanan.R., *"Fluid Hydraulics and Fluid Machines"*, Dhanpat rai Publishing House (P) Ltd , New Delhi, 2000.
3.Modi.P.N. and Seth.S.M., *"Hydraulics and Fluid mechanics, including Hydraulic machines"*, Standard book house,Delhi, 2002

Reference Books
1.Streeter, Victor L . and Wylie, E. Benjamin, *"Fluid Mechanics"* , McGraw Hill Ltd., 1998.
2.Natarajan.M.K., *" Fluid Machines"*, Anuradha Agencies, Vidayal Karuppur, Kumbakonaam, 1995.
3.Kumar.K.L., *"Engineering Fluid Mechanics"*, Eurasia Publishing House (P) Ltd., New Delhi, 2000.

12M2Z2 ENGINEERING MATHEMATICS II
(Common to all branches)

L	T	P	C
3	1	0	4

VECTOR CALCULUS (09)

Gradient , Divergence , Curl – Directional derivative – Irrotational and Solenoidal fields-Vector identities - Line, Surface and Volume Integrals – Green's Theorem in a Plane , Gauss Divergence and Stoke's Theorems (Statements only) – Verifications and Applications.

ORDINARY DIFFERENTIAL EQUATIONS (09)

Linear equations of Second and Higher order with constant coefficients-Simultaneous first order   Linear equations   with constant coefficients - Linear equations of Second and Higher order with variable coefficients -Legendre type –Method of variation of parameters-method of reduction of order.

COMPLEX DIFFERENTIATION (09)

Functions of a Complex variable-Analytic functions- Cauchy   Riemann   equations and sufficient conditions(excluding proof)–Harmonic and orthogonal properties of analytic functions –Construction of analytic functions-Conformal mappings : $w = z + a$, az ,$1/z$, z^2 , e^z, cos z , sin z and Bilinear Transformation.

COMPLEX INTEGRATION (09)

Cauchy's integral theorem, Cauchy's integral formula -Taylor's and Laurent's theorems (Statements only) and expansions – Poles and Residues – Cauchy's Residue theorem – Contour integration – Circular and semi circular contours.

LAPLACE TRANSFORMATIONS (09)

Laplace transforms - Properties and standard transforms-Transforms of unit step, unit impulse and error functions – Transforms of periodic functions - Inverse Laplace transforms - Initial and Final value theorems –Convolution theorem(statement only) and applications- Applications to Solution of Linear y differential equations of second order with   constant coefficients.

LECTURE: 45 TUTORIAL: 15 TOTAL : 60

Text Books

1. *Veerarajan.T.,"Engineering Mathematics" for Semesters I and II* , Tata McGraw Hill Publishing Co., New Delhi., 2010.
2.*Dr.Kandasamy.P., Dr.Thilagavathy.K and Dr.Gunavathy.K., "Engineering Mathematics" for First Year B.E/B.Tech, S. Chand & Co., Ram Nagar, New Delhi, 2010.*

Reference Books

1. *N.P.Bali., Dr. Manish Goyal., "A text book of Engineering Mathematics" vol. II , University science Press, New Delhi, 2010.*
2. *H.C.Taneja., "Advanced Engineering Mathematics" vol.II, I.K.International Pub. House Pvt.Ltd., New Delhi, 2007.*
3. *Baburam., "Engineering Mathematics", Pearson, New Delhi, 2010.*
4. *B.V.Ramana., "Higher   Engineering Mathematics" Tata McGraw Hill Publishing   Co., New Delhi, 2007.*
5. *Grewal B.S., "Higher Engineering Mathematics"(40th Edition) Khanna Publishers, New Delhi., 2007.*

12M304 ENGINEERING METALLURGY

(Common to Production)

	L	T	P	C
	3	0	0	3

CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS (09)

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbon equilibrium diagram.

HEAT TREATMENT AND SURFACE TREATMENT (09)

Definition – Full annealing, process annealing, stress relief, recrystallisation - spheroidizing –normalising, hardening and tempering of steels – austempering, martempering - Isothermal transformation diagrams – cooling curves superimposed on I.T diagram- CCR - hardenability, Jominy end quench test. Case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

FERROUS AND NON FERROUS METALS (09)

Plain carbon steels – alloy steels - Effect of alloying elements (Mn, Si, Cr, Mo, V , Ni,Ti and W) on properties of steel - stainless and tool steels – Gray, White malleable, Spheroidal graphite - alloy cast irons –heat resistant steels and die steels. Copper, Aluminium, Nickel, Magnesium, Titanium, Lead, Tin - Important alloys - their composition, properties and applications.

FOUNDRY AND POWDER METALLURGY (09)

Solidification of pure metals and alloys – melting – super heating – fluxing – micro and macro segregation – hot tears – heat transfer and structural change. Production of powders , mixing, blending, compacting , sintering and hot pressing – secondary operations- application of powder metallurgy – advantages and limitations.

WELDING METALLURGY AND TESTING OF MATERIALS (09)

Weldability – heat distribution during welding and thermal effects on parent metals – HAZ – factors affecting HAZ- hardening, cracking, distortion and residual stresses – stress relief treatment of welds – Mechanical tests - tension, compression, impact, hardness. Non Destructive Testing basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic Particle inspection and Liquid penetrant inspection test Eddy current testing.

TOTAL: 45

Text Books

1. Higgins R.A., *"Engineering Metallurgy"*, 5th edition, Elbs,1983.
2. O.P.Khanna *"Material Science And Metallurgy"*, Dhanpat RaiPublication ,2011
3. Sydney H.Avner *"Introduction to Physical Metallurgy"*Tata McGraw Hill Book Company, 1994.

Reference Books

1. William D Callsber *"Material Science and Engineering"*, Wiley India pvt Ltd 2007.
2. Lakhtin Yu., *"Engineering Physical Metallurgy and Heat Treatment"*, Mir Publisher,1985.
3. Kenneth G.Budinski and Michael K.Budinski *"Engineering Materials"* Prentice-Hall of India Private Limited, 4thIndian Reprint 2002.
4. Guy.A.G., *"Elements of Physical Metallurgy"*, Oxford &IBH Pub.Co,1990.

12M305 MANUFACTURING TECHNOLOGY II

(Common to Production)

	L	T	P	C
	3	0	0	3

THEORY OF METAL CUTTING (09)

Mechanism of metal cutting – types – cutting force – chip formation – Merchant's circle diagram – calculations – tool geometry – machinability – tool wear – tool life – cutting tool materials – cutting fluids – types.

AUTOMATS, SHAPING AND PLANNING MACHINES (09)

Capstan and turret lathes – construction - indexing mechanism - operations - working principle of single and multi-spindle automats – shaping and planning machines – types – construction - mechanism – principle of operation – different shaping operations - work holding devices.

DRILLING, BROACHING AND GRINDING MACHINES (09)

Drilling machines – specifications, types - feed mechanism, operations – drill tool nomenclature – broaching –specifications, types, tool nomenclature, broaching operations – grinding – types of grinding machines – grinding wheels, specifications – bonds –mounting and reconditioning of grinding wheels.

MILLING AND GEAR GENERATING MACHINES (09)

Milling – specifications – types - cutter nomenclature – types of cutters – milling processes – indexing – gear forming in milling – gear generation - gear shaping and gear hobbing – specifications - cutters – cutting spur and helical gears - bevel gear generators – gear finishing methods.

NON-TRADITIONAL MACHINING (09)

Classification of machining processes – process selection - ultrasonic machining – abrasive jet machining – water jet machining - laser beam machining – electron beam machining – plasma arc machining.

TOTAL: 45

Text Books
1. Hajra Choudhry S.K. and Bose S.K., **"Workshop Technology Vol II"**, Media Promoters and Publishers Pvt. Ltd., Bombay, 2004
2. Sharma P.C., **"A Text Book of Production Technology"**, S.Chand & Company Ltd., New Delhi, 10th Revised edition, 2010

Reference Books
1. Serope Kalpakjian and Steven R.Schmid, **"Manufacturing Engineering and Technology"**, Addison Wesley Longman (Singapore) Pte Ltd, Delhi, 2009
2. Jain R.K. and Gupta S.C., **"Production Technology"**, Khanna Publishers, New Delhi, 1999
3. HMT, **"Production Technology"**, 2006

12M306 STRENGTH OF MATERIALS
(Common to Production)

	L	T	P	C
	3	1	0	4

STRESS AND STRAIN (09)

Stress and strain at a point-Tension, compression, shear stresses - Hooke's law - Compound bars –lateral strain-Poisson's ratio-Volumetric strain- Bulk modulus-Relationship among elastic constants –stress strain diagrams for mild steel, cast iron-Ultimate stress-Yield stress-Factor of safety-Thermal stresses-Thin cylinders -Strain energy due to axial force-Resilience- Stress due to gradual load, suddenly applied load and Impact load.

SHEAR FORCE AND BENDING MOMENT (09)

Beams – Types of Beams - Types of loads, supports - Shear force – Bending moment – shear forces and bending moment diagrams for cantilever, simply supported and over hanging beams with concentrated , uniformly distributed and uniformly varying load-Relationship between rate of loading, shear force, bending moment- Point of contra flexure.

THEORY OF BENDING AND COMPLEX STRESSES (09)

Theory of bending-Bending equation-Section Modulus-Stress distribution at a cross section due to bending moment and shear force for cantilever, simply supported beams with point, UDL loads(Rectangular, circular, I and T sections only)-strain energy due to bending-combined direct and bending stresses, Kernel of section (Rectangular, Circular Sections only).

2D State of stress- 2D Normal and shear stresses on any plane-Principal stresses and Principal planes-Principal Strains and direction-Mohr's circle of stress.

DEFLECTION OF BEAMS AND THEORY OF LONG COLUMNS (09)

Determinations of deflection curve – Relation between slope, deflection and radius of curvature – Slope and deflection of beam at any section by Moment area method and Macaulay's method –Concept of Conjugate beam method (Theory only no problems)- Euler's theory of long Columns- Expression of crippling load for various end conditions-Effective length-Slenderness ratio-limitations of Euler equation-Rankine formula for columns.

THEORY OF TORSION (09)

Torsion of shafts – Torsion equation –Polar modulus- Stresses in Solid and Hollow circular shafts - Torsional rigidity -Power transmitted by the shaft – Importance of angle of Twist - Strain energy due to Torsion-Modulus of rupture – Torsional resilience – Combined bending and Torsion- Stresses in helical springs-Deflection of helical spring-Leaf springs.

LECTURE:45 TUTORIAL: 15   TOTAL :60

Text Books
1. Sadhu Singh, **"Strength of Materials"** , Khana Publishers, New Delhi, 2000.
2. Rajput.R. K ., **"Strength Of Materials"** , S. Chand & Company Ltd., New Delhi 1996
3. James M.Gere , **"Mechanics Of Materials"**, Thomson India, Brooks/cole, 2006

Reference Books
1. Dr.B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain., **"Mechanics of Materials"**, Lakshmi Publications Pvt Ltd, New Delhi, 2002.
2. Kazimi, **"Solid Mechanics"**, Tata McGraw Hill, New Delhi, 1998.
3. Robert L.Mott, **"Applied Strength of Materials"**, PHI Learning Pvt. Ltd, New Delhi, 2009

4. Rayhulse, Keith Sherwin, Jackcain, **"Solid Mechanics"**, Palgrave Mcmillan, 2002
5. Ramamrutham S and Narayan R, **"Strength of Materials"**, Dhanpat Rai and Sons, New Delhi, 1997.
6. Jindal U C, **"Textbook on Strength of Materials"**, Asian Books Pvt. Ltd., 2007.

12M403 APPLIED ELECTRONICS AND MICROPROCESSORS
(Common to Production)

	L	T	P	C
	3	0	0	3

ELECTRONIC CIRCUITS   (09)
Biasing of BJT and FET-DC load line-Types of Biasing-Fixed and Self biasing of BJT,FET,MOSFET-RC coupled and Transformer coupled amplifiers -Power amplifiers - Class A Power amplifier - Class B pushpull amplifier - Distortion in amplifiers. Oscillators - Barkhausen criterion -RC phase shift oscillator- Hartley Oscillator-Colpitts Oscillator.

DIGITAL ELECTRONICS   (09)
Combinational circuits - Adders and subtractors - A/D and D/A converters - weighted resistor DAC -R-2R ladder DAC - servo tracking A/D - successive approximation A/D converter -Dual slope ADC-Sequential Circuits-Flip flops-RS flip flop-JK,RS,D,T flip flops -Memories - ROM - EPROM -EEPROM-RAM.Operational amplifier-applications of opamp as adder,subtractor,Differentiator,Integrator.

MICROPROCESSOR STRUCTURE AND PROGRAMMING   (09)
Architecture of 8085A microprocessor - Instruction formats - addressing modes -instruction set of 8085A Instruction cycle - machine cycle - OP code fetch cycle -Timing diagram-Memory and I/O read cycle - memory and I/O write cycle - interrupt acknowledge machine cycle - Wait, Hold and Halt states- simple assembly language programs for 8085A .

MICROPROCESSOR INTERRUPTS AND DATA TRANSFER SCHEMES   (09)
Software interrupts - Hardware Interrupts - Vectored Interrupts - Non-vectored interrupts – Priority interrupts - Data transfer schemes - synchronous transfer, asynchronous transfer, interrupt driven transfer and DMA transfer

MICROPROCESSOR INTERFACING AND APPLICATIONS   (09)
Interfacing - interfacing A/D converters - interfacing D/A converters - applications –Temperature control - traffic light control - stepper motor control.

                                                                         TOTAL: 45

Text Books
1. Ramesh S. Goankar, "Microprocessor Architecture and Programming and Applications 8085 / 8080a", Penram International Publishing (India) 2004 .
2. Mathur S.P., Kulshreshtha D.C., Chadha P.R. "Electronic Devices and Applications and Integrated Circuits", Umesh Publications, 2004.
3. Morris Mano M., "Digital Design", Prentice Hall Of India Pvt. Ltd. 2008.

Reference Books
1. Mathur A.P., "Introduction to Microprocessor", Tata Mcgraw Hill, New Delhi 2003.
2. Ajit Pal, "Microprocessor Principles and Applications", Tata Mcgraw Hill, New Delhi   1999.
3. D.Roychoudhury, Shail Jain, "Linear Integrated Circuits", Wiley Eastern Ltd. 2008.

12M401 PROBABILITY AND STATISTICS
(Common to Production)

L T P C
3 1 0 4

PROBABILITY AND RANDOM VARIABLES (09)

Sample spaces – Events - Probability Axioms – Conditional Probability – Independent Events – Baye's Formula. Random Variables : Distributions Functions – Marginal Distributions – Conditional Distributions – Expectation – Conditional Expectation and Conditional Variance – Moments - Moment Generating Functions.

PROBABILITY DISTRIBUTION (09)

Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple problems) Chebyshev's inequality (Simple problems).

TEST OF HYPOTHESIS (09)

Tests for Means , Variances and proportions – Tests for Means , Variances and Attributes using t , F , Chi – Square distribution – Interval estimation for mean , Standard deviation – Proportion.

ANALYSIS OF VARIANCE (09)

One way classification, Two way classification and Latin square design (Only problems).

STATISTICAL QUALITY CONTROL AND CORRELATION ANALYSIS (09)

Statistical basis for control charts – Control limits – Control charts for variables : $\bar{X}$, R Charts – Control chart for defective : p , np Chart - Control chart for defects : c charts. Correlation – Regression – Multiple and Partial Correlation – Partial Regression (Problems Only)

LECTURE: 45 TUTORIAL: 15   TOTAL: 60

Text Books
1. S.C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand&Sons, New Delhi – 1999.
2. S. P. Gupta, *Statistical Methods*, Sultan Chand & Sons, New Delhi, 1999.

Reference Books
1. K. S. Trivedi, *Probability and Statistics with Reliability, Queuing and Computer Science Applications,* John Wiley and Sons,Second edition, New Delhi.2002.
2. T. Veerarajan,Probability , *Statistics and Random Process* , Tata McGraw Hill Publishing Company Ltd., New Delhi – 2003.
3. P. Kandasamy, ,K.Thilagavathy and K.Gunavathy, *Probability and Random Process,* S.Chand & Co. Ltd., New Delhi – 2007.
4. A.O.Allen,' *"Probability, Statistics and queueing Theory with Computer Applications"* Elsevier, Second Edition, 2005.
5. Hwei Hsu, *"Schaum's outline of Theory and Problems of Probability, Random Variables and Random Processes"*, Tata McGraw Hill Publishing Company Ltd., New Delhi – 2004.

12M402 METROLOGY AND MEASUREMENTS
(Common to Production)

	L	T	P	C
	3	0	0	3

METROLOGY: LINEAR AND ANGULAR MEASUREMENTS (09)

Length Standards- Length Measuring instruments - Vernier instruments - micrometer, height gauge, dial indicators, Bore gauges, Slip gauges, Comparators -Mechanical, Electrical, Optical and Pneumatic, Optical Projector. Angle measuring instruments - Bevel protractor, Spirit level, Sine bar, Autocollimator, Angle dekkor, Interferometry.

FORM MEASUREMENT (09)

Screw thread terminology- Measurement of effective diameter by two wire and three wire methods - errors in threads- Measurement of pitch, profile errors and total composite errors, Gear tooth terminology- Methods of measurements of run out, pitch, profile, lead, backlash, tooth thickness-composite method of inspection - Parkinson gear tester, Measurement of surface finish - Stylus probe instruments - profilometer- Tomlinson and Talysurf instrument-Straightness, Flatness and Roundness measurement.

MEASURING MACHINES AND ADVANCES IN METROLOGY (09)

Tool maker's microscope - Computer controlled CMM - Universal measuring machine - Automatic and multidimensional inspection machine - Computer aided inspection -Machine vision-Laser interferometer.

MEASUREMENTS:
STRAIN, FORCE, TORQUE AND PRESSURE MEASUREMENTS (09)

Electrical, Metallic Resistance Strain Gauge – Strain Gauge Ballast / Bridge circuit - Load cells - hydraulic and pneumatic systems - Pressure measuring transducers - Elastic and diaphragms – Mechanical, Hydraulic, Electric and Transmission Dynamometers.

TEMPERATURE, FLUID FLOW (09)

Bi-Metallic strips - pressure thermometers, thermo couples, optical and radiation pyrometer. Flow measurement - Obstruction meters - Pitot tubes- Rotameters - Turbine – type meters magnetic flow meters- hot wire anemometer -Vibrometers and accelerometers – seismic accelerometers.

TOTAL: 45

Text Books

1. Jain.R.K. *"Engineering Metrology"*, Khanna Publishers, Delhi, 2004.
2. Thomas G. Beckwith, Roy D, Marangoni, John H.Lienhard V., *"Mechanical Measurements"*, Addison Wesley Publishing Company, 2004

Reference Books

1. Gupta. I.C., *"A text book of Engineering Metrology"*, Dhanpat Rai & Sons, Delhi, 2003
2. Holman J P., *"Experimental Methods for Engineers"* McGrawHill Book Company, 2004
3. Jain R K, *"Mechanical and Industrial Measurements"*, Khanna Publishers, Delhi, 2004.

12M404 ELECTRICAL MACHINES AND DRIVES

(Common to Production)

	L	T	P	C
	3	0	0	3

DC MACHINES (10)

Construction – Generator Principle – EMF equation – Characteristics of different types of DC generators – Motor principle – Torque equation – Characteristics of different types DC motors – Starters – Speed control – Electric braking – Swinburne's test – Brake test.

SYNCHRONOUS MACHINES (09)

Alternators – Types and constructional features – EMF equation – Voltage regulation – Synchronous motor principle – V and inverted V curves – Hunting – Methods of starting – Applications.

INDUCTION MACHINES (10)

Construction of three-phase induction motors – Principle of operation – Torque-slip characteristics – Starting and speed control methods – Single phase induction motor – Types – Methods of starting – Applications – Universal motor.

SOLID STATE SPEED CONTROL (Power circuits and Qualitative treatment only) (08)

Control of DC drives using rectifiers and choppers – Control of three phase induction motor using stator voltage control – V/f control – Slip power recovery schemes – Rotor resistance control.

SELECTION OF DRIVES AND SPECIAL MOTORS (08)

Types of electrical drives – Factors influencing the choice of electric drives – Loading conditions and classes of duty – Determination of power rating – Selection of motor for steel rolling mills, paper mills, sugar mills, textile mills, and machine tool applications – DC and AC servomotors – Stepper motors.

TOTAL: 45

Text Books

1. Theraja B.L and Theraja A.K., 'A Text book of Electrical Technology', volume – II, S.Chand & Co., 2007.

2. Pillai S.K., 'A first course on Electrical Drives', New Age International Publishers., New Delhi, 2nd Edition (Reprint) 2011.

Reference Books

1. De N.K and Sen P.K., 'Electric Drives', PHI, 2010.

2. Deshpande M.V., 'Electric motors application and control', PHI, 2010.

3. Sugandhi R.K. and Sugandhi K.K., 'Thyristors: Theory and applications', New Age International Publishers, 2nd edition (reprint) 2005.

4. Dubey G.K., 'Fundamentals of Electric Drives', Alpha Science International Ltd., 2001.

5. Vedam Subramaniam., 'Electric Drives: Concepts and Applications', McGraw Hill, 2010.

12M405 KINEMATICS OF MACHINES

L	T	P	C
3	1	0	4

MECHANISMS (09)

Terminology and definitions – Degree of freedom – Mobility – Grashoff's law – Kinematic inversions of four bar chain and slider crank chains – Mechanical advantage – Transmission angle – Description of mechanisms – Single, double and offset slider mechanisms – Quick return mechanisms.

KINEMATICS (09)

Displacement, velocity and acceleration analysis on simple mechanisms – Graphical method – Velocity and acceleration polygons – Instantaneous center of velocity – Coriolis component – Klein's construction for slider crank chain-Analytical solution for velocity and acceleration of slider crank chain.

FRICTION DRIVES (09)

Belt and rope drive – Open and cross belt drive – Belt materials – Creep and slip - Ratio of tensions – Effect of centrifugal force – condition for maximum power – Friction in Journal Bearing - Flat pivot bearing - Friction clutches – Single plate – Multi plate – Cone clutches-Brakes - Shoe brake and Internal Expanding brake only.

CAMS (09)

Types of cams and followers – Construction of cam profiles for SHM, uniform acceleration and retardation with reciprocating and oscillating followers – Knife-edge, roller and flat.

GEARS (09)

Types - Spur gear terminology and definitions – Pressure angle and undercutting - Law of gearing – Gear profiles –Interference – Minimum number of teeth to avoid interference - Gear trains – Simple, compound, reverted and epicyclic.

LECTURE: 45 TUTORIAL: 15 TOTAL: 60

Text Books
1. Thomas Bevan, *"Theory of Machines"*, Pearson Education Limited, 2010
2. Rattan S S, *"Theory of Machines"*, Tata McGraw -Hill Publishers, New Delhi, 2009.

Reference Books
1. Shigley J.E and Uicker J.J, *"Theory of Machines and Mechanisms"*, Mcgraw Hill Inc, 1995.
2. Ghosh A and Mallick A.K, *"Theory of Mechanisms and Machines"*, Affiliated East-West Press Pvt Ltd, New Delhi, 1998.
3. V.P.Singh, *"Theory of Machines"*, Dhanapat Rai & Sons, 2005
4. George H.Martin, *"Kinematics and Dynamics of Machines"*, Waveland Pr Inc, 2002

12M406 ENGINEERING THERMODYNAMICS

(Use of Approved Steam Tables and Charts are Permitted)

L	T	P	C
3	1	0	4

CONCEPT OF THERMODYNAMICS (09)

Basic definitions, Microscopic and Macroscopic approach, Types of systems – Thermodynamic processes – Point and Path function – Thermodynamic equilibrium – Quasi-static process. Heat and work – Zeroth law – First law of thermodynamics – Applications to closed and open systems – Steady flow processes – applications

SECOND LAW OF THERMODYNAMICS AND ENTROPY (09)

Limitations of First law – Kelvin-Plank and Clausis statements – Heat engines – Refrigerators – heat pumps- efficiency and COP – Carnot cycle – Entropy – principle of increase in entropy – reversibility and irreversibility – applications.

IDEAL AND REAL GASES (09)

Equation of state – Ideal and Real gases – Properties calculations - Generalized compressibility chart - Vanderval's Equation – specific heats C_p and C_v - Joule-Thomson coefficient – ideal gas mixtures.

COMBUSTION (09)

Fuels – Combustion equations- Stoichiometric air-fuel ratio – Exhaust and flue gas analysis – practical analysis of combustion products – Dissociation – internal energy and enthalpy of reaction – Enthalpy of formation – Calorific value of fuels – power plant thermal efficiency – practical determination of calorific values – air fuel – vapour mixtures.

PROPERTIES OF STEAM AND VAPOUR POWER CYCLE (09)

Properties of steam – use of steam tables and mollier chart – dryness fraction calculations. Basic Rankine cycle – Rankine cycle with reheating and regeneration – application Binary vapour cycle.

LECTURE: 45   TUTORIAL: 15   TOTAL: 60

Text Books
1. Nag. P.K., *"Engineering Thermodynamics"* , Tata McGraw Hill Company, Third Edition, 2010.
2. Eastop.T.D, McConkey .A, *"Applied Thermodynamics"*, Pearson Education, 2010.
3. Yunus Cengel, *"Thermodynamics"* Tata McGraw Hill Company, Third Edition, 2010.

Reference Books
1. Kothandaraman, C.P., *"Thermal Engineering"*, Dhanpat Rai & Sons.
2. Holman, J.P., *"Thermodynamics"* McGraw Hill Company,2000
3. Rajput, R.K. *"Thermal Engineering"* Laxmi Publications 2010
4. Ballaney P.L., *"Thermal Engineering"*, Khanna Publishers.

12M501 ENGINEERING ECONOMICS AND MANAGEMENT
(Common to Production)

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L  T  P  C
3  0  0  3
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INDUSTRIAL ECONOMICS   (09)
Nature and scope of Economics- Importance of study of Economics for Engineers. Demand and Supply- Elasticity, cost concepts- cost and output relationship in the short and long run-Equilibrium of the firm. Pricing policies and methods.

MONEY BANKING AND TRADE   (09)
Nature and functions of money- value of money- Inflation and deflation- Functions of commercial and reserve banks Global trade- importance- foreign exchange- Balance of Payments- International Monitory institutions.

ELEMENTS OF MANAGEMENT   (09)
Evolution of scientific management- Functions of management- planning, organizing, co-ordinating- directing and controlling- Production and productivity- Factors affecting productivity- plant location and plant layout- Work study.

FINANCIAL MANAGEMENT   (09)
Concept and Definition- Purpose of investment- Types of capital- Sources of Finance-Financial statements- Stock exchange- Cash flow statements- Break even analysis.

MARKET MANAGEMENT AND PSYCHOLOGY   (09)
Sales and market management- Management of sales- Advertisement- Market research- Sales Forecasting. Psychology- Definition- Industrial psychology- Individual vs group behavior- Attitude- Motives- Morale- Fatigue- Accidents.

TOTAL: 45

Text Books
1. *Dwivedi D.N., "**Managerial Economics**", Vikas Publishing House Private Limited, New Delhi, 2009.*
2. *Bhusan Y.K., "**Fundamentals of Business Organization and Management**", Sultan Chand and Sons, New Delhi, 2001.*
3. *Robbins S.P., "**Organizational Behaviour**", and Prentice Hall of India Ltd., New Delhi, 2009.*

Reference Books
1. *Harold Koontz, Heinz Weihrich, "**Essentials of Management**", McGraw Hill, 2003.*
2. *Sundharam K.P.M., "**Money, Banking and International Trade**", Sultan Chand Sons, New Delhi, Reprint 2002.*
3. *Fred Luthans, "**Organizational Behaviour**", Tata McGraw Hill, Singapore 2006.*

12M502 DESIGN OF MACHINE ELEMENTS

(Use of Approved P S G Design Data Book is permitted)

L	T	P	C
3	1	0	4

BASICS OF DESIGN (09)

Machine design-Basic procedure of machine design-Basic requirements of machine elements-Stress-strain diagrams-Mechanical properties of engineering materials– preferred numbers, fits and tolerances – Modes of failure- Factor of safety- Stresses in machine elements: Tension, Compression, Direct Shear, bearing stress, Stress due to bending and stress due to Torsion-Eccentric axial loading-Principal stresses-Theories of elastic failure-Selection and use of Failure theories.

FLUCTUATING STRESSES AND DESIGN OF SHAFT (09)

Stress concentration – Fluctuating Stresses-Fatigue failure-Endurance limit-low and high cycle fatigue – Notch Sensitivity-Reversed stresses (Design for finite and Infinite life) - Soderberg, Goodman and Gerber relations-Design shaft under static and fatigue loading.

DESIGN OF ENERGY STORING ELEMENTS (09)

Design of helical, leaf springs, torsional and disc springs - Design of flywheels considering stresses in rims and arms for engines and punching machines

DESIGN OF TEMPORARY AND PERMANENT JOINTS (09)

Design of riveted, welded joints – design of eccentrically loaded riveted and welded joints – design of bolted joints-design of joints with variable loading -design of adhesive joints.

MISCELLANEOUS ELEMENTS (09)

Design of rigid coupling and power screws – design and selection of sliding and rolling contact bearing. - Selection of Seals and Gaskets.

LECTURE: 45 TUTORIAL: 15 TOTAL: 60

Text Books

1. Shigley, J.E. and Mischke, C.R., ***"Mechanical Engineering Design"****, Sixth Edition, McGraw Hill International, 2003.*
2.Dr. S. S. Wadhwa, Er. S. S. Tolly, ***"Machine Design"****, Dhanpat Rai & Co, Delhi 2008.*
3.Ugural A.C, *"****Mechanical Design – An Integral Approach****, McGraw-Hill Book Co,2004.*

Reference Books

1. Deutschman.D. Michels, W.J. and Wilson, C.E., ***"Machine Design Theory and Practice"****, Macmillan, 1992.*
2. Juvinal, R.C., ***"Fundamentals of Machine Component Design"****, John Wiley, 2006.*
3.Khurmi. R. S. ***"Machine Design"****, S. Chand & Co, 2006*
4. ***"Design Data"*** *– P.S.G. College of Technology, Coimbatore.*

12M503 THERMAL ENGINEERING
(Use of Approved Steam, Refrigeration and Air Conditioning Tables and Charts are Permitted)

L	T	P	C
3	1	0	4

THERMODYNAMIC CYCLES (09)
Air standard cycles – Otto, Diesel, Dual and Brayton cycles – air-standard efficiency – mean effective pressure – P-V and T-s diagrams. Actual cycles, working principle of 2 stroke and 4 stroke cycle – I.C Engine – valve and port timing diagrams.

I.C ENGINES (09)
Fuel, ignition, cooling and lubrication system for spark ignition and compression ignition engines, Cetane and Octane rating of fuels – combustion, knocking and detonation, scavenging and supercharging – performance characteristics of I.C Engines.

AIR COMPRESSORS (09)
Reciprocating compressors – effect of clearance – multi stage – optimum intermediate pressure and perfect inter-cooling – rotary, centrifugal and axial flow compressors.

REFRIGERATION AND AIR CONDITIONING (09)
Air-refrigeration cycle, vapour compression refrigeration cycle – sub-cooling and super heating vapour absorption cycles. Principles of psychometry – use of psychometric chart – principles of air-conditioning – types of air conditioning system – cooling load calculation.

STEAM NOZZLES AND TURBINES (09)
Flow through nozzles, shape of nozzle, effect of friction, critical pressure ratio and supersaturated flow. Impulse and reaction turbines – compounding, velocity diagrams for single stage turbines.

LECTURE: 45   TUTORIAL: 15   TOTAL: 60

Text Books
1. Domkundwar and Kothandaraman, C.P, **"Thermal Engineering"**, *Khanna Publishers, New Delhi 2010.*
2. Ganesan. V, **"Internal Combustion Engines"**, *Tata McGraw Hill, New Delhi, 2010.*

Reference Books
1. Yunus Cengel, **"Thermodynamics"** *Tata McGraw Hill Company, 2010.*
2. Nag. P.K., **"Engineering Thermodynamics"**, *Tata McGraw Hill Company, 2010.*
3. Rajput, R.K. **"Thermal Engineering"** *Laxmi Publications (P) Ltd., 2010.*
4. Ramalingam K.K., **"Internal Combustion Engines –Theory and Practice"** *Scitech Publications, 2010*
5. Eastop.T.D, McConkey .A, **"Applied Thermodynamics"**, *Pearson Education, 2010*

12M504 DYNAMICS OF MACHINES

	L	T	P	C
	3	1	0	4

FORCE ANALYSIS (09)

Free body diagrams – static equilibrium conditions –static force analysis in simple mechanisms like Four bar mechanism, slider crank mechanism– dynamic force analysis –Inertia force and inertia torque-D'Alemberts principle –Principle of superposition – dynamic force analysis of four bar and slider crank mechanism –graphical method– turning moment diagrams – fly wheel.

BALANCING (09)

Static and dynamic balancing – balancing of rotating masses–Balancing of Reciprocating masse- Primary and secondary unbalanced forces-partial balancing of unbalanced primary force-partial balancing of Locomotives-Variation of tractive force, Swaying couple and Hammer blow.

FREE VIBRATION (09)

Basic features of vibratory systems –degrees of freedom– free vibration – equations of motion – natural frequency – types of damping – damped vibration - critical speeds of simple shaft – torsional systems: single, two rotor systems.

FORCED VIBRATION (09)

Response to periodic forcing – harmonic forcing – unbalanced forcing - force transmissibility and amplitude transmissibility – vibration isolation.
Selection of vibration measuring instruments – accelerometer – dynamic properties and selection of structural materials for vibration control.

MECHANISM FOR CONTROL (09)

Governors – types – centrifugal governors – gravity controlled and spring controlled centrifugal governors – characteristics – effect of friction – controlling force. Gyroscopes – gyroscopic forces and torques – gyroscopic stabilization – gyroscopic effects in automobiles, ships and airplanes.

LECTURE: 45   TUTORIAL: 15   TOTAL: 60

Text Books
1. Shigley J.E and Uicker J.J., **"Theory of Machines and Mechanisms"**, McGraw Hill Inc., 1995.
2. Rattan S.S."**Theory of Machines**", Tata McGraw Hill Publishing Co.Ltd., New Delhi, 2006.

Reference Books
1. Thomas Bevan, **"Theory of Machines"**, Pearson Education Limited, 2010
2. Ghosh A. and Mallick A.K., **"Theory of Mechanisms and Machines"**, Affiliated East-West Press Pvt.Ltd, 2000.
3. George H.Martin, "**Kinematics and Dynamics of Machines**", Waveland Pr Inc,2002
4. V.P.Singh, "**Theory of Machines**", Dhanapat Rai & Sons, 2005

L	T	P	C
0	0	3	2

LIST OF EXPERIMENTS

- Test on pin fin apparatus.
- Test on counter flow heat-exchanger.
- Determination of convection heat transfer coefficient.
- Determination of thermal resistance and conductivity.
- Determination of emissivity of non-black surfaces.
- Determination of transient temperature distribution.
- Performance test on cooling tower.
- Determination of COP of mechanical heat pump.
- Determination of COP of a refrigeration system.
- Determination of COP of an air-conditioning system.
- Study of Boiler, steam turbine and Steam Engines.

TOTAL: 45

12M506 HYDRAULIC AND PNEUMATIC CONTROLS

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L  T  P  C
3  0  0  3
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FLUID POWER SYSTEMS AND FUNDAMENTALS   (09)

Introduction to fluid power- Advantages of fluid power- Application of fluid power system- Types of fluid power systems-Properties of hydraulic fluids – types of fluids – Fluid power symbols-Basics of hydraulics – Applications of Pascal's Law-Losses in pipe, valves and fittings - Pumping theory – Pump classification – Gear , Vane and piston pumps- construction and working of pumps – pump Selection.

CONTROL COMPONENTS, ACTUATORS AND ANCILLARY DEVICES   (09)

Pressure, Flow and Directional control valves - 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 - Gear, Vane and Piston motors- Accumulators - Sizing of Accumulator - Intensifier.

DESIGN OF HYDRAULIC CIRCUITS   (09)

Reciprocating- sequencing – synchronizing – regenerative –Pump unloading circuit– double pump circuits –Counterbalance valve application circuit - Accumulators circuits - Intensifier circuits - Fail_sfe circuits - Speed control Circuits - Selection of components for hydraulic systems.

PNEUMATIC SYSTEMS AND COMPONENTS   (09)

Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, and pneumatic actuators- Control elements – position- pressure sensing – switching- Speed control circuits - Pneumo-hydraulic circuit - Sequential circuit design for simple applications using cascade method,step counter method- Selection of components for pneumatic systems.

SERVO SYSTEMS AND MAINTENANCE   (09)

Servo systems – Hydro Mechanical servo systems - Electro hydraulic servo systems and proportional valves - Introduction to Electro Hydraulic/Pneumatic logic circuits, ladder diagrams- PLC applications in fluid power control - Fluid power circuits -installation and maintenance - failure and trouble shooting.

TOTAL: 45

Text Books

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education Inc. 2010
2. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw-Hill, 1995

Reference Books

1. Michael J., Pinches and John G.Ashby, "Power Hydraulics", Prentice Hall, 1989.
2. Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
3.James L. Johnson, "Introduction to Fluid Power", Delmar/Thomson Learning,2003.

12M601 OPERATIONS RESEARCH
(Use of Approved Statistical Tables Permitted)

L	T	P	C
3	1	0	4

LINEAR MODELS (09)
Phases and characteristics of operation research study – graphical method – simplex algorithm – duality – dual simplex method.

NETWORK MODELS (09)
Network models – shortest route – minimal spanning tree – maximum flow models – project network – PERT and CPM networks – critical path scheduling – sequencing models.

INVENTORY, TRANSPORTATION AND ASSIGNMENT MODELS (09)
Inventory models – economic order quantity models – safety stock – reorder point – lead time – quantity discount models – transportation problems – assignment problems.

QUEUING THEORY (09)
Queuing models – queuing systems and structures – notation parameter – single server and multi server models – poisson arrival – exponential service – simulation – Monte Carlo technique – use of random numbers.

DECISION MODELS (09)
Decision models – game theory – two person zero sum games – graphic solution – replacement models – replacement policies - models based on service life – economic life.

LECTURE: 45   TUTORIAL: 15   TOTAL: 60

Text Books
1.Sharma, S.D. **"Operations Research"**, kedarNath Ram Nath & Co. Meerut, 1994.
2.P.K. Gupta & D.S. Hira, **"Problems in Operations Research (Principles & Solutions)"**, S.Chand & Co. Ltd., 2003.
3.Taha Hamdy A, **"Operations Research**, Prentice Hall of India Pvt. Ltd., 1997.

Reference Books
1.Dharani Venkatakrishnan. S. **"Operations Research"** (Principles & Problems), Keerthi Publishing House Pvt. Ltd., 1996.
2.Don. T. Phillips, Ravindren, A and James Solberg,**" Operations Research"**, John Wiley & Sons, 1987.

12M603 DESIGN OF TRANSMISSION SYSTEMS
(Use of Approved P S G Design Data Book is permitted)

	L	T	P	C
	3	1	0	4

DESIGN OF POWER TRANSMISSION ELEMENTS   (09)
Wire ropes, pulleys – flat belt – V belt – ribbed V belt – selection of transmission chains and sprockets – silent chains.

SPUR AND HELICAL GEARS   (09)
Kinematics – force analysis in gears – stress analysis – dynamic effects – gear blank design -estimating gear size, module and face width - power rating calculations based on strength and wear considerations, crossed helical gear terminology - estimating the size of the pair of crossed-helical gears.

BEVEL AND WORM GEAR   (09)
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.

DESIGN OF GEAR BOX   (09)
Geometric progression - standard step ratio - ray diagram, kinematic layout - design of sliding mesh and constant mesh gear box - introduction to planetary gear box.

FRICTION CLUTCHES AND BRAKES   (09)
Design of plate clutches – axial clutches-cone clutches-internal expanding rim clutches- internal and external shoe brakes.

LECTURE: 45 TUTORIAL: 15 TOTAL: 60

Text Books

1.Joseph Edward Shigley and Charles, R. Mischke, **"Mechanical Engineering Design"**, McGraw Hill International Editions, 1989.
2.V.B. Bhandari, **"Design of Machine Elements"**, Tata McGraw Hill Publication Co., 1994.
3.T.V. Sundarajamoorthy and N. Shanmugam, **"Machine Design"**, Khanna Publishers, 1989.

Reference Books

1. Gitin M. Maitra and L.V. Prasad, **"Hand Book of Mechanical Design"**, II Edition, Tata McGraw Hill, 1985.
2. Juvinal R.C. **"Fundamentals of Machine Components Design"** John Wiely and Sons. 2006
3. Spott's M.F and Shoup T.E **"Design of Machine elements"**, Prentice Hall International.
4. **"Design Data"** – P.S.G. College of Technology, Coimbatore.

12M604 COMPUTER AIDED DESIGN AND MANUFACTURING

	L	T	P	C
	3	0	0	3

INTRODUCTION (09)

Evolution of CAD/CAM and CIM – segments of generic CIM – programmable logic controllers (PLC) – logic ladder program – timers. Flexible Manufacturing System (FMS). Computers and workstation, elements of interactive graphics, input/ output display and storage devices in cad – an overview of CIM software – 2D graphics: clipping- line drawing algorithm (Mid point algorithm only) – 2D and 3D translation, rotation and scaling.

GEOMETRIC MODELING (09)

Design process – CAD process – wireframe, surface, solid modeling – b-rep, constructive solid geometry– surface of revolution, swept surfaces, ruled and developed surfaces, Bezier and B-Spline curves and surfaces – engineering analysis – design review and evaluation, automated drafting – CAD hardware and software, data presentation.

NC, CNC AND DNC (09)

Numerical control - classifications – point-to-point, straight cut and contouring – positioning – incremental and absolute systems – driving devices – feed back devices – NC part programming – manual programming for simple components – computer aided part programming- Introduction to Automatically Programmed Tools (APT) programming – programming with interactive graphics – computer automated part programming.

COMPUTER AIDED SHOP FLOOR CONTROL (09)

Introduction to group technology, part classification and coding, production flow analysis, cellular manufacturing systems – computer aided material handling system – computer aided process planning – variant and generative process planning methods – artificial intelligence in process planning.

PRODUCT DATA MANAGEMENT (09)

Introduction to product data management (PDM) – CAD integration in product data management – issues related to integration of CAD with PDM – examples, tools and uses.

TOTAL: 45

Text Books

1. Mikell P.Groover, *"Automation, Production Systems and Computer-Integrated Manufacturing"*, Pearson Education, New Delhi, 2003.
2. P. Radhakrishnan and S. Subramanyan, Raju. V *"CAD/CAM/CIM"* New Age International(P) Ltd, New Delhi – 2002.
3. Kundra T.K. , Rao P.N. and Tiwari N.K. ,*"CNC Machine Tools and Computer Aided Manufacturing,"* Tata Mc Graw Hill Pub. New Delhi, 1991.

Reference Books

1. Mikell P. Groover and Enory W. Zimmers Jr. *"CAD/CAM: Computer Aided Design and Manufacturing,"* Prentice Hall of India, New Delhi.2005.
2. Steve Krar, Arthar Gill *"CNC Technology and Programming"*, McGraw Hill Pub.Company, New Delhi, 1990.
3. David Bedworth, *"Computer Integrated Design and Manufacturing"*, TMH, New Delhi, 1998.
4. Zeid Ibrahim, *"CAD/CAM Theory and Practices"*, McGraw Hill International Edition, 2000.
5. P. Radhakrishnan and S. Subramanyan *"CAD/CAM/CIM"* Willey Eastern Limited, New Delhi, 1994.
6. Donald Hearn and M.Pauline Baker, *"Computer Graphics"* Prentice Hall Inc., 2002.

12M605 HEAT AND MASS TRANSFER

(Use of Approved Heat and Mass Transfer Data Book is permitted)

L	T	P	C
3	1	0	4

CONDUCTION (09)

Fundamental differential equation of heat conduction in Cartesian coordinates- representation of general heat conduction equation in cylindrical and spherical coordinates – Fourier law of heat conduction – boundary and initial conditions – plane wall and radial systems – critical thickness of insulation – conduction with thermal energy generation – heat transfer from extended surfaces – transient heat conduction.

CONVECTION (09)

Principles of convection – convection boundary layer – laminar and turbulent flow – empirical relations for external and internal forced convection flows – flat plate, cylinders, spheres – empirical relations for free convection flows – horizontal cylinders, horizontal plates, vertical planes, inclined surfaces and enclosed spaces.

RADIATION (09)

Nature of thermal radiation – radiation intensity – relation to emission, irradiation and radiosity – black body radiation – loss of radiation – emissivity – surface emission – Kirchhoff's law – gray surface – view factor – radiation exchange between black surfaces – radiation exchange between gray surfaces – electrical analogy – radiation shields.

HEAT EXCHANGERS (09)

Types – overall heat transfer coefficient – fouling factor – heat exchanger analysis using log mean temperature difference (LMTD) and effectiveness – number of transfer units (NTU) method – compact heat exchangers, methodology of heat exchanger design calculations.

MASS TRANSFER (09)

Introduction – concentration , velocities, fluxes – mechanisms of diffusions , diffusion in a stationary and moving medium – mass convection – analogy between convective heat and mass transfer – simultaneous heat and mass transfer.

LECTURE: 45   TUTORIAL: 15   TOTAL: 60

Text Books

1. Sachdeva R.C., **"Fundamentals of Engineering Heat and Mass Transfer"**, *New Age International Publishers, New Delhi, 2010.*
2. Kothandaraman C.P., **"Fundamentals of Heat and Mass Transfer"**, *New Age International Publishers, New Delhi, 2010*

Reference Books

1. Frank P Incropera and David P. Dewitt, **"Fundamentals of Engineering Heat and Mass Transfer"**, *John Wiley and Sons, 2010*
2. Holman J.P., **"Heat and Mass Transfer"**, *Tata McGrawHill, 2010*
3. Yadav R., **"Heat and Mass Transfer"**, *Central Publishing House, Allahabad, 2010*
4. Ozisik M.N., **"Heat Transfer"**, *McGraw Hill Book Co., 2005*
5. Yunus Cengel, **"Heat Transfer"** *McGraw Hill Company, 2008.*

12M701 AUTOMOBILE ENGINEERING

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COMPONENTS OF AN AUTOMOBILE   (09)

Main systems of an Automobile-Chassis Construction-Automobile materials-Engine rating-Firing order-rotary engines-Turbocharged engines-Emission and its Control.

DETAILS OF AUTOMOTIVE ENGINES   (09)

Construction details-Cylinder block-Cylinder-Pistons connecting rods-Crank shafts-Valves and valve actuating Mechanisms-Fuel Systems for petrol and diesel engines-carburetor types-Electronic fuel injection-fuel pumps for S.I. engines-Fuel injectors-Common rail diesel injection system-Engine sensors-Microprocessor Control.

ELECRTICAL, LUBRICATION SYSTEMS AND ENGINE SERVICE   (09)

Automotive electrical circuits-Electronic ignition system-Electrical circuits-Engine lubrication-type of lubrication systems-Details of engine service.

AUTOMOTIVE TRANSMISSION SYSTEM   (09)

Clutch-types and principles of operation-types of gear box-Automatic and hydraulic transmission-propeller shaft-Rear axles and differentials.

AUTOMOTIVE CHASSIS AND ALTERNATIVE FUELS AND VEHICLES   (09)

Steering systems-Components and types-Power steering-Caster and Camber-toe in and toe out-suspension system-front and rear suspension-shock absorption-Wheels and tyres-use of nitrogen brakes-types-ABS technology- Alternative fuels-CNG-Fuel Cell-Electric and Hybrid vehicles-Recent trends in automobile technologies.

TOTAL: 45

Text Books

1. Dr. Kirpal Singh, *"Automobile Engineering Vol. I & II"*, Standard Distributors Publishers, 2006.
2. R.B. Gupta, *"Automobile Engineering"* Sathya Prakashan,New Delhi-2006.
3. Joseph Heinter *"Automobile Mechanics Principles and Practice"* Affiliated East West Press, 1997.

Reference Books

1. K.K. Ramalingam, *"Automobile Engineering – theory and Practice"* SciTech Publications, 2001.
2. William H.Crouse, *"Automotive Mechanics"*, McGraw Hill Book Co. 2004

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FUNDAMENTALS OF ROBOT   (08)

Robot - definition - robot anatomy - co-ordinate systems - work envelope - types and classification - specifications - joint notations – types of joints - speed of motion - pay load - robot parts and their functions - need for robots in Indian scenario.

ROBOT DRIVE SYSTEMS AND END EFFECTORS   (09)

Drives - hydraulic, pneumatic, mechanical, electrical - servo motors - stepper motors - salient features, application - end effectors – types: tools - grippers - mechanical grippers - pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, multiple grippers.

SENSORS AND MACHINE VISION   (10)

Requirements of sensors – principles, types and applications of following types of sensors proximity (inductive, Hall effect, capacitive, ultrasonic and optical) – range (Triangulation, structured light approach, laser range) – speed, position (resolvers, optical encoders, pneumatic) – force – torque – touch sensors (binary, analog sensor) - introduction to machine vision - functions - image processing and analysis.

ROBOT KINEMATICS AND ROBOT PROGRAMMING   (09)

Forward kinematics and reverse kinematics of manipulators - two, three degrees of freedom (in 2 dimensional) – homogeneous transformation matrix - simple problems - lead through programming, robot programming languages - VAL programming – motion commands - sensor commands - end effecter commands - simple programs for loading, unloading and palletizing operations.

APPLICATIONS, IMPLEMENTATION AND ROBOT ECONOMICS   (09)

Robot cell design – types - Application of robots in processing - assembly - inspection - material handling - loading - unloading - automobile - implementation of robots in industries - safety considerations for robot operations - economic analysis of robots - pay back method and rate of return method.

TOTAL: 45

Text Books
1. M.P.Groover, *"Industrial Robotics – Technology, Programming and Applications"*, McGraw-Hill, 2001.
2. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., *"Robotics Control, Sensing, Vision and Intelligence"*, Mc Graw Hill Book Co., 1987.
3. Richard D.Klafter, Thomas A.Chmielewski and Micheal Negin, *"Robotic engineering –An Integrated Approach"*, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 2005.

Reference Books
1. Janakiraman.P.A. *"Robotics and Image Processing"*, Tata McGraw-Hill, 1995.
2. Yoram Koren, *"Robotics for Engineers"*, McGraw-Hill Book Co., 1992.
3. A.K.Gupta and S.K.Arora, *"Industrial Automation and Robotics"*, Laxmi Publications Pvt ltd, 2007.

12M703 TOTAL QUALITY MANAGEMENT

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INTRODUCTION (09)

Definition of quality, dimensions of quality, quality planning, quality costs concepts - basic concepts of total quality management, principles of TQM, leadership concepts - quality council, quality statements, strategic planning- steps in strategic planning- Deming philosophy, barriers to TQM implementation.

TQM PRINCIPLES (09)

Customer satisfaction - customer perception of quality - customer retention, employee involvement - motivation, empowerment, performance appraisal, continuous process improvement – Juran trilogy, PDSA cycle, 5S concept, kaizen, supplier partnership - supplier rating – performance measures- Malcom Balridge National Quality Award.

STATISTICAL PROCESS CONTROL (SPC) (09)

Seven old and new tools of quality - statistical fundamentals - population and sample – normal curve - control charts for variables and attributes- state of control and out of control - process capability - concept of six sigma.

TOOLS AND TECHNIQUES (09)

Benchmarking - benchmarking process - quality function deployment (QFD) - house of quality - Taguchi quality loss function - total productive maintenance (TPM)- pillars of TPM - Failure Mode Effective Analysis (FMEA)- Failure rate- types of FMEA - stages of FMEA.

QUALITY SYSTEMS (09)

Need for ISO 9000 and other quality system - ISO 9000:2008 quality system – elements - implementation of quality system - documentation - quality auditing - QS 9000, ISO 14000 - concept, requirements and benefits- integrating ISO 14000 with ISO 9000.

TOTAL: 45

Text Books

1. Dale H.Besterfield, et al., **"Total Quality Management"**, *Pearson Education,2008.*
2. Subburaj Ramasamy, **"Total Quality Management"**, *Tata McGraw Hill, 2008.*

Reference Books

1. James R.Evans , William M.Lidsay, **"The Management and Control of Quality"**,*Thomson Learning, 2002 .*
2. Feigenbaum.A.V. **"Total Quality Management"**, *McGraw-Hill, 1991.*
3. Zeiri. **"Total Quality Management for Engineers"** *Wood Head Publishers, 1991.*

12M704 REFRIGERATION AND AIR CONDITIONING
(Use of Approved Refrigeration and Air conditioning Tables and Charts are Permitted)

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REFRIGERATION CYCLES AND REFRIGERANTS   (09)
Air refrigeration cycles - reversed Carnot cycle, Bell Coleman cycle, simple vapour compression refrigeration cycle, compound compression refrigeration cycles, and cascade refrigeration cycles.

VAPOUR ABSORPTION AND OTHER SYSTEMS   (09)
Ammonia - water system, Lithium Bromide – water system. steam jet refrigeration and solar refrigeration systems. Refrigerants – properties and classification - eco friendly refrigerants .

SYSTEM COMPONENTS   (09)
Refrigerant compressors - reciprocating, rotary and centrifugal compressors, evaporators- flooded, dry expansion, shell and tube and double pipe evaporators, condensers - air cooled, water cooled and evaporative condensers, expansion devices - automatic, capillary tube and thermostatic expansion valve.

DUCT DESIGN AND DISTRIBUTION   (09)
Air distribution systems - study of different types of duct systems, methods of duct design, duct insulation, air purity - air cleaning methods.

AIR CONDITIONING AND COOLING LOAD   (09)
Psychrometry, psychrometer, psychometric processes, moist air behaviour, effective temperatures, sensible heat factor ratio and cooling load estimation for an air conditioned space.

LECTURE: 45   TUTORIAL: 15   TOTAL: 60

Text Books
1.Arora C.P, **Refrigeration and Air Conditioning**, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2.Arora S C and Domkundwar S., **"Refrigeration and Airconditioning"**, Dhanpat Rai & Sons, New Delhi, 1997.

Reference Books
1.Stocker, **Refrigeration and Air Conditioning**, Tata McGraw Hill Publishing Company Limited, New Delhi, 1982.
2.Roy J Dossat, **Principle of Refrigeration**, Wiley Eastern Limited, Fifth Edition 2001.
3.Manohar Prasad, **Refrigeration and Air Conditioning**, Wiley Eastern Limited, 2004.
4.Jordan and Prister, **Refrigeration and Air Conditioning**, Prentice Hall of India Limited, NewDelhi, 1985.

12M6E0 POWER PLANT ENGINEERING

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ECONOMICS OF POWER GENERATION (09)

Introduction-Load-Duration Curves-Location of Power Plants-Power Plant Economics-Indian Energy Scenario-Coal-Fueled Electricity Generating Unit-Fluctuating loads on Power plant-Peak load plants.

ENVIRONMENTAL DEGRADATION AND USE OF RENEWABLE ENERGY (09)

Greenhouse Effect and its control-Acid rain-Smog-Nuclear Radiation-Solar Energy-Wind Energy-Ocean Energy Systems-Geothermal Energy-Small Hydro-Energy from Biomass.

STEAM POWER PLANT AND HYDRO ELECTRIC POWER PLANT (09)

Layout of a Modern steam power plant-Fuel Handling-Fluidized Bed Combustion-High Pressure boilers-Draught-Ash Handling-Dust Collection-Steam Condenser and cooling towers-Cogeneration-Layout of Hydro Power plant-Essential features of Hydro-electric power plant-Hydrology.

DIESEL ENGINE AND GAS TURBINE POWER PLANT (09)

General layout of Diesel Engine power plant-Applications-Advantages and Disadvantages of Diesel Engine power plant-Applications-Site selection-Merits of Gas Turbine-Combined operations of different power plants.

NUCLEAR POWER PLANTS AND DIRECT ENERGY CONVERSION (09)

General aspects of nuclear engineering-Main Components of a nuclear power plant-Description of Reactors-Types-Advantages-Site Selection and Applications-Safety measures of Nuclear power plants-Future of Nuclear power-Direct Energy Conversion System-Thermo electric and thermionic conversion-Fuel cells-Photovoltaic Power system-MHD-EGD-Nuclear Batteries.

TOTAL: 45

Text Books
1. S.C. Arora and S. Domkundwar, "A Course in Power Plant Engineering", Dhanpat Rai &sons, 2002.
2. G.R. Nagpal, "Power Plant Engineering", Khanna publishers, 2002.
3. R.K. Rajput, "A Textbook of Power Plant Engineering", Laxmi Publications pvt ltd, fourth edition 2007.

Reference Books
1.P.K. Nag, "Power Plant Engineering", Tata McGraw Hill, 2001.
2.P.C. Sharma, "A Text Book of Power Plant Engineering", S.K. Kataria and sons, Nai Sarak, New Delhi,2005.
3Frederick T. Mores, "Power Plant Engineering", Affiliated East – West Press Private Ltd.1953.

12M6E1 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

(Common to Production)
(Use of Approved Data book is permitted)

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LOCATING AND CLAMPING PRINCIPLES (09)

Tool design objectives - tool design in manufacturing - planning the design - principles of supporting and locating elements - referencing, basic rules of locating - planes of movement -locating from a flat surface - locating from internal and external diameter - external profile -ejectors - principles of clamping and work holding – types - non mechanical clamping - clamping accessories - materials used in jigs and fixtures.

DESIGN OF JIGS (09)

Drill bushes – different types of jigs – plate, latch, channel, box, angle plate, post, turnover, pot jigs - Automatic drill jigs - Rack and pinion operated, air operated jigs - design and development of jigs for simple components.

DESIGN OF FIXTURES (09)

General principles of milling boring, lathe and broaching fixtures - Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures- modular fixtures - design and development of fixtures for simple component – quick change fixtures.

PRESS ELEMENTS AND CUTTING DIE DESIGN (09)

Press working terminology – types - presses and accessories - tonnage requirements - strip lay out calculations - shearing action - die and punch elements - strippers, knockouts, stops, pilots, selection of standard die sets - design and development of progressive and compound dies for blanking and piercing operations.

DESIGN OF BENDING, FORMING, DRAWING AND MISCELLANEOUS DIES (09)

Bending– forming and drawing dies – types - design and development of above dies - design considerations in forging - extrusion –recent trends in tool design – computer aids for sheet metal forming analysis – basic introduction.

TOTAL: 45

Text Books
1.Kempster, *"Jigs and Fixtures Design"*, The English Language Book Society, 1998.
2. Joshi P.H, *"Jigs and Fixtures"*, Tata McGraw-Hill Publishing Company Limited, New Delhi 2004.
3. Donaldson C, *"Tool Design"*, Tata McGraw-Hill, New Delhi, 2003.
4.Elanchezhian, B. Vijayaramnath, T. Sunder selwya, *"Design Of Jigs, Fixtures and press tools"*, The Science and Tech Book Publishers, Chennai, 2005.

Reference Books
1. K.Venkataraman, *"Design of Jigs, Fixtures and Press tools"*, Tata McGraw-Hill Publishing Company Limited, New Delhi 2005.
2. Edward G Hoffman, *"Jigs and Fixture Design"*, Thomson – Delmar Learning, Singapore, 2004.
3.Hiram E Grant, *"Jigs and Fixture"* Tata McGraw Hill, New Delhi, 2003.
4.*"Fundamentals of Tool Design"*, CEEE Edition, ASTME, 1983.

12M6E2 COMPUTATIONAL FLUID DYNAMICS

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FLUID DYNAMICS AND GOVERNING EQUATIONS (09)

Basic fluid dynamics equations, Equations in general orthogonal coordinate system – Continuity, Momentum and Energy equations – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour - Elliptic, Parabolic and Hyperbolic equations.

FINITE DIFFERENCE METHOD (0 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.

FINITE VOLUME METHOD (FVM) FOR CONDUCTION (09)

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

FINITE VOLUME METHOD FOR CONVECTION (09)

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

CALCULATION FLOW FIELD BY FVM (09)

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.

TOTAL: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.

Reference Books

1.Patankar, S.V. *Numerical Heat Transfer and Fluid Flow*, Hemisphere Publishing Corporation, 2004.
2.Muralidhar, K., and Sundararajan, T., *Computational Fluid Flow and Heat Transfer*, Narosa Publishing House, NewDelhi, 1995.
3.Prodip Niyogi, Chakrabarty .S.K., Laha .M.K. *Introduction to Computational Fluid Dynamics*, Pearson Education, 2005.
4.Anil W. Date, *Introduction to Computational Fluid Dynamics*, Cambridge University Press, 2005.

12M6E3 MACHINE TOOL DESIGN

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STATIC AND DYNAMIC STIFFNESS, FORCE ANALYSIS   (09)

Static stiffness and compliance – deformation caused by weight, forces – deformation caused by cutting forces – forced vibrations, self – excited vibrations. Force distribution in different parts of lathe, drilling machine, milling machine and planning machines.

DESIGN OF STRUCTURES   (09)

Beds, columns and housing for maximum strength and rigidity – cast and welded construction, - CNC machine tools, - structure – main drive and feed drive – ball screws – automatic tool changers – chip conveyors – tool magazines – tool turrets.

DESIGN OF SLIDE WAYS   (09)

Selection of materials – integrated and attached ways – hydro-static guide ways – aero-static guide ways – antifriction guide ways – design of friction guide ways – plastic inserted guide ways and LM guide ways.

DESIGN OF MACHINE TOOL SPINDLES AND DRIVES   (09)

Design requirements – standards – selection of spindle bearings – materials for spindles – typical spindle design - design considerations of electrical, mechanical and hydraulic drives in machine tools.

MACHINE TOOL CHATTER   (09)

The dynamics of cutting process – physical causes of chatter – theory of machine tool chatter – chatter in different types of machines tools – milling machine, lathes and grinding machines – the theory of chatter with several degree of freedom – chatter suppression. Design of control mechanisms – selection of standard components – dynamic measurements of forces and vibrations in machine tools – use of vibration dampers.

TOTAL: 45

Text Books

1. Sen and Bhattacharya, "**Principles of Machine Tools**, New Central Book   Agency, Calcutta, 1992.
2. Mehta .N.K, "**Machine Tool Design**" ,Tata McGraw Hill, 1989.

Reference Books

1. Koenisberger. F., "**Design Principles of Metal cutting Machine Tools**", Pergamon press, 1964
2. Acherkan .N. "**Machine Tool Design**", Vol. 3&4, MIR Publishers, Moscow, 1968.

12M6E4 DESIGN FOR MANUFACTURE

L	T	P	C
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DESIGN PRINCIPLES FOR MANUFACTURABILITY (07)

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, process capability - feature tolerances geometric tolerances - assembly limits -datum features - tolerance stacks.

FACTORS INFLUENCING FORM DESIGN (09)

Working principle, material, manufacture, design- possible solutions - materials choice - influence of materials on form design - form design of welded members, forgings and castings.

COMPONENT DESIGN - MACHINING (10)

Design features to facilitate machining - drills - milling cutters - keyways - doweling procedures, counter sunk screws - reduction of machined area- simplification by separation - simplification by amalgamation - design for machinability - design for economy - design for clampability - design for accessibility - design for assembly.

COMPONENT DESIGN - CASTING (10)

Redesign of castings based on parting line considerations - minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - modifying the design - group technology.

DESIGN FOR ENVIRONMENT (09)

Introduction – environmental objectives – global issues – regional and local issues – basic DFE methods – design guidelines – lifecycle   assessment method – techniques to reduce environmental impact –design for energy efficiency – design to regulations and standards.

TOTAL : 45

Text Books
1. Robert Matousek, " **Engineering Design- A systematic approach** " , Blackie&sons ltd., 1963
2. Harry Peck, **"Design for Manufacture"**, Pitman Publishers, 1983.

Reference Books
1. Boothroyd, G, **Design for Assembly Automation and Product Design**. New York, Marcel Dekker. 1980
2. Bralla, **Design for Manufacture handbook**, McGraw hill, 1999.

12M7E0 MANAGEMENT ACCOUNTING

L	T	P	C
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BASICS OF MANAGEMENT ACCOUNTING (09)
Nature, scope, definitions, comparison with financial accounting and cost accounting - utility and limitations of management accounting

ANALYSIS AND INTERPRETATION OF FINANCIAL STATEMENTS (09)
Concepts and limitations of financial statements - analysis and interpretation- comparative financial statements - common size statements - trend percentages - ratio analysis

FUND FLOW AND CASH FLOW ANALYSIS (09)
Concept of funds - sources and use of funds - construction of fund flow statement -distinction of cash from funds - utility of cash flow statement - construction of cash flow statement.

BUDGETS AND BUDGETARY CONTROL (09)
Nature and objectives of budgetary control - uses and limitations - preparation of various budgets.

CAPITAL BUDGETING (09)
Nature of capital expenditure - capital budgeting procedure – Evaluation procedures – Discounted and Non- discounted cash flow methods- Project selection under Capital rationing.

TOTAL: 45

Text Books
1. Maheshwari, S.N., **"Principles of Management Accounting"**, Sultan Chand and Sons, New Delhi, 2007
2. Maheshwari, S.N., **"Management Accounting and Financial Control"**, Sultan Chand and Sons, New Delhi, 2006

Reference Books
1. James Van Horne, **"Financial Management and Policy"**, Prentice Hall of India, 2006
2. Khan and Jain, **" Financial Management"**, Tata McGraw Hill Publishers, New Delhi,2009

(Common to Production)

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BASIC FRENCHDOSSIER O   (05)

Rencontres, presentations , nationalities - saluer, vous excuser, vous presemter - demander et donner votre identite - computer et peeler des mots - les verbes etre, avoir et s' appeler, au present (singulier) des noms et des adjectives au singulier - C'est + nom ou pronom - // est + adjective - La negation ne... pas - Des phrases interrogative.

DOSSIER 1   (05)

I' arrivee en France - une inscription (a un club de cyclotourisnce) - ce qu' on dit en classe (consignes) - Vous informer sur l' identite d'une personne - distinguer les formes – familieres et les formes de politesse - des articles et des adjectives possesifs, au singulier - des mots interrogatifs: quell (adjective), qui (pronoun) ou, comment (adverbs) - des noms de professions.

DOSSIER 2   (05)

La famille - quelques personagers celebres - presener votre famille et des amis - dire ou sont les gens et d'ou ils viennent - les verbes en-er, etre, avoir, faire et venire au present - le plural des noms, des adjectives, des articles et des adjectives possessifs - la negation ne … pas de + nom - l' interrogation avel est – ce que - a, an et de + nouns de villes et de pays.

DOSSIER 3   (10)

Maisons et appartements - demenagements, locations, petites annonces – monuments parisiens - situer des meubles et des objects (la localisation) - indiquer la possession - donner des orders et des interdictions - exprimer l' accord et le refus-les verbes en–er, faire, prendre et nettre, au present et a l' imperative - le pronom on - les pronoms toniques après preposition - les adjectives demonstratifs - les adjectives ordinaux - la response si - il ya … un / des.

INITIATIVE TO GERMAN LANGUAGE
INTRODUCTION   (10)

Alphabets, Greetings, Vocabulary, Grammar – Pronouns, Verbs and their conjugations, Articles, Question words, Statements and questions, Negation, Countries, Nationalities and Languages. Simple dialogues, Exercises.

POSSESSIVE PRONOUNS   (10)

Family, Professions, the verb 'sein', Number system, Nouns – singular and plural. Imperative statements. A small text and dialogues related to family. Exercises

More irregular verbs, Accusative and dativ declensions of pronouns and articles. Modal verbs and their related grammatical structure. Dialogues and usages of modal verbs. Exercises.

Time and time related particles. Daily routines, related verbs and question words. Related vocabulary and grammar. Sample dialogues and exercises.

Separable and inseparable verbs and their related usage pattern. Invitations and telephone conversations. Exercises.
(FINAL EXAM – Hearing, Oral and Written)

TOTAL: 45

Text Books

*1. Capelle, Guy and Gidon, Noelle. **Le Nouvel Escapes**. Paris: Hachette Livre, 1998.*
2.Tangram Aktuell 1 (Deutsch als Fremdsprache) - Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr - Max Hueber   Verlag, 2004.
3. Lernziel Deutsch - Wolfgang Hieber - Max Hueber Verlag, 1983.
4. Grundkurs Deutsch - Roland Schäpers, Renate Luscher , Manfred Glück, 1980

12M7E2 INTERNAL COMBUSTION ENGINES

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INTRODUCTION (09)

Fuel air cycle and Actual cycle analysis, Engine Classification, Different parts of I.C. Engines, Four Stroke Cycle Engines, Two Stroke Cycle Engines, Laboratory tests for fuel – Cetane and Octane number. Performance Parameters, Basic Measurements, Engine Performance Curves.

SI ENGINES: CARBURETION AND IGNITION SYSTEMS (09)

Carburetion and Carburetors - factors influencing carburetion, - Types of Carburetors- Description of Some Important Makes of Carburetors, Introduction to Fuel Injection- Direct Injection- Indirect Injection- Injection Considerations- Comparison of Petrol Injection and Carburetted Fuel Supply Systems - Electronic Fuel Injection. Ignition System - requirements of an Ignition System - Basic Ignition System- Magneto Ignition- Firing Order - Electronic Ignition Systems, Lubrication Systems.

CI ENGINES: INJECTION AND LUBRICATION SYSTEMS (09)

Functional Requirements of an Injection System - Fuel Injection System- Air Injection- Solid or Airless Injection, Fuel Pump, Fuel Atomizer, Types of Nozzles and Fuel Spray Patterns - Main Requirements of an Injector Nozzle, Lubrication Systems- Wet Sump Lubrication System- Dry Sump Lubrication System- Mist Lubrication System- Lubrication of Different Engine Parts- Lubrication of Ball and Roller Bearings- Oil Filters, Crankcase Ventilation.

COMBUSTION IN S.I. ENGINES (09)

Definition of Combustion- Ignition Limits, Combustion Phenomenon- Normal Combustion- Abnormal Combustion, Effect of Engine Variables on Ignition Lag, Factors Affecting Ignition Timing, Pre Ignition. Detonation - Effects of Detonation- Factors Affecting Detonation, Performance Number, Combustion Chamber Design- Swirl- Squish and Tumble- Flame Propagation - Surface to Volume Ratio- Stroke to Bore Ratio- Compression Ratio, Some Types Of Combustion Chambers- Divided Combustion Chambers.

COMBUSTION IN C.I. ENGINES (09)

Combustion Phenomenon in C.I. Engines, Fundamentals of the Combustion Process, Delay Period- Factors Affecting Delay Period, Diesel Knock, Combustion Chambers – Primary Design Consideration – Types - Basic Methods of Generating Air Swirl, Cold Starting. Combustion chambers for Homogeneous charge compression ignition systems – Dual and alternate fueled engine systems.

TOTAL: 45

Text Books

1. Ganesan .V , "**IC Engines**" , Tata McGraw-Hill, 2003.
2. John B. Haywood, "**Internal Combustion Engine Fundamentals**", McGraw-Hill Automotive Technology Series , 1988.

Reference Books

1. Richard Stone, "**Introduction to IC Engines**", Macmilan,– 1992.
2. K. K. Ramalingam, "**Internal Combustion Engines**", Scitech publications, 2003.
3. Heldt,P.M., "**High Speed Combustion Engines**", Oxford IBH Publishing Co., 1985.
4. Obert,E.F., "**Internal Combustion Engine analysis and Practice**", International TextBook Co., Scranton, 1988.

12M7E3 ENTREPRENEURSHIP AND PRODUCT DEVELOPMENT STRATEGIES

L	T	P	C
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INTRODUCTION TO ENTREPRENEURSHIP (09)

Definition – characteristics and functions of an entrepreneur – common myths about entrepreneurs – importance or entrepreneurship. sources of new ideas – methods of generating ideas – creative problem solving – entrepreneurial process - the importance of a business model – components of an effective business model – developing and writing the business plan. appraisal of Projects.

FINANCING AND MARKETING THE NEW VENTURE (09)

Determining financial needs – sources of financing – equity and debt funding – evaluating financial performance, industry analysis – competitor analysis – marketing research for the new venture – defining the purpose or objectives – gathering data from secondary sources – gathering information from primary sources – analyzing and interpreting the results – the marketing process

INTRODUCTION TO PRODUCT DEVELOPMENT STRATEGIES (09)

Product development versus design-types of design and redesign-modern production development process - reverse engineering and redesign - product development process –   S-curve-new product development - Gathering customer needs - organizing and prioritizing customer needs-establishing product function - FAST method-establishing system functionality. Tear down method-post teardown report-benchmarking and establishing engineering specifications-product portfolios.

CONCEPTS GENERATION AND DESIGN FOR ENVIRONMENT (09)

Information gathering-brain ball-C-sketch/6-3-5 method-morphological analysis-concept selection-technical feasibility-ranking-measurement theory- Design for Manufacture and Assembly (DFMA) - design for robustness - Methods - life cycle assessment-weighted sum assessment method-techniques to reduce environmental impact – disassembly-recyclability-remanufacturing regulations and standards-analytical and numerical model solutions.

PHYSICAL PROTOTYPES (09)

Types of prototypes - use of prototypes-rapid prototyping technique - scale - dimensional analysis and similitude - physical model and experimentation – design of experiments-statistical analysis of experiments.

TOTAL: 45

Text Books
1.Karl. T. Ulrich and Stephen D. Eppinger, *"Product Design and Development"*, McGraw Hill, New York, 1994.
2.Robert D Hisrich, Michael P Peters and Dean Shepherd, *"Entrepreneurship"*, Tata McGraw Hill, 2007.

Reference Books
1.Bruee R Barringer and Duane Ireland, *"Entrepreneurship – Successfully Launching New Ventures"*, Pearson – Prentice Hall, 2006.
2.Kevin Otto, Kristin Wood, *"Product Design – Techniques in Reverse Engineering and New Product Development"*, Pearson Education, New Delhi, 2004.
3. Marc J Dollinger, *"Entrepreneurship – Strategies and Resources"*, Pearson Education, 2003.
4.Mary Coulter, *"Entrepreneurship in Action"*, Prentice Hall of India, 2006.

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WORK STUDY AND ERGONOMICS (09)

Method study – Basic procedure - steps in method study, recording, selection and recording techniques – micro motion and memo motion study – techniques of work measurement - time study – production study - work sampling - ergonomics.

PLANT LOCATION (09)

Objective and subjective factors – break even analysis –single facility location problem – multi facility location problems – model for warehouse location problem - facility location model – Brown and Gibson model.

PLANT LAYOUT AND MATERIAL HANDLING (09)

Introduction – classification of layout – layout design procedures – CRAFT, ALDEP and CORELAP. Materials Handling – unit load concept – material handling principles – classification of material handling equipments.

PRODUCTION PLANNING (09)

Demand forecasting - time series forecasting models - Delphi method of forecasting -forecast errors – Material resource planning (MRP) and Enterprise resource planning (ERP).

PRODUCTION CONTROL (09)

Functions of production control - product design and analysis – process planning and design – value analysis – standardization – simplification and specialization – make or buy decisions – Inventory control-need for inventory-purchase order model-economic order quantity - model with and without shortages – simple problems in determination of EOQ.

TOTAL: 45

Text Books
1.Samuel Eilon, *"Elements of Production Planning and Control"*, Universal Book Corporation, 1984.
2. Panneerselvam, R., *"Production and Operations Management"*, 2nd edition, Prentice Hall of India, New Delhi, 2006.

Reference Books
1.Barnes, *"Motion and Time study"*, John Wiley, New York, 1990.
2.Apple, J.M. *"Plant Layout and Materials Handling"*, Ronald Press Company, New York, 1977.
3.ILO, *"Introduction to work study"*, ILO, Geneva, 1974.
4. Buffa, E.S., *"Modern Production/Operations Management"*, 7th edition, John Wiley sons, 1983.
5.Scheele et al. *"Principles and Design of Production Control Systems"*, Prentice Hall Inc.,
6.Norman Gaither G. Frazier, *"Operations Management"*, Thomson Learning, 9th Edition IE, 2007.

12M7E5 COMPOSITE MATERIALS

(Common to Production)

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INTRODUCTION TO COMPOSITE MATERIALS (09)

Types and characteristics of composite materials-Mechanical behavior-Basic terminology and Manufacture of laminated fiber-Reinforced composite materials-Current and potential advantages-Applications of composite materials.

REINFORCEMENT AND MATRICES (09)

Different types of fibers-Properties and applications of fibers-Roll of matrix-Matrix materials, Selection of matrix-Thermoset matrix-Thermoplastic matrix, Fiber architecture.

INTRODUCTION TO COMPOSITE STRUCTURES DESIGN (09)

Elements of Design-Steps in design process-Elements of analysis in design-Analysis iterations-Design analysis stages-Material selection-Configuration selection-Laminate joints-Design requirements and design failure criteria.

MANUFACURING OF ADVANCED COMPOSITES (09)

Bag-Molding process-Compression molding-Pultrusion-Filament winding-Liquid composite molding processes-Resin film infusion-Elastic reservoir molding-Tube rolling-Forming methods for thermoplastic matrix composites.

METAL, CERAMIC AND CARBON MATRIX COMPOSITES (09)

Metal matrix composites-Manufacturing processes-Ceramic matrix composites-Mechanical properties-Manufacturing processes-Carbon matrix composites-Fabrication methods-Applications.

TOTAL: 45

Text Books
1. Krishnan K. Chawla, "Composite Materials Science and Engineering", Springer (India) Private Limited, 2009
2. P.K.Mallick , "Fiber Reinforced Composite materials, Manufacturing and Design",CRCPress,Taylor and Francis Group,Boca Raton,London,Newyork 2010
3. A.K.Bhargava, "Engineering Materials: Polymers, ceramics and composites", Pentice Hall of India Limited, 2005.

Reference Books
1. Madhujit Mukhopadhyay , "Mechanics of Composite Materials and Structures ", Universities Press (India) Private Limited, 2009.
2.Robert M.Jones, " Mechanics of Composite Materials", Taylor and Francis Group, 2010.
3.Web Portal: Composite Materials{Nptel 3.1.2 Civil Engineering}

12M7E6 HUMAN VALUES AND PROFESSIONAL ETHICS

(Common to Production)

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HUMAN VALUES   (09)
Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality

ENGINEERING ETHICS   (09)
Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

ENGINEERING AS SOCIAL EXPERIMENTATION   (09)
Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

SAFETY, RESPONSIBILITIES AND RIGHTS   (09)
Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies.
Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

GLOBAL ISSUES   (09)
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India

TOTAL : 45

Text Books
1. Mike Martin and Roland Schinzinger, **"Ethics in Engineering"**, McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, **"Engineering Ethics"**, Prentice Hall of India, New Delhi, 2004.
3. Tripathi A N, **"Human values"** , New Age international Pvt. Ltd., New Delhi, 2002

Reference Books
1. Charles D. Fleddermann, **"Engineering Ethics"**, Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, **"Engineering Ethics – Concepts and Cases"**, Wadsworth Thompson Learning, United States, 2000 .
3. John R Boatright, **"Ethics and the Conduct of Business"**, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, **"Fundamentals of Ethics for Scientists and Engineers"**, Oxford University Press, Oxford, 2001.

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MECHATRONICS SYSTEMS (09)

Introduction to mechatronics –components of mechatronic systems- measurement systems – mechatronics approach.Basic system models-mathematical models- mechanical system building blocks –electrical system building blocks- Fluid system building blocks.

SENSORS AND TRANSDUCERS (09)

Introduction – performance terminology – displacement, position and proximity – velocity and motion – fluid pressure – temperature sensors – light sensors – selection of sensors.

SIGNAL CONDITIONING (09)

Signal conditioning processes-Operational amplifier– protection – conversion –filtering –wheat stone bridge- digital signal conditioning.

CONTROLLERS (09)

Introduction-Control modes-PD, PI, PID Controllers-digital controllers-adaptive control system. Programmable logic controller – basic structure – input /output processing – programming - mnemonics – timers – internal relays and counters – data handling – analog input/output - selection of PLC.

DESIGN OF MECHATRONICS SYSTEMS (09)

Stages in designing mechatronics systems – traditional and mechatronics design – case studies of mechatronics systems – pick and place robot – automatic car park system – engine management system-automatic washing machine .

TOTAL: 45

Text Books
1.W.Bolton, *"Mechatronics"* , Longman,2nd Edition,1999
2.S. Ramachandran, A. Sivasubramanian *"Mechatronics"*, Air Walk Publication, 2004.

Reference Books
1.Michael B. Histand and David G.Alciatore, *" Introduction to Mechatronics and Measurement Systems"*, Tata McGraw Hill, 2nd Edition,2003
2.D.A.Bradley,D.Dawson,N.C.Buru and A.J.Loader, *"Mechatronics"* Chapman and Hall,1993
3.Dan Necsulescu, *"Mechatronics"*,Pearson Education Asia,2005
4.Devdas Shetly, Richard A. Kolk, *"Mechatronics System Design"*, Thomson, PWS publishing co, 2007.

12M7E8 WELDING TECHNOLOGY

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FUNDAMENTALS OF WELDING PROCESSES (09)

Classification and characteristics - welding processes and methods-Arc welding equipments - Electrodes – Coatings – Principles of Resistance welding –spot welding-seam welding – Percusion welding - Gas metal arc welding – Flux cored – Submerged arc welding –TIG welding - ultrasonic welding - explosive welding- diffusion welding- friction welding.

SPECIAL WELDING PROCESSES (09)

Plasma Jet Surfacing - vacuum shielded - electron beam welding - laser beam welding, hybrid welding- Under water welding - brazing and soldering- wetting and spreading- joint design of soldering and brazing, brazing and soldering fluxes.

INSPECTION AND TESTING OF WELDMENTS (09)

Testing of welds - quality in weldment - computer applications in welding- expert systems in welding- weldability of stainless steel, cast iron, aluminum alloys and titanium alloys, low alloy steels and ultra high strength steels - weldability assessment and weldability tests

WELDING OF DISSIMILAR AND NON METALLIC MATERIALS (09)

Welding of dissimilar metals - welding of ceramics, composites, micro welding of thin components - defects in weldments, mechanism- reasons and remedies of cold cracking- hot cracking- reheated cracking and lamellar tearing- NDT evaluation of weldments.

WELDING METALLURGY (09)

Weld thermal cycles – Heat Affected Zone(HAZ) – Weldability of steels – Cast Iron –Stainless steel,aluminium – Copper and Titanium alloys – Hydrogen embrittlement – Pro and post weld heat Treatments – weld defects.

TOTAL: 45

Text Books
1.Parmer R.S., *"Welding Engineering and Technology"*, Khanna Publishers, New Delhi, 1997.
2.Parmer R.S., *"Welding Processes and Technology"*, Khanna Publishers, New Delhi, 1992.

Reference Books
1.Nadkarni S.V., *"Modern Arc Welding Technology"*, South Asia Books, 1988.
2.Little R.L., *"Welding and welding Technology"*, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 1989.
3.Davis A.C., *"The Science and Practice of Welding"*, Cambridge University Press, Cambridge, 1993
4.O.P.Khanna,*"Welding Technology"*,Dhanpat Rai and sons,2008.

12M7E9 PLANT LAYOUT AND MATERIAL HANDLING
(Common to Production)

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INTRODUCTION (09)
Factors to be considered for location of plant layout - physical facilities - equipments required for plant operation. Capacity, serviceability and flexibility and analysis in selection of equipments space requirements, man power requirements.

PLANT LAYOUT (09)
Plant layout - need for layout, factors influencing product, process, fixed and combination layout - tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models - machine data- Layout planning procedure- Visualization of layout revision and improving existing layout, balancing of fabricating and assembly lines.

MATERIAL HANDLING (09)
Principles, importance and scope of material handling. Planning, operation and costing principles - types of material handling systems, factors influencing their choice.

UTILITIES (09)
Industrial buildings and utilities - centralized electrical pneumatic water line systems- Types of building, lighting, heating, air-conditioning and ventilation utilities. Planning and maintenance, waste handling statutory requirements. Packing and storage of materials - layout for packaging - packaging machinery - wrapping and packing of materials, cushion materials.

ANALYSYS OF MATERIAL HANDLING EQUIPEMENTS (09)
Analysis of material handling - factors involved, motion analysis, flow analysis, graphic analysis, safety analysis, and equipment cost analysis, analysis of operation material handling surveys.

TOTAL: 45

Text Books
1. James, M. Apple., *'Plant Layout and Material Handling'*, John Wiley & Sons, INC, 1977.
2. Rudenko. N., *"Materials handling equipment"*, Elnvee Publishers, 1970.

Reference Books
1. James, M. Moore, *'Plant Layout and Design'*, Macmillan Company, NY, 1963
2. Muther, R., *'Practical Plant Layout'*, Mc Graw Hill Book Company, NY, 1955

12M8E0 PROCESS PLANNING AND COST ESTIMATION

(Common to Production)

	L	T	P	C
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DESIGN AND CONCEPTS OF PROCESS PLAN (09)

Introduction- Place of process planning-economics- Process and Production Planning, Process Planning and Concurrent Engineering-Types of production- standardization- Production design and selection: Selection of processes, tools, cutting parameters and machine tools- Jigs and Fixtures - Grouping of processes- Sequencing of operations- Selecting primary manufacturing processes for rough and refined needs- Process capability, Process Charts.

MANUAL AND COMPUTER AIDED PROCESS PLANNING (09)

Retrieval type/variant approach, group technology – generative approach, logics decision trees and tables, axiomatic approach – AI expert systems – feature recognition – applications -Estimating and Costing - Concepts, differences, different costing methods – classification of costs – cost grid-problems.

DIRECT AND INDIRECT COST COMPONENTS (09)

Labour cost–direct, indirect– estimation– labour norms–time study rating – labour cost variances - material cost–direct, indirect–estimation–material issue valuation – material cost variances–problems. Overhead cost - Elements – factory, administrative, sales and distribution expenses–methods of absorbing overheads – Direct Labour, Direct Material, Machine Hour Rate methods – depreciation – methods –accounting for service department expenses – problems.

COST CALCULATIONS (09)

Machined components–welded components, forged components, powder metallurgy parts, calculation of sales cost, case studies, use of computers in cost estimation, cost of rejection- Optimum Machining Conditions: Taylors equation, deriving the equation for optimum economic cutting velocity– selection of cutting speed for optimum cost, problems process capability analysis.

BREAK EVEN ANALYSIS AND COST MANAGEMENT (09)

Concept, make or buy decision, assumptions, merits and demerits of break even analysis. Applications - Linear, multi product break-even analysis - Cost Management - Learning curves, product life cycle cost analysis -Tools and techniques – activity based costing - concepts, cost drivers; introduction to target costing - need and applications.

TOTAL: 45

Text Books

1. Kannappan D, **"Mechanical Estimating and Costing"**, Tata McGraw Hill, New Delhi, 2003.
2. Frederic C Jelen and James H Black, **"Cost and Optimization Engineering"**, McGraw Hill Inc., New York, 1983
3. Banga T R and Sharma S C, **"Mechanical Estimating and Costing"**, Khanna Publishers, New Delhi,.

Reference Books

1. Thomas E.Vollmann et all, **"Manufacturing Planning and Control Systems"**, Galgotia Publications Pvt. Ltd., New Delhi, 1998.
2. Gideon Halevi and Roland D.Weill," **Principles of Process Planning** ", Chapman & Hall, UK, 1995.
3. Samuel Eilon, **"Elements of Production Planning and Control"**, MacMillan, London, 1985.
4. Haslehurst M, **"Manufacturing Technology"**, ELBS, 1985.
5. Kesavon R **"Process Planning and Cost Estimation"**, New Age International Pvt. Ltd., Chennai, 2008.

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FUNDAMENTAL PRINCIPLES (09)

Definition, classification of functional nanomaterials - size and scale - units, scaling laws, atoms, molecules and clusters, supra molecules - nanoscale phenomena - tunneling, chemical bonds, intermolecular forces, molecular and crystalline structure, hierarchical structures and functionalities - surfaces and interfaces, bulk to surface transition, self assembly and surface reconstruction.

PROPERTIES OF NANOMATERIALS (09)

Size dependence of properties - phenomena and properties of nanoscale - brief introduction to calculational approaches - mechanical / frictional properties, optical properties, electrical transport, magnetic properties.

NANOMATERIAL CHARACTERISATION (09)

Principle, equipment, operation of Scanning electron microscopy, electron probe microscope, transmission electron microscopy, Auger electron spectroscopy, x-ray spectroscopy.

SYNTHESIS OF NANOMATERIALS (09)

Fabrication techniques: self assembly, self replication, sol - gels, Langmuir - Blodgett thin films, nano lithography - bio inspired synthesis, micro fluidic processes, chemical vapour deposition metals: colloidal gold, silver and metal clusters - semiconductors: cadmium sulphide, silicon - fullerines / carbon nanotubes, nanocomposites, nanoporous materials, biological materials.

APPLICATIONS OF NANOMATERIALS (09)

Nanoelectronics - nano sensors - environmental - biological - energy storage and fuel cells.

TOTAL: 45

Text Books
1.Nalwa H.S., *"Handbook of Nano Structured Materials and Nano Technology"*,
Vol. I – V, *Academic Press, 2000.*
2. Guozhong Cao, *"Nano Structured and Nano Materials"*, Imperial College Press, 2006.

Reference Books
1.Edelstein A.S. and Cammarata R.C., *"Nanomaterials – Synthesis, Properties and Applications"*, Institute of Physics Publishing, London, 1998.
2.Dreselhaus M.S., Dreselhaus G., and Eklund P., *"Science of Fullerines and Nano Tubes*, Academic Press, 1996.

12M8E2 KNOWLEDGE BASED SYSTEMS IN MANUFACTURING

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ARTIFICIAL INTELLIGENCE   (09)
Artificial intelligence - expert / knowledge based systems - definition - expert system architecture: software components - knowledge base - inference engine, inference sub systems.

NETWORK   (09)
Hardware requirements - knowledge acquisition, knowledge base, knowledge representation - semantic networks - structures ⲧ objects, nodes - links attributes values.

EXPERT SYSTEMS   (09)
Knowledge representation - rule based system - heuristic rules - frame based knowledge representation - inference engine components - inference strategies; backward and forward chaining, monotonic and non-monotonic reasoning - search strategies - expert system building tools - languages, shells.

APPLICATIONS IN MANUFACTURING   (09)
Commercial software for manufacturing applications in CAD, CAPP, MRP - adaptive control of devices, robotics, process control, fault diagnosis, failure analysis etc; linking expert systems to other software such as DBMS, MIS, MDB, process control and office automation.

APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN ENGINEERING   (09)
Knowledge based systems, expert systems, case-based reasoning systems. - Fuzzy logic; neural networks - use of AI for problem solving - consultation and training purposes - applications of AI in engineering – decision support system - condition monitoring and maintenance.

TOTAL: 45

Text Books
1. Peter Jackson , *"Introduction to Expert systems"*, 3rd edition, Addison Wesley Longman, 1999.
2. Stuart Russel Peter Norvig *"Artificial Intelligence: A Modern Approach"*, Pearson Education, 2003.

Reference Books
1. Elaine Rich, Kevin Knight, *"Artificial Intelligence"* 2nd Edition, TMH, 1991
2. Dan W Patterson, *"Introduction to Artificial Intelligence and Expert Systems"*, - (Seventh Indian Reprint 1999) (EEE) ,PHI,2000.
3. Rex Mauss, Jessica Keyes, *"Handbook of Expert Systems in Manufacturing"*, McGraw Hil, 2000.

12M8E3 NEWER PRODUCTION PROCESSES

(Common to Production)

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MODERN MACHINING PROCESSES   (08)

Need of modern machining processes – classification and selection of technology – mechanical processes – abrasive jet machining (AJM), water jet machining (WJM), ultrasonic machining (USM).

ELECTROCHEMICAL AND CHEMICAL METAL REMOVAL PROCESSES   (09)

Electrochemical machining (ECM), electrochemical grinding (ECG), electrochemical deburring and honing – chemical machining (CHM).

THERMAL METAL REMOVAL PROCESSES   (09)

Electric discharge machining (EDM), wire cut electric discharge machining (WEDM). Plasma arc machining (PAM), Electron beam machining (EBM), Laser beam machining (LBM), Ion beam machining (IBM).

FORMING PROCESSES AND FOUNDRY TECHNIQUES   (09)

Explosive forming, Electro – hydraulic forming, electro – magnetic forming, dynapak machine-high pressure moulding, squeeze casting, vacuum castings.

RAPID PROTOTYPING   (10)

Introduction – advantages – limitations – principle – rapid prototyping systems – stereo- lithography(SLA), selective laser sintering(SLS), fused deposition modeling(FDM), laminated object manufacturing (LOM), solid ground curing (SGC), three dimensional printing. Application of reverse engineering in rapid prototyping.

TOTAL: 45

Text Books

1. P.C.Pandey, *"Modern machining processes"*, Tata McGraw Hill publishing company Ltd. 2007.
2. P.C.Sharma, *"A text book of Production Technology"*, S.Chand & Company Ltd. 2007.
3. V.K.Jain, *"Advanced Machining Process"*, Allied Publishers PVT Ltd 2007

Reference Books

1. Bhattacharya, *"New Technology"*, Institution of Engineers, 1997.
2. CMTI, *"Electrochemical machining"*, Bangalore, 1978.
3. Gary.F.Benedict, *"Nontraditional machining Processes"*, Marcell Dekker Inc, 2001
4. HMT, *"Production Technology"*, Tata McGraw Hill Publishers, 1992.
5. Ronenthal. C *"Principles of Metal Castings"*, Tata McGraw Hill Publishing co. Ltd, 1996.

12M8E4 SUPPLY CHAIN MANAGEMENT
(Common to Production)

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INTRODUCTION (09)
Supply chain – Objectives, Importance, Decision phases- Process view of supply chain-Competitive and supply chain strategies-achieving strategic fit - drivers of supply chain performance - framework for structuring drivers – conceptual model of SCM-evolution of SCM-SCM approach: Traditional, modern-new corporate model.

SUPPLY CHAIN NETWORK (09)
The role of distribution in the supply chain-Factors influencing distribution network design-Design options for a distribution network-the role of network design in the supply chain-factors influencing network design decisions-models for facility location and capacity allocation-the role of IT in network design-the impact of uncertainty on network design-discounted cash flow analysis-evaluating network design decisions using decision trees.

OPERATION, PROCUREMENT MANAGEMENTS IN SUPPLY CHAIN (09)
Basic principles of manufacturing management-key concepts in lean manufacturing-lean manufacturing and SCM-Lean introduction to supply chain-Integration of lean manufacturing and SCM-Mass customization-SCM for mass customization-Benefits and disadvantages of mass customization-Purchasing cycle-Traditional Inventory Management-Inventory Models-EOQ-New paradigms in inventory and purchase management-Material requirements planning.

LOGISTICS MANAGEMENT (09)
Evolution of Logistics-Elements of Logistic management-Distribution management-Inventory management-Transportation management-Fleet Management-Containerisation-Warehousing-Warehouse Automation-Warehouse management systems-3PL-4PL-Technology component of 4PL.

INFORMATION TECHNOLOGY FOR SCM (09)
IT applications in SCM-advanced planning and scheduling-data mining-data mining tools in SCM-supply chain IT frame work-customer relationship management-Internal supply chain management-supplier relationship management-Lack of supply chain Coordination and Bullwhip effect-Effect on performance of lack of Coordination-Collaborative planning, Forecasting, and Replenishment(CPFR)-Role of IT in Coordination.

TOTAL: 45

Text Books

1. Sunil Chopra., Peter Meindl., *"Supply Chain Management: Strategy, Planning and Operation,"* Pearson Education, Inc. , 2005.
2. Rahul V Altekar, *"Supply Chain Management – Concepts and Cases"*, PHI., New Delhi, 2005.

Reference Books

1. Nicolas, J.N., *"Competitive Manufacturing Management – Continuous Improvement, Lean Production, Customer focused quality"*, McGraw Hill, 1998.
2. Ayers, J.B., *"Hand book of supply chain management"*, The St. Lencie press, 2000.
3. Scharj, P, B., Lasen, T.S., *"Managing the global supply chain"*, Viva books", New Delhi, 2000
4. Simchi – Levi Davi, Kaminsky Philip and Simchi-Levi Edith, *"Designing and Managing the Supply Chain"*, Tata McGraw Hill, New Delhi, 2003.
5. Thomas E Vollman and Clay Whybark D, *"Manufacturing Planning and Control for Supply Chain Management"*, Tata McGraw Hill, New Delhi, 2005.

12M8E5 INDUSTRIAL TRIBOLOGY
(Use of approved data book is permitted)

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INTRODUCTION (10)
Introduction – Navier Stoke's equations – derivation of Reynolds equation from Navier Stoke's equations – energy equation – mechanisms of pressure development – Idealized journal bearing – Infinitely long, short and gas lubrication bearings.

LUBRICATION PRINCIPLES (08)
Lubricants and their physical properties – Lubrication Regimes – Elasto, Plasto and Magneto hydrodynamic lubrication – hydrostatic lubrication – gas lubrication.

SURFACE TOPOGRAPHY, FRICTION AND WEAR (09)
Surface interactions, surface topography, roughness measurements, Hertzian contacts, Real area of contact, Theories of friction, Friction of metal and non-metals, Temperature of sliding surfaces, Stick-slip, Rolling friction, wear of metals, Adhesive, Abrasive and corrosive wear, erosion, fatigue and impact wear, Wear of elastomers, wear of ceramics and composite materials, Measurement of friction and wear.

FLUID FILM BEARINGS (10)
Performance characteristics – Numerical solutions – Hydrodynamic instability – Bearing design – Idealized hydrodynamic bearings – Plane slider bearings – Thrust bearing and Multi recess pad bearing – Analysis of externally pressurized bearings.

TRIBO MEASUREMENT IN INSTRUMENTATION (08)
Surface topography measurements – Electron microscope and friction and wear measurements – Laser method – Instrumentation – International standards – Bearing performance measurements – Bearing vibration measurement.

TOTAL: 45

Text Books
1. Cameron. A., **"Basic lubrication theory"**, Ellis Herward Ltd, UK, 1981.
2. Sushil Kumar Srivastava, **"Tribology in Industries"**, S. Chand & Company Ltd, New Delhi.

Reference Books S
1. Williams. J.A., **"Engineering Tribology"**, Oxford University Press, 1994.
2. Moore. D.F., **"Principle and Application of Tribology"**, Pergamon Press, New York.

12M8E6 LEAN MANUFACTURING

(Common to Production)

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INTRODUCTION   (09)

Objectives of lean manufacturing-key principles and implications of lean manufacturing- traditional Vs lean manufacturing – Lean benefits.

LEAN MANUFACTURING CONCEPTS   (09)

Value creation and waste elimination- Major kinds of waste- pull production-different models of pull production-continuous flow-continuous improvement / Kaizen- Worker involvement Part family- Production flow analysis – Composite part concept – Machine cell design -Case studies.

LEAN MANUFACTURING TOOLS AND METHODOLOGIES   (09)

Standard work -communication of standard work to employees -standard work and flexibility -visual controls-quality at the source- 5S principles -preventive maintenance-total quality management-total productive maintenance –change over/setup time -batch size reduction.

VALUE STREAM MAPPING   (09)

The as-is diagram-the future state map-application to the factory simulation scenario-line balancing -poke yoka-Kanban – overall equipment effectiveness -JIT - elements of JIT - Kanban system.

IMPLEMENTING LEAN   (09)

Road map-senior management Involvement-best practices- reconciling lean with other systems -Toyota production system-lean six sigma-lean and ERP-lean with ISO9001: 2000

TOTAL: 45

Text Books

1. Michael L George, David T Rowlands, Bill Kastle, *"What is Lean Six Sigma"*, McGraw Hill Inc., New York, 2004.
2. Askin R.G, Goldberg J.B, *"Design and Analysis of Lean Production Systems"*, John Wiley & Sons, New York, 2003.

Reference Books

1. Joseph A De Feo, William W Bearnard Juran Institute *"Six Sigma Break Through and Beyond"*, Tata McGraw Hill, New Delhi, 2004.
2. Richard B Chase F Robert Jacobs and Nicholas J Aquilano, *"Operations Management for Competitive Advantage"*, McGraw Hill Inc., New York, Tenth Edition, 2003.
3. Poka - Yoke, *"Improving Product Quality by Preventing Defects"*, Productivity Press, Portland, Oregon, 1993.
4. Micheal Wader, *"Lean Tools: A Pocket guide to Implementing Lean Practices"*, Productivity and Quality Publishing Pvt Ltd, 2002.

12M8E7 PRECISION ENGINEERING
(Common to Production)

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FUNDAMENTALS OF PRECISION ENGINEERING (08)

History of precision engineering- principles and definitions of precision machine design-prototyping and full production from ultra precision machining through micro-engineering-microelectronics and molecular manipulation- application of displacement transducers to machines and instruments- tolerance technology.

ULTRAPRECISION AND MICROMACHINING PROCESSES (10)

Atomic structure- electrical and physical properties of atoms- diamond turning, grinding and polishing-effects of tooling, material and the environment on the surface characteristics of workpieces - material removal using electron, photon, ion beams - molecular beam epitaxy, chemical and physical vapour deposition- advanced sputtering and ion-implantation- deposition techniques- process controls and film characteristics.

PRECISION MECHANISM DESIGN (10)

Fundamental concepts in designing precision machinery - metrological instrumentation, ultra-precision motion generators and precision assembly- flexure mechanisms for precision engineering- mechanics of contact, kinetic coupling, vibration isolation and material selection- actuators and sensors to control mechanisms- manufacturing of micron scale machinery and structures using non- conventional processes.

OPTICAL ENGINEERING (09)

Coherent optics - fibre optics - geometrical optics - paraxial optics, monochromatic and chromatic aberrations- computer evaluation of optical systems, spot diagrams, MTF- light sources, detectors and imaging systems- industrial laser applications and optical systems- optical interferometry - applications to precision measurement.

PRECISION OF NUMERICAL CONTROL SYSTEMS (08)

Errors due to numerical interpolation and displacement measurement system – periodic errors - errors due to velocity lags - transient response slide ways friction - feed drive stiffness – zero stability.

TOTAL: 45

Text Books
1. Raman. R "Elements of Precision Engineering" Oxford & I B H Publishing Co. 1984
2. Murty. R.L. "Precision Engineering in Manufacturing" New Age International Publishers, 1996.
3. Gary. F. Benedict "Non-traditional Manufacturing Processes" Marcel Dekker, Inc. New York, 1992.

Reference Books
1. Kovan.V, "Fundamentals of Process Engineering", Foreign Languages Publishing House (FLPH), Moscow, 1986.
2. Gopel, "Sensors – A comprehensive Survey" Vol I to Vol VIII, Second Edition, BCH Publisher, New York, 1999.
3. Davidson, "Handbook of Precision Engineering", Vol. 1 & 2, McMillan, 1972.
4. Mark J Madou, "Fundamentals of Micro Fabrication", CRC Press, 2002.

12M8E8 RELIABILITY AND TOTAL PRODUCTIVE MAINTENANCE

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L  T  P  C
3  0  0  3
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INTRODUCTION   (10)
Reliability function - MTBF - MTTR - mortality curve - availability -maintainability.

FAILURE DATA ANALYSIS   (08)
Repair time distributions - exponential, normal, log normal, gamma, and weibull - reliability data requirements - graphical evaluation.

RELIABILITY PREDICTION   (12)
Failure rate estimates - effect of environment and stress - series and parallel systems - RDB analysis – standby systems - complex systems.

RELIABILITY MANAGEMENT   (05)
Reliability demonstration tests - reliability growth testing - Duane curve - risk assessment - FMEA, fault tree.

TOTAL PRODUCTIVE MAINTENANCE   (10)
Causes of machine failures - downtime - maintenance policies – restorability predictions - replacement models- spares provisioning - maintenance management - cleanliness and house keeping.

TOTAL: 45

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

Reference Books
1. Gopalakrishnan.P, and Banerji A.K., *"Maintenance and Spare Parts Management "*, PrenticeHall of India, 1996.
2. Telsang Mertand.T, *"Industrial Engineering And Production Management"*, S.Chand&CO., 2004

12M8E9 NUMERICAL METHODS

(Common to CIVIL, EEE, EIE, CSE, IT, Production branches)

L	T	P	C
3	0	0	3

SOLUTIONS OF EQUATIONS AND EIGEN VALUE PROBLEMS (09)

Iterative method – Newton – Raphson Method for single variable and for simultaneous equations with two variables – Solutions of Linear system by Gauss elimination , Gauss – Jordan , Crout's and Gauss Seidel Methods – Relaxation Method – Eigen value of a Matrix by Power Method.

INTERPOLATION (09)

Operators – Relation between the operators – Newton's divided difference formula – Lagrange's and Hermite's Polynomials – Newton Forward and Backward difference formulae – Stirling's and Bessel's Central difference formulae.

NUMERICAL DIFFERENTIATION AND INTEGRATION (09)

Numerical differentiation with Interpolation Polynomials – Numerical Integration by Trapezoidal and Simpson's (Both $1/3^{rd}$ and $3/8^{th}$) rules – two and three point Gaussian quadrature formula – Double integrals using Trapezoidal and Simpson's Rules – Difference equation.

INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS (09)

Single step methods – Taylor series , Euler and Modified Euler, Runge – Kutta method of order four for first order differential equations – Multistep methods – Milne and Adam – Bashforth predictor and Corrector methods.

BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS (09)

Finite difference solutions for the second order ordinary differential equations – Finite difference solutions for one dimensional Heat equation (Both Implicit and Explicit) – One dimensional Wave equation -Two dimensional Laplace and Poisson equations.

LECTURE: 45   TUTORIAL: 15   TOTAL: 60

Text Book

1. Dr.Kandasamy. P, Dr.Thilagavathy . K, Dr. Gunavathy . K., *"Numerical methods"*, S. Chand and Co.New Delhi, 2010.

Reference Books

1. Veerarajan. T and Ramachandran. T., *"Numerical Methods with Programming in C"*,Tata Mc.Graw Hill Publishers, New Delhi, 2007.
2. Balagurusamy .E. *"Numerical Methods"*, Tata McGraw Hill Publishers, New Delhi, 1999, reprint 2007.
3. Grewal. B. S. and Grewal. J.S., *"Numerical Methods in Engineering and Science"*,, Khanna Publishers, New Delhi, 2004.
4. Gerald.C.F. and Wheatley. P.O., *"Applied Numerical Analysis"*, (Sixth Edition), Pearson Education,Asia, New Delhi, 2006.
5. Sankar Rao K, *"Numerical Methods for Scientists and Engineers"*, (Third edition), Prentice Hall of India, New Delhi , 2007.
6. Dr.Manish Goyal , *"Statistics and Numerical methods"*, University Science Press, New Delhi, 2010.
7. Dr.J.S.Chitode, *"Numerical Methods "*, Technical Publications, Pune, 2010.