ACADEMIC REGULATIONS
(UNDER-GRADUATE COURSES)

The students admitted in 2010-11 shall be governed by the relevant rules as indicated below:

1.0 DEFINITIONS

1.1 'Academic Year' or 'Academic Session' of the University shall ordinarily be between July to June and shall consist of two semesters.

1.2 'Semester' is an academic term of normally 18-20 weeks including examinations.

1.3 'Course' means a unit of instruction or a segment of a subject matter to be covered in a semester. Each course is assigned a specific number, title and credits.

1.4 'Credit Hour' also written as 'Credit' means the numerical weight allotted to the course, including its theory and practical parts. One credit will represent one hour of lecture and two to three hours of laboratory/field practical in each week.

1.5 'Grade point' is a numerical number which denotes students' performance in a course. It is obtained by dividing the percentage marks obtained by ten.

1.6 'Credit point' is the product of credit and grade point obtained by the student in a course.

1.7 'SGPA' (Semester Grade Point Average) is the average of the credit points of a semester.

1.8 'OGPA' is the overall cumulative grade point average obtained by the student in the courses taken in all the semesters completed by him/her.

1.9 'Year' means an academic session consisting of two semesters. Say, first year means the first academic session of the prescribed course of a degree programme. Similarly, second year, third year, and fourth year mean second, third and fourth academic sessions, respectively.

1.10 'Equivalent percentage' is the percentage obtained by multiplying grade point, SGPA, and OGPA respectively by ten.

2.0 THE PROGRAMME AND GRADUATION REQUIREMENTS

2.1 Minimum residential requirement and maximum period for all the programmes:

Minimum residential requirement	8 semesters
Maximum period for which a student can remain on the college roll	12 semesters

Note: In case a student does not complete his/her course work satisfactorily (5.0 OGPA out of 10) within the maximum prescribed period he/she shall no longer be a student of the university and the respective Dean of the college shall drop him from the college roll.

3.0 EXAMINATION

There shall be a main theory and/or practical examination conducted by the university at the end of each semester. The theory and practical examinations shall be of three hours duration except otherwise specified. Besides this, there will be a mid-term examination.

3.1 Mid-Term Examination:

A mid-term examination of 20 maximum marks shall be held after completion of about 50% syllabus in each course. The mid-term examination shall be of one hour duration.

"If a student misses the mid term examination due to any legitimate reason including deputation by the university, then he/she will be permitted to appear in a special mid term examination before the final examination". Only one special mid-term examination per course shall be conducted for all eligible students under this rule.

Students who are deputed by the university will have to submit the information in advance to the concerned department for awarding attendance.

3.2 The distribution of marks for the mid-term examination, final theory examination and practical examination shall be as follows:

Credit (Marks T/P)	Mid-Term Examination	Final (University) Examination		Total
		Theory	Practical	
1/2/3/4+1	20(T)	50	30	100
0+1/2/3/4	20(P)	-	80	100
1/2/3/4+0	20(T)	80	-	100
1+/2/3/4	20(P)	30	50	100

3.3 The distribution of marks for the final practical examination shall be as under

	Practical with Maximum Marks	**30**	**50**	**80**
(a)	Practical record and day-to-day assessment (Sessional work)	5	10	15
(b)	Practical exercises (may include any exercises as decided by the external examiner)	20	30	50
(c)	Viva-voce	5	10	15

3.4 Grading System

(i) A numerical grading system is followed for evaluation. Each course has a numerical weightage known as credit. The total marks obtained in each course (including its mid-term, theory and practical parts) are converted into percentage and divided by 10 to obtain the grade point for that course. The grade point when multiplied by the total course credit, gives credit points for the course.

(ii) Semester Grade Point Average (SGPA) is simply average of the credit points for a semester. The Overall Grade Point Average (OGPA) is the average for all courses upto the current semester.

If C_i and G_i are the credit and grade points for a course, then OGPA and SGPA are given by the following formulae:

$$\text{SGPA} = \frac{\sum C_i G_i}{\sum C_i} \quad \text{where the summation is for all courses in the semester}$$

$$\text{OGPA} = \frac{\sum C_i G_i}{\sum C_i}$$ where the summation is for all courses of preceding semester including the current one

(iii) The percentage equivalent of OGPA shall be determined by multiplying OGPA by ten.

(iv) The division of the under graduate student shall be determined by the OGPA at the end of successful completion of program as follows:

Division	OGPA
First	6.00 and above
Second	5.00 and above

3.5 Pass Requirements:

(i) Candidates are required to pass separately in final theory and/or practical examinations in each course

(ii) For a pass, a candidate is required to obtain at least 40% marks in each theory final examination as well as in each practical final examination and 4.00 grade point in the course.

(iii) The minimum OGPA required for degree is 5.00.

3.6 Promotion to Higher Classes:

(i) The promotion to next class shall be decided only at the end of an academic year.

(ii) A student will not be eligible for promotion to fourth year unless and until he/she clears all courses of 1st year.

(iii) A student will be promoted to higher class if he/she secures an OGPA as mentioned in the table below.

Year to which promotion is being Considered	Minimum OGPA required for Promotion
Second	4.00
Third	4.50
Fourth	4.75 (with no Backlog of 1st Year)

(iv) A student who has been promoted to the first Semester of a class as a result of above rule, shall be automatically promoted to the second semester of that class regardless of the result of the year's first semester examination.

(v) If a student is not promoted to a higher class, he/shall become an ex-student of the failed class and has to clear the backlog and/ or improve his/her OGPA to be eligible for promotion.

(vi) Provisional Promotion **:**

(a) The Promotion will be provisional with the permission of Concerned Dean to higher class till the result of the previous semester is declared.

(b) Student has to register as per academic calendar, i e. Date of registration without late fee and date of registration with late fees would be applicable.

(c) Student has to give an undertaking that on declaration of result, if he/ she is not eligible, the registration would stand cancelled automatically.

(d) Student should have a minimum OGPA as per existing UG rules.

(e) Per-requisite courses, if any, have to be cleared prior to the regular courses.

3.7 Clearing of Backlogs and Repeating of Courses for Improvement of OGPA:

A. Clearing of Backlog:

(a) All the students with backlog (whether promoted or ex-students) shall have to appear in the examination of backlog courses in the main examination of the semester in which such courses are regularly offered. The student will be permitted to appear in backlog examination in failed part only whether it is theory or practical or both. He/she shall not be required to attend regular classes for such courses.

(b) Mid term marks obtained by a student will not be carried over for backlog examination and proportionate marks shall be awarded.

(c) The university shall conduct final examination as per current scheme of examinations. Students offered backlog courses would be required to appear in the equivalent course in the new programme. In case of variation in the course content, student has to do self preparation.

(d) If the backlog course is the result of being detained on account of shortage of attendance, the student has to appear in both theory and practical examinations by regularly offered courses or as a contact course, if time table adjustment is not possible

B. Improvement of OGPA

(a) Student should apply to improve the OGPA within 11 days from the date of issue of mark sheet of last semester. They should surrender the original mark sheet issued to them and submit the same along with application form.

(b) A student would be given only one chance for improvement of OGPA.

(c) Student will be allowed to repeat two courses of his/her choice irrespective of grade obtained in the course (s) or semester, provided that the course is being offered as regular course in current semester.

(d) There will be a common examination for regular students and for those who have been offered courses for improvement.

(e) Students will not be issued PDC till the result of the courses offered for improvement is declared.

(f) The repeated course shall be marked as “Repeat” in the revised mark-sheet.

(g) In case PDC has been issued to the student he/she will not be eligible for improvement.

(h) The student would be required to pay regular semester fees if he/she wishes to attend the classes. Otherwise he/she shall be treated as Ex-student.

(i) The examination fee for courses offered for improvement will be Rs. 1000.00 (Rupees one thousand only) per paper irrespective whether it is a regular course or a special paper.

(j) The student has to submit an undertaking that the marks obtained in the examinations taken for improvement will replace the marks obtained in the original examination of the paper(s), if he/she gets more than previous result.

(k) In case a student fails in the improvement course, he/she will be awarded minimum pass marks in that paper.

(l) Mid term marks in improvement courses: In such cases, the student will be awarded proportionate marks based on marks obtained in final examination.

3.8 Special Backlog Examination:

A. In case student has completed 8th Semester and has backlog in only one course which is not of 1st year :

(i) Special examination will be conducted earliest possible after the declaration of semester result i.e. September/ October of 1st semester of the academic year for only that course.

(ii) Student will be charged fee as prescribed by the university, irrespective of whether it is a regular course or a special paper.

(iii) Student has to apply for special examination within 11 (eleven) days of declaration of result of 8th semester, failing which his/her application will not be considered.

(iv) In case if a student chooses for re-evaluation and fails, examination for such a paper will be conducted along with regular papers of that semester only.

(v) If a student fails in a special paper examination, he/she would be allowed to reappear with regular examination of next semester only i.e. once in a semester.

B. In case a student has completed 8th semester and has got backlog of up to 6 courses irrespective of semester:

(i) Backlog examination will be conducted along with regular examination of the semester.

(ii) If regular examination is being conducted for a particular paper, he/she would have to pay normal fee for that paper and special fee of Rs. 1000/- per paper will be charged for the course which are not listed for conducting the examinations in that semester.

(iii) If a student does not clear one or more backlog course, he/she will have to appear as Ex-student along with regular examination in the next semester and fee will be charged at regular rate, if the courses are listed for conducting the examination in that semester, otherwise, special fee of Rs. 1000/- will be charged

C. Other rules like maximum number of semesters, minimum passing marks, etc will be applicable as per rules.

3.9 Re-evaluation for answer book:

(i) (a) Re-evaluation is permissible only in Theory paper of semester's final examination.

(b) Re-evaluation is not permissible in the Answer book of unfair means case (s)

(ii) The candidate may apply for re-evaluation within 11 days of the issue of the mark sheet on the prescribed form through Head of the institution depositing required fee and original mark-sheet. Incomplete and late submitted application shall not be considered.

(iii) The re-evaluation fee per paper shall be as prescribed and will not be refundable on any pretext.

(iv) Re-evaluation shall be done by an examiner of the subject to be appointed by the Vice Chancellor.

(v) If the marks obtained after re-evaluation increase / decrease within 20% of the maximum marks prescribed for the paper, the same will be taken as marks obtained after re-evolution. However, if the marks awarded by the re-evaluation increase /decrease by more than 20% of maximum marks prescribed for the paper then the answer book will be referred to the second re-evaluation and the average of two closest awarded marks (the middle award in case the three awards if uniformly spread) shall be taken as the marks obtained after re-evaluation and shall be awarded. However, a student who was declared Pass prior to re-evaluation and fails after re-evaluation, shall be awarded minimum pass marks.

(vi) Marks awarded after re-evaluation of the paper will be considered for award of merit.

(vii) (a) No one shall be admitted in the next higher class and considered for any beneficial claim only on account of submission of application of the re-evaluation of Answer Book(s) in the office.

(b) A student becoming eligible for admission on account of result of re-evaluation may be admitted in next higher class without late fee. He will be required to pay full fees for the year within 7 days of declaration of the result. Attendance in such case shall be counted from the date of admission.

3.10 Moderation of Results:

The result committee shall also act as Moderation Committee to review the results for the normal distribution of marks, the percentage of pass and failure. Any moderation suggested in a paper shall be uniformly applied to all the students registered in that paper, with the approval of the Vice Chancellor. Any moderation effected should not be more than 10 % of maximum marks in a paper. However, if after moderation or otherwise, if a student is failing only by one mark in a paper, Controller of Examinations may award one grace mark to pass the student in that paper.

4.0 GENERAL RULES PERTAINING TO EXAMINATIONS

4.1 A student who has been deputed by College/University authorities to represent at a national/international meet/ championship/tournament/extra curricular activities, does not appear in the final examination due to such participation, may be permitted to take missing paper(s) at next main examination, when such course(s) are regularly offered as a special case. He/she, however, will be required to seek prior permission from the Vice-Chancellor.

4.2 No special examination shall be held for students who miss the examination on account of police custody, court attendance or fail to attend for other reason, whatsoever.

4.3 Examinations will not be postponed due to failure of electricity.

4.4 The boycotted and walked out papers shall not be recounted. This authority rests only with the Chancellor of the university.

5.0 PRACTICAL WORK EXPERIENCE REQUIREMENTS

After successful completion of all the courses including practical trainings with minimum OGPA of 5.0, a student will become eligible for the degree.

Details of practical training (Training in factory, workshop, mine, engineering works/design, office etc.) which students are to undertake in different degree programmes are given below:

	Branch of Engineering	Duration	Year
(a)	Agriculture*	30 + 30 = 60 days	At the end of II & III year
(b)	Mechanical	30 + 30 = 60 days	- do -
(c)	Mining**	30 + 30 = 60 days	- do -
(d)	Electrical	30 + 30 = 60 days	- do -
(e)	Computer Science & Engg.	30 + 30 = 60 days	- do -
(f)	Electronics & Communication	30 + 30 = 60 days	- do -
(g)	Information Technology	30 + 30 = 60 days	- do-
(h)	Civil Engineering	30 + 30 = 60 days	- do-

* *In addition to the above 2 months training programme, the agricultural engineering graduates have to undergo experiential learning or Hands-on training (4 month) in the second semester of final year BE.(Ag.).*

In order to take policy decision and to solve the operational and administrative bottleneck, if any, there shall be a college level committee consisting of the followings. The committee will guide in selection of cafeteria courses and experiential learning/project.

Senior most Head of the Department	-	*Convenor*
Heads of concerned Department	-	*Member*
Training Officer	-	*Member*
Class Advisor of IV year	-	*Member*

Procedure for evaluating the students on all the above practical trainings will be followed as prescribed.

** *The Mining Engineering students shall have to undergo 12 days mining camp at the end of I semester of II year and 12 days survey camp at the end of I semester of III year, in addition to 60 days practical training.*

6.0 ATTENDANCE REQUIREMENTS

6.1 The student shall be permitted to appear in the university main examination only if a minimum attendance of 75% is maintained separately in theory and practical in each course from the date of registration in that course. However, in NCC/NSS/NSO the minimum attendance requirement would be 65%. In case of sickness or any other valid reasons, the vice-chancellor may condone the attendance to an extent of 10%.

6.2 A student who is short of attendance in one or more courses will be detained form appearing in the final semester examination of all such course(s) and will be awarded zero grade point. Such courses shall be denoted by letter “DE” in the mark sheet.

6.3 En-mass absence shall be treated as absent in the attendance record of the students and will be charged a fine of Rs. 2000/- on en-mass cutting of the classes for more than 3 days.

6.4 If a student absents continuously for 7 working days in a semester in any subject, his/her registration in the semester will be cancelled and parents informed accordingly. Such students will be provided an option for re-admission in the course/programme within 7 days of the cancellation of their registration by paying a fee of Rs. 500/-.

6.5 If a student who has been admitted to the 1st semester of a programme and fails to attend the classes continuously for a period of 30 days without the permission of the Dean of the college, the name of such a student will be removed from the college roll. No petition is permitted in this case. He/she may have to seek re-admission as a fresh candidate.

6.6 If a regular student of the college in subsequent semester fails to register on schedule time or fails to attend the class after registration continuously for 30 days without the permission of the Dean of the college, the student will be removed from the college roll and parents informed accordingly. A student so removed may apply to the Dean within 15 days of his/her removal for reconsideration for re-registration in the next academic session, giving valid and strong reasons for failing to take permission. His removal may be revoked, provided that, his/her advisor is satisfied with the performance of the student and the same is approved by the Dean. The period of removal shall be counted towards the number of semester, though no grade/marks would be awarded for this semester.

7.0 ADVISORY SYSTEM

Student will be required to report to the respective class advisors for getting registration form and examination form for the purpose of registration. Class advisors will also be responsible for distribution of marksheet obtained from the university.

8.0 SYMBOLS AND THEIR MEANING

Following symbols would be used to designate the status of the student:

Symbol	Significance
F	Fail
DE	Detained
UM	Unfairmeans
R	Repeat

Note - *All such courses which are cleared by repeating the same or repeated for improvement of OGPA to bring it to the minimum required level shall be marked by letter 'R' in the transcript.*

9.0 WITHDRAWAL FROM SEMESTER

(a) A student shall be permitted to withdraw from a semester only two times in the degree programme, on the grounds of ill-health and personal exigencies subject to the condition that the reasons for withdrawal are convincing. For this the student has to submit a written request at least one week prior to the commencement of the main examination of the semester from which the student wants to withdraw.

(b) A student who has withdrawn from a semester has to join the same semester during next year.

(c) The period lost due to withdrawal (one year for one withdrawal) shall not be counted towards maximum permissible period for which a student can remain on the college roll.

10.0 EXAMINATION OF PRACTICAL TRAINING, PROJECT AND SEMINAR

(a) For the examination of practical training (including industry visit, mining camp, survey camp, etc.) there will be an internal board appointed by the Dean. The board will comprise of concerned Head of the Department as chairman and one or two teachers of the concerned department(s) as members. The marks will be awarded on the basis of work report, practical record, quiz. viva-voce, etc. and added to the marks list in the Final year's examination.

(b) For project viva-voce examination there shall be a Board of examiners consisting of project committee and one/two external examiners. The concerned Head of the Department will be the Chairman of the committee. However, in Agriculture Engineering discipline, the Chairman will be the Project Chairman. The Chairman will then nominate two teachers as members. The Board may meet in one or two meetings according to the availability of external examiner(s). A candidate will be assessed for the work done during semester by the Project Advisor and the Project Committee.

As the project is assigned in the first semester of the final year and the student works on it during both the semesters the assessment of the project shall be done in both the semesters. The internal viva-voce of first semester and both the seminars shall be assessed by the Project Committee. However the marks shall be counted in the second semester only. The distribution of marks shall be as follows :

Particulars	I Semester	II Semester	Total
Day-to-day assessment by the major advisor	15	20	35
Seminar	10	15	25
Viva-voce	10 (Internal)	30 (External)	40
TOTAL	35	65	100

(c) For seminar, wherever prescribed as a course of study, there shall be a board of examiners consisting of the Head of the Department as chairman and two teachers of the department.

11.0 CHANGE OF BRANCH OF STUDY IN SECOND YEAR B.TECH.

The students, in the second year, can avail one opportunity to change their branch of study on merit basis in accordance with rules framed by the university from time to time.

12.0 ADMISSION OF DIPLOMA STUDENTS IN SECOND YEAR B.TECH.

The diploma holders from the Board of Technical Education, Rajasthan with 10+2 qualification can seek direct admission in second year B.Tech. The number of seats, admission procedure, educational and other requirement would be as specified by the Government and/or approved by the university from time to time.

13.0 GRADUATION REQUIREMENT AND AWARD OF DIVISION

(a) A student shall be awarded degree only if he has passed all the courses and completed other requirements prescribed for the programme and secured an OGPA of 5.00 or above.

(b) The division of the student shall be determined by the OGPA at the end of successful completion of the program as follows :

Division	OGPA
First	6.00 and above
Second	5.00 and above

SCHEME OF TEACHING AND EXAMINATION

(Mechanical Engineering)

First Year B.Tech. (Common for All Branches)

I-SEMESTER

Course No.	Title	Credit		Hours/Week			Marks		
		Th.	P	L	T	P	Th.	P	MT
BS 111	Mathematics - I	3	0	3	0	0	80	-	20
ME 113	Mechanical Engg. - I	3	0	3	0	0	80	-	20
ME 114	Workshop Practice	0	1	0	0	3	0	80	20
CE 115	Engineering Drawing	0	1	0	0	3	0	80	20
	NCC/NSS/NSO[1]	-	-	0	0	2	-	-	-
GROUP I									
BS 100P	Engineering Physics	2	1	2	0	2	50	30	20
CE 100	Engineering Mechanics	2	1	2	0	2	50	30	20
EE 100	Electrical Engg. - I	3	1	3	0	2	50	30	20
ENVS 100	Environmental Studies	2	1	2	0	2	50	30	20
GROUP II									
BS 100C	Engineering Chemistry	2	1	2	0	2	50	30	20
EC 100	Electronics and Instrumentation	3	1	3	0	2	50	30	20
CS 100	Introduction to Computer Programming and Data Structure	3	1	3	0	2	50	30	20
BS 100E	English and Communication Skill[2]	1	1	1	0	2	50	30	20
	Total	15	6	15	0	16	-	-	-
Total Credits/Hours/Marks		**21**		**31**			**800**		

[1] NCC/NSS/NSO is compulsory and the student will be assessed as satisfactory/ unsatisfactory at the end of IV semester.

[2] The examination (Theory and Lab) shall be conducted internally by the college.

Note: *The courses BS 100P, CE 100, EE 100, ENVS 100, BS100C, EC 100, CS 100 and BS 100E shall be offered in both the semesters. The students will be divided in two groups in I semester itself and shall remain in the same group in II semester as well. However, they have to offer all the eight courses in first year.*

II-SEMESTER

Course No.	Title	Credit		Hours/Week			Marks		
		Th.	P	L	T	P	Th.	P	MT
BS 121	Mathematics - II	3	0	3	0	0	80	-	20
CE 122	Civil Engineering	1	1	1	0	2	50	30	20
ME 123	Machine Drawing - I	0	1	0	0	3	0	80	20
ME 124	Workshop Technology	2	1	2	0	3	50	30	20
	NCC/NSS/NSO[1]	-	-	0	0	2	-	-	-
GROUP I									
BS 100C	Engineering Chemistry	2	1	2	0	2	50	30	20
EC 100	Electronics and Instrumentation	3	1	3	0	2	50	30	20
CS 100	Introduction to Computer Programming and Data Structure	3	1	3	0	2	50	30	20
BS 100E	English and Communication Skill[2]	1	1	1	0	2	50	30	20
GROUP II									
BS100P	Engineering Physics	2	1	2	0	2	50	30	20
CE 100	Engineering Mechanics	2	1	2	0	2	50	30	20
EE 100	Electrical Engineering - I	3	1	3	0	2	50	30	20
ENVS 100	Environmental Studies	2	1	2	0	2	50	30	20
	Total	15	7	15	0	18	-	-	-
Total Credits/Hours/Marks		**22**		**33**			**800**		

[1] NCC/NSS/NSO is compulsory and the student will be assessed as satisfactory/ unsatisfactory at the end of IV semester.

[2] The examination (Theory and Lab) shall be conducted internally by the college.

SECOND YEAR B.Tech.

III-SEMESTER

Course No.	Title	Credit		Hours per week			Marks		
		Th.	Pr.	L	T	P	Th.	Pr.	MT
BS 211 (All Branches)	Mathematics-III	3	0	3	0	0	80	0	20
ME 211	Mechanics of Solids-I	3	1	3	1	2	50	30	20
ME 212	Materials Science	2	0	2	0	0	80	0	20
ME 213	Foundry and Welding Technology	3	1	3	0	2	50	30	20
ME 214	Kinematics of Machines	3	0	3	0	0	80	0	20
ME 215	Machine Drawing-II	0	1	0	0	3	0	80	20
EE 213 (AE, ME, MI)	Electrical Engineering-II	2	1	2	0	2	50	30	20
	NSS/NCC/NSO[2]	-	-	0	0	2	-	-	-
	Total	16	4	16	1	11	-	-	-
Total Credits/Hours/ Marks		**20**		**28**			**700**		

T - Tutorials do not carry any credit

IV-SEMESTER

Course No.	Title	Credit		Hours per week			Marks		
		Th.	Pr.	L	T	P	Th.	Pr.	MT
BS 221 (EC, EE, ME, MI)	Mathematics-IV	3	0	3	0	0	80	0	20
ME 221	Mechanics of Solids-II	3	0	3	0	0	80	0	20
ME 222	Engineering Thermodynamics	3	0	3	0	0	80	0	20
ME 223	Manufacturing Processes	3	1	3	0	2	50	30	20
ME 224	Dynamics of Machines	3	0	3	0	0	80	0	20
ME 225	CAD Lab-I	0	2	0	0	4	0	80	20
ME 226	Steam Power Engineering	3	1	3	0	2	50	30	20
	NSS/NCC/NSO[2]	-	-	0	0	2	-	-	-
	Total	18	4	18	0	10	-	-	-
Total Credits/Hours/ Marks		**22**		**28**			**700**		

[2] NSS/NCC/NSO is compulsory and the student will be assessed as satisfactory/ unsatisfactory at the end of IV semester.

Note: *Students have to undergo a practical training of 30 days at the end of IV semester during summer break for which the assessment will be made at the beginning of the next semester.*

THIRD YEAR B.Tech.

V-SEMESTER

Course No.	Title	Credit		Hours per week			Marks		
		Th.	Pr.	L	T	P	Th.	Pr.	MT
ME 311	Mechanical Vibrations	3	1	3	0	2	50	30	20
ME 312	Fluid Mechanics	3	1	3	0	2	50	30	20
ME 313	Machine Tools	3	1	3	0	2	50	30	20
ME 314	IC Engines	3	1	3	0	2	50	30	20
ME 315	Machine Design-I	3	0	3	1	0	80	0	20
ME 316	Industrial Engineering-I	2	0	2	0	0	80	0	20
ME 317	CAD Lab-II	0	2	0	0	4	0	80	20
	Total	17	6	17	1	12	-	-	-
Total Credits/Hours/ Marks		**23**		**30**			**700**		

T - Tutorials do not carry any credit

VI- SEMESTER

Course No.	Title	Credit		Hours per week			Marks		
		Th.	Pr.	L	T	P	Th.	Pr.	MT
ME 321	Heat Transfer	3	1	3	0	2	50	30	20
ME 322	Fluid Machines and Systems	3	1	3	0	2	50	30	20
ME 323	Industrial Inspection and Quality Control	3	1	3	0	2	50	30	20
ME 324	Refrigeration and Air Conditioning	3	1	3	0	2	50	30	20
ME 325	Machine Design-II	3	0	3	1	0	80	0	20
ME 326	Industrial Engineering-II	2	1	2	0	2	50	30	20
ME 327	Computer Applications in Mechanical Engineering	0	1	0	0	2	0	80	20
	Total	17	6	17	1	12	-	-	-
Total Credits/Hours/ Marks		**23**		**30**			**700**		

T - Tutorials do not carry any credit

Note: *Students have to undergo a practical training of 30 days at the end of VI semester for which assessment will be made at the beginning of the next semester.*

FOURTH YEAR B.Tech.

VII-SEMESTER

Course No.	Title	Credit		Hours per week			Marks		
		Th.	Pr.	L	T	P	Th.	Pr.	MT
ME 411	CAD/CAM	3	1	3	0	2	50	30	20
ME 412	Instrumentation & Control	3	1	3	0	2	50	30	20
ME 413	Production Engineering	3	0	3	0	0	80	0	20
ME 414	Power Plant Engineering	2	0	2	0	0	80	0	20
ME 415	Design Engineering	3	1	3	0	2	50	30	20
ME 416	Elective-I	3	0	3	0	0	80	0	20
ME 425	Project[1]	0	-	0	0	4	-	-	-
	Total	17	3	17	0	10	-	-	-
Total Credits/Hours/ Marks		**20**		**27**			**700**		

[1] The topic for the project (ME425) will be allotted in the VII semester but assessed in both the semesters. The total credits will however be counted in the VIII semester.

ELECTIVE-I

ME 416(a)	Finite Element Method	ME 416(e)	Vibration and Noise Control
ME 416(b)	Computer Aided Design	ME 416(f)	Fracture Mechanics
ME 416(c)	Stress Analysis and Experimental Methods	ME 416(g)	Optimisation Methods in Engineering Design

ME 416(d) Tribology

ME 416(h) Design for fatigue and Fracture

VIII-SEMESTER

Course No.	Title	Credit		Hours per week			Marks		
		Th.	Pr.	L	T	P	Th.	Pr.	MT
ME 421	Gas Dynamics and Turbines	3	0	3	0	0	80	0	20
ME 422	Operation Research	3	0	3	0	0	80	0	20
ME 423	Elective-II	3	0	3	0	0	80	0	20
ME 424	Elective-III	3	0	3	0	0	80	0	20
ME 428	Automobile Engineering	3	0	3	0	0	80	0	20
ME 425	Project[1]	0	8	0	0	12	0	100	0
ME 426	Practical Training & Industrial Visit	0	4	0	0	0	0	100	0
ME 427	Seminar	0	2	0	0	4	0	100	0
	Total	15	14	15	0	16	-	-	-
Total Credits/Hours/ Marks		**29**		**31**			**800**		

[2] The marks of the practical trainings conducted during summer breaks (at the end of IV and VI semester) will be considered in VIII semester out of 90 marks. The industrial visit will be assessed out of 10 marks. If the tour does not undergo, the trainings will be assessed out of 100 marks.

ELECTIVE-II

ME 423 (a)	Plasticity and Metal Working
ME 423 (b)	Reliability and Maintenance Engineering
ME 423 (c)	Advanced Joining Technology
ME 423 (d)	Manufacturing Automation
ME 423 (e)	Tool Engineering
ME 423 (f)	Plant Layout and Material handling
ME 423 (g)	Production Management
ME 423 (h)	Quality Control and Reliability

ELECTIVE-III

ME 424 (a)	Non-conventional Energy Sources
ME 424 (b)	Advanced Refrigeration
ME 424 (c)	Cryogenic Engineering
ME 424 (d)	Air Conditioning System Design
ME 424 (e)	Computational Methods in Thermal and Fluid Engineering
ME 424 (f)	Theory and Design of Fluid Machinery
ME 424 (g)	Tractors and Agricultural Machinery

Note: *The students have to take one elective each out of the lists (Electives I, II & III) given. However, the elective may not be offered if faculty expertise is not available or a minimum of 10 students do not opt for a particular elective.*

COURSE CONTENT

FIRST YEAR B.TECH. (I SEMESTER)

BS 111 MATHEMATICS – I

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Taylor's and Maclaurin's expansions; Asymptotes, Curvatures, Simple curve tracing.

Unit-II

Partial differentiation; Homogeneous functions and Euler's theorem; Composite functions and total differential coefficient; Jacobians; Error and Approximations.

Unit-III

Double and Triple integrals; Change of order of integration; Rectification of standard curves; Volumes and surfaces of revolution of curves.

Unit-IV

Differential equations of higher order with constant coefficients: Methods of finding complementary functions and particular integrals; Homogeneous equations with constant and variable coefficient.

Text Books/References

1. Y.N. Guar and C.L. Koul. (2005). Engineering Mathematics, (Vols.-I, II), Jaipur Publishing House, Jaipur.
2. N.P. Bali and N.Ch.S.N. Iyengar. (2003). A text book of Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi.

ME 113 MECHANICAL ENGINEERING – I

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Thermodynamics: Thermodynamic properties, closed and open systems, flow and non-flow processes, gas laws, laws of thermodynamics, internal energy. Application of First Law in heating and expansion of gases in non-flow processes. First Law applied to steady flow processes.

Second law of thermodynamics: Kelvin-Planck and Claussius statements. Reversible processes, Carnot cycle, Carnot theorem. Entropy, physical concept of entropy, change of entropy of gases in thermodynamic processes.

Unit-II

Properties of Steam: Difference between gas and vapour, change of phase during constant pressure process. Generation of Steam, triple point and critical point. Internal energy and entropy of steam. Use of steam tables and Mollier chart, heating and expansion of vapour in non-flow processes, measurement of dryness fraction.

Unit-III

Vapour Power Cycles: Introduction, Carnot Cycle. Desirable properties of working fluid used for power plants. Rankine cycle. Expansive and non expansive working.

Steam Generators : Classification of steam boilers. Cochran, Lancashire, locomotive and Babcock-Wilcox boilers. Boiler mountings and accessories.

Steam Engines: Introduction to simple and compound steam engines, saturation curve and missing quantity, governing.

Unit-IV

Gas Power Cycles: Introduction. Air Standard efficiency, other engine efficiencies and terms. Otto, diesel and dual cycles. Calculation of efficiency, mean effective pressure and their comparison.

Internal Combustion Engines: Introduction. Classification, terminology and description of IC Engines. Four stroke and two stroke petrol, gas and diesel engines. Valve timing diagrams. Comparison of petrol and diesel engines. Simple carburettor. Ignition system of SI engine, diesel fuel pump and injectors.

Text Books/References

1. M. L. Mathur and F. S. Mehta. Thermal Engineering, (Vol. I, SI Edition), Jain Brothers, New Delhi.
2. R. K. Purohit. Thermal Engineering. 2nd Ed., Scientific Publishers, Jodhpur.

ME 114 WORKSHOP PRACTICE

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**0**	**3**

Carpentry Shop: Acquaintance with types of wood, tools and their uses. Simple exercises involving basic operations like sawing, planning, chiselling, etc. Preparation of simple joints, cross half lap joint, dovetail joint, bridle joint, tennon and mortise joint.

Smithy Shop: Acquaintance with types of tools and their uses. Simple exercises involving basic operations like bending, drawing, punching, shaping, upsetting, and riveting.

Fitting Shop: Acquaintance with tools, measuring and marking tools, precision measuring tools and their uses. Simple exercises involving basic operations like sawing, chipping, filling, drilling, reaming, threading with taps and dies.

Sheet Metal and Plumbing Shop: Demonstration of basic tools, pipe fittings and operations.

Texts/References

1. S. K. Hajra Choudhury and AK Hajra Choudhury. Elements of Workshop Technology (Vol. I), Media Promoters & Publishers Pvt. Ltd., Bombay.

CE 115 ENGINEERING DRAWING

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**0**	**3**

Introduction and letter writing. Construction and use of plain, diagonal and vernier scale. Methods of drawing ellipse, parabola and hyperbola. Methods of drawing cycloids, spirals. Orthographic projection and projection of points.

Projection of lines, projection of planes, projection of solids. Introduction of prism, pyramid, cylinder and cone.

Section of solids, introduction of intersection of surfaces. Development of plane and curved surface. Isometric projection.

Text/Reference

1. N.D. Bhatt. Elementary Engineering Drawing, Rupalee publication, Anand.
2. Lakshmi Narayan and Vaishwanar. A Text Book of Practical Geometry, Jain Brother, New Delhi.
3. R.B. Gupta. A Text Book of Engineering Drawing, Satry Prakashan, New Delhi.
4. Fundamentals of Technical Drawing, Parkinson.

BS 100P ENGINEERING PHYSICS

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

Unit-I

Electric Field: Line integral of electric field, Potential difference, Field as gradient of potential, Divergence of a vector function, Differential form of Gauss's law, Laplacian, Laplace equations, Curl of a vector function. Gauss's divergence theorem.

Magnetic Field: Curl and Divergence of a magnetic field, Magnetic scalar and vector potential.

Unit-II

Varying Field: Faraday's law-integral and differential form, Self and mutual inductance, Neumann's equation, Charge and discharge of a capacitor through register, Growth and decay of current in LR circuit, Energy stored in electric and magnetic field, Displacement current, Maxwell's equations.

Unit-III

Laser: Coherence, Einstein's coefficient, Spontaneous and stimulated emission, Population inversion, Laser gain (pumping), Spectral narrowing in laser, Coherence length, Ruby and He-Ne laser.

Interference: Division of amplitude, colour of thin films, Newton's ring, Febry-Perot interferometer-principle, operation, determination of wave length and difference in wave length.

Unit-IV

Diffraction: Double slit Fraunhofer diffraction pattern, Fraunhofer diffraction by a plane transmission grating, Formation of spectra.

Polarization: Analysis of linearly, circularly and elliptically polarized light (Half wave and quarter wave plates), Optical activity, specific rotations, Laurent's half shade and its use for determination of specific rotation of sugar solution.

Practicals

1. To find refractive index and dispersive power of material of prism by spectrometer.
2. To find wave length of light by Newton's ring.
3. To find wave length of light by diffraction grating.
4. To find specific rotation of sugar solution by polarimeter.
5. To find wave length of light by Fresnel Biprism.
6. To find frequency of A.C. mains.
7. To determine dielectric constant of liquid using series resonance method.
8. To study charge and discharge of condenser through a resistor (C.R. Circuit).
9. To study LCR resonant circuit, resonance, quality factor and sharpness in (i) series circuit (ii) parallel circuit.

Text Books/References

1. K.K. Tiwari. (1995). Electricity and Magnetism, S. Chand and Company, New Delhi.
2. N. Subrahmanyam and Brijlal. (1993). A Text Book of Optics, S. Chand and Company, New Delhi.
3. Ahmed and Lal. (1966). Electricity, Magnetism and Electronics, Unitech House, Lucknow.
4. D.S. Mathur. (1993). Mechanics, S. Chand and Company, New Delhi.
5. Gupta and Kumar. (1995). Practical Physics, Pragati Prakashan, Meerut.

CE 100 ENGINEERING MECHANICS

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

(A) STATICS

Unit-I

Introduction of condition of equilibrium: Force, system of force, coplanar forces.

Moment and couples: Moment and parallel forces, Couples, General conditions of equilibrium

Practical Applications: Levers, Cracked levers, Steel yards. Sagging chains and toggle joints.

Centre of Gravity: Centre of parallel forces, C.G. in some simple cases, C.G. of Solids.

Moment of Inertia: Moment of inertia, Radius of gyration and perpendicular axis. Determination of moment of inertia of simple sections. Mass of moment of inertia.

Unit-II

Friction: Introduction, Critical angle of friction, Friction on horizontal planes, Friction on inclined planes, Wedge and block, Screw jacks, Rolling friction.

Machines: Introduction, Effects of friction, Loss of work, Reversible and irreversible machine, Law of machine, Wheel and axle, Differential wheel and axle, Pulley block, Screw jack, Single and double purchase crab, Worm and Worm wheel, System of pulleys.

Frames: Statically determinate plane frames, Method of joints, Method of sections, Graphical method.

(B) DYNAMICS

Unit-III

Rectilinear Motion, Motion under gravity, Projectiles equation of the path, Maximum height attained, Time of flight, Horizontal range. Angle of projection, Projectile from a given height, Projectile on an inclined plane, Problems.

Work, Power and Energy: Work, Power, Work done by torque, Energy, Law of conservation.

Unit-IV

Centripetal and centrifugal forces, Laws of motion: Newton's Law of motion and their explanation, Collision of elastic bodies; Impulse and impulsive force, Principle of conservation of momentum, Loss of kinetic energy during impact.

Practicals

1. Verification of law of polygon of forces.
2. Verification of principle of moment in case of compound level.
3. Verification of principle of moment in case of bell crack level.
4. Determination of reaction in case simply supported beam with or without overhang.
5. To determine coefficient of friction between different surfaces on horizontal plane.
6. To determine coefficient of friction between different surfaces in inclined plane.
7. Study of different wheel and Axle.
8. Study of single purchase crab.
9. Study of worm and worm wheel.
10. Study of Weston's pulley block.
11. Determination of mechanical advantage, velocity ratio and efficiency of single purchase crab.
12. Determination of mechanical advantage, velocity ratio and efficiency of double purchase crab.
13. Determination of mechanical advantage, velocity ratio and efficiency of first system of pulley.
14. Determination of mechanical advantage, velocity ratio and efficiency of second system of pulleys.
15. Determination of mechanical advantage, velocity ratio and efficiency of third system of pulleys Flywheel.

Text Books/References

1. I.B. Prasad. Engineering Mechanics, Khanna Publisher, New Delhi.
2. R.S. Khurmi. Applied Mechanics, S. Chand & Company Ltd., New Delhi
3. S.B. Junnarkar. Applied Mechanics, Charotar Publishing House, New Delhi.
4. Saluja. Applied Mechanics, Satya Prakashan, New Delhi.

EE 100 ELECTRICAL ENGINEERING – I

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

D.C. Networks: Kirchoff's law, node voltage and mesh current methods, delta-star and star delta transformation, source conversion; solution of DC circuits by network theorems: Thevenin's, Norton's, superposition, Reciprocity and Maximum Power Transfer theorem.

Unit-II

Single Phase A.C.Ciruits : Single Phase EMF generation, average and effective values of sinusoidal and linear periodic wave forms, instantaneous and average power, power factor, reactive & apparent power, solution of R-L-C, series, parallel, series-parallel circuits, complex representation of impedances, phasor diagram, series and parallel resonance.

Unit-III

Three Phase A.C., Circuits : Three phase EMF generation, delta and star-connection, line and phase quantities, solution of the 3- phase balanced circuits, Phasor diagram, measurement of power in three phase balanced circuits.

Transformer: Faraday's laws of Electromagnetic induction, construction and principle operation of single phase transformer, EMF equation, voltage and current relationship and Phasor diagram for ideal transformer.

Unit-IV

Electrical Measuring Instruments : Introduction; type of measuring Instruments, Deflecting controlling & Damping Torque, D.C. PMMC instruments, shunts and multipliers, Moving iron ammeters and voltmeter, Dynamometers wattmeter, Induction type energy meter.

Practicals : Based on theory

Text Books/References

1. B. L. Therja. Electrical Technology, S. Chand
2. M.E.Van Valkenberg. Network analysis, PHI
3. Soni and Gupta. Introduction to Electrical Network Theory, Dhanpat Rai Publisher
4. R.A. Gupta and Nikhal Gupta. (2002). Fundamentals of electrical & Electronics Engineering, JPH, Ist Edition,
5. H.P. Tiwari. (2002). Electrical & Electronics Engineering, College Book Centre, Jaipur.
6. J.B. Gupta. (2002). Fundamentals of Electrical & Electronics. S.K. Kataria and Sons. Dehli.

ENVS 100 ENVIRONMENTAL STUDIES

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

Unit–I

The Multidisciplinary nature of environmental studies:

Definition, scope and need for public awareness. Environmental problems and their consequences

Natural Resources:

Renewable and non-renewable resources

Natural resources and associated problems

a) Forest resources: Use over-exploitation, deforestation, and case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams, benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer- pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land and a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, Equitable use resources for sustainable lifestyles.

Unit-II

Ecosystems

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem.

a. Forest ecosystem

b. Grassland ecosystem

c. Desert ecosystem

d. Aquatic ecosystems (ponds, streams, lakes, rovers, oceans, estuaries)

Biodiversity and its conservation

Introduction – Definition: genetic, species and ecosystem diversity, Biogeographically classification of India, Value of biodiversity: Consumptive use, productive use, social, ethical, and aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-III

Environmental Pollution

Definition, Causes, effects and control measures of: -

Air pollution

Water pollution

Soil pollution

Marine pollution

Noise pollution

Thermal pollution

Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.

Unit-IV

Social Issues and the Environment - From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people: its problems and concerns, Case studies, Environmental ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies, Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

Human Population and the Environment

Population growth, variation among nations, Population explosion- Family Welfare Programme, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Practicals

Visit to river, forest, hill, mountain, local polluted plant, pond ecosystem

Text Books/References

1. K. C. Agarwal. (2001). Environmental Biology, Nidi Publications, Bikaner.
2. B. L. Chaudhary and Jitendra Pandey. (2005). Environmental Studies, Apex Publishing House, Udaipur.
3. H Jhadav & V. M. Bhosale. Environmental Protection & Laws, Himalaya Pub. House, Delhi
4. M. N. Rao and A. K. Datta. Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd.
5. B. K. Sharma. Environmental Chemistry. Goel Publishing House, Meerut
6. Pratap Singh, N. S. Rathore and A. N. Mathur. (2004). Environmental Studies, Himanshu Publications, Udaipur.
7. R. K. Trivedi and P. K. Goel. Introduction to Air Pollution, Techno Science Publications.

BS 100C ENGINEERING CHEMISTRY

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

Unit-I

Sources of water, common impurities, requisites of drinking water in municipal water supply. Purification of water, sedimentation, sterilization, break point chlorination. Hardness, determination of hardness by Complixemetric (EDTA) method, degree of hardness, chloride, dissolved oxygen, carbon dioxide and sulphate, control of pH of water used in industry, Boiler troubles, carry over corrosion, Sludge and scale formation. Caustic embrittlement, cause of boiler troubles and their prevention.

Unit-II

Classification of fuels, solid fuels, coal origin and its classification, Proximate and ultimate analysis of coal, significance of constituents, Gross and net calorific values. Liquid fuels- advantages, Petroleum origin, classification, Refining of Petroleum, Gasoline, knocking, octane number, anti knock agents . Flue gas analysis by Orsat Apparatus, Calculations based on combustion.

Unit-III

Corrosion: Definition and its significance, theories of corrosion, protection of corrosion use of inhibitors and passavasion, Alloying protective coatings -Metallic, inorganic and Organic.

Refractories: Definition, Properties, Classification. Properties of Silica and Fireclay refractories.

Unit-IV

Chemical Kinetics- Order and Molecularity of reaction, first and second order reaction, Derivation of equations for first and second order reaction, determination of order of reaction, Energy of activation and Arrhenius equations, Numericals of first and second order reactions.

Practicals

1. Determination of viscosity of a liquid.

2. Determination Surface Tension of a liquid by Stalagmometer method.
3. Determination of carbonate and non carbonate hardness by soda reagent method.
4. Determination of temporary and permanent hardness by EDTA method.
5. Estimation of free chlorine in a water sample.
6. Determination of copper sulphate iodometrically.
7. Estimation of potassium dichromate iodometrically
8. Determination of purity of Ferrous Ammonium Sulphate (Mohr's Salt) using Potassium Permanganate.
9. Determination of Potassium Dichromate using Potassium Ferrycyanide as an external indicator.
10. Estimation of available chlorine in bleaching powder sample
11. Analysis of Brass
12. Analysis of Iron ore
13. Analysis of Pyrolusite
14. Analysis of common salt.

Text Books/References

1. Jain and Jain. Engineering Chemistry, Dhanpat Rai & Sons, Nai Sarak, Delhi.
2. Jain and Gupta. A Text Book of Engineering Chemistry, Jaipur Publishing House.
3. B.K. Sharma. Engg. Chemistry, Krishna Prakashan Media (P) Ltd., Merrut.
4. S.S. Dara. A Text Book of Engineering Chemistry, S.Chand & Co., New Delhi.
5. M.A. Uppal. A Text Book of Engineering Chemistry, Khanna Publishers, Delhi.
6. S.S. Dara. A Text Book on Experiments and Calculations Engg. Chem. Ram Nagar, Delhi.
7. S.K. Banerji and S.K. Jain. Hand Book of Technical Analysis, Jain Brothers, New Delhi.

EC 100 ELECTRONICS AND INSTRUMENTATION

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Passive Components: Construction and characteristics of carbon composition , wire wound and film resistors. Potentiometer, color codes and rating of resistors. Characteristics and rating of capacitors for electronics circuits.
Semi conductor: Basic electrical characteristics of semi conductors. Theory of p-n junction. Characteristics and ratings of junction diodes.basics of zener diode, photo diode and LED.

Unit-II

Bipolar Junction Transistor: npn and pnp transistors,, Various configurations (CB, CC,CE) of BJT. Transistor biasing (Fixed, self, potential dividers) Basic classification of amplifier (Voltage and power amplifier). Basic concept of Class A, B , AB and C amplifiers.

Unit-III

Generation of waveforms: Concept of positive and negative feed back. Introduction of oscillators like R-C , L-C and Crystal oscillators.
Power supply: Circuit configuration and analysis of Half wave, Full wave and Bridge rectifier .Basic concept of regulation, Zener diode voltage regulator.,Transistor serier regulator.

Unit-IV

Transducers: Definition, classification : Active and passive transducer, primary and secondary transducers, Analog and digital transducers. Measurement of displacement, temperature, velocity, force and pressure using potentiometer, resistance thermometer, thermocouples , bourden tube, LVDT, strain gauge and techogenerator.

Practicals : Based on theory

Text Books/References

1. Millman and Halkias. Integrated elecronics: Mc Graw Hill
2. W.D Cooper. Electronics Instrumentation and Measurement : PHI
3. M.L.Gupta. Electrical Engineering Materials
4. Malvino. Principles of Electronics
5. Jhon D. Ryder. Electronics Fundamentals

CS 100 INTRODUCTION TO COMPUTER PROGRAMMING AND DATA STRUCTURE

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit–I

Computer Fundamentals: History of Computers; Organization of Computers: input unit, output unit, Storage Unit, Arithmetic Logic Unit, Central Processing Unit; CPU Operation; Memory Subsystem: RAM, ROM, Cache Memory & memory Hierarchy; Instruction Format and Instruction Execution Cycle; Number System & Codes: Binary, Decimal, Octal & Hexadecimal Number System, Conversion from one number system to another, sign magnitude, 1's Complement & 2's Complement representation of numbers; Numerical & Character codes: BCD, Excess – 3, Gray, ASCII & EBCDIC Codes.

Unit-II

Basics of Programming in C: Constants, Variables and Data Types, Operators and Expressions, Input and Output operations, Decision making & Branching: if-else, switch statement; Decision making and looping; Arrays.

Unit-III

Character Arrays & strings, User defined function, Structures & Unions, Pointer Management, Dynamic Memory allocation & linked lists.

Unit–IV

Introduction to Data Structures : Introduction to Linear Arrays & Representation of Linear Array in Memory, Traversing, Insertion & Deletion in Linear arrays, Bubble Sort, Linear & Binary search; Introduction to linked list – Representation of linked list in memory, Traversing, Searching, Insertion & Deletion in a linked list.

Practicals : Based on Theory

Text Books/References

1. E. Balagurusamy. "Programming in ANSI C", Tata McGraw Hill.
2. Kernighan and Ritchie. "The C Programming language", Printice Hall
3. P.M. Jat. "Programming with C", Apex Publishing House, Jaipur.
4. Dharm Singh. "Fundamentals of Compute Organization", Paragon International Publishers, New Delhi.
5. P.K. Sinha & P. Sinha. "Computer Fundamentals", BPB Publication.
6. Seymour Lipschutz. "Data Structure", Schaum's outline series, McGraw Hill.

BS 100E ENGLISH AND COMMUNICATION SKILL

Cr. Hrs. 2 (2 + 0)

	L	T	P
Credit	**2**	**0**	**0**
Hours	**2**	**0**	**0**

(A) ENGLISH

Grammar and Usage – Tenses, Agreement of Subject and verb, Passive Voice, Basic Sentence Patterns, Prepositions, Phrasal verbs, Common Grammatical Errors, Use of articles, Punctuations, Modals, Gerund, Participle, Infinitive, Word Formation (affixes, prefixes, suffixes, synonyms and antonyms), Idioms, Synthesis & Transformation of sentences, Sentence Linkers.

Comprehension – Unseen Passage

Composition – Precise writing, Personal Letters, Business letters, Job Applications, Writing of technical Report, Essay writing

Introduction to sounds – Vowels, Diphthong, Consonants Phonetics Transcriptions. Word stress and exercises on pronunciation, Group discussion on current topics and Presentation of Technical report.

Practice in Language Laboratory

(B) COMMUNICATION SKILL

Communication Skills: Meaning and process of communication, Verbal and non-verbal communication; Quality of good communicator; Writing skills, Group discussion; Organizing seminars and conferences.

Text Books/ References

1. Thomson and Martinet. (1997). A Practical English Grammar Exercise Book, Vol. I and II, O.U.P. Publication.
2. Michal Swan. (1995). Practical English Grammar, O.U.P. Publication.
3. David Green. (1990). Contemporary English Grammar Structure Composition, Macmillan Publication.
4. S. Allen. (1997). Living English Structures, Orient Longmans.
5. Daniel Jones, Drills and Tests in English Sound, ELBS.
6. Hornby. (1990). Advanced Learners Dictionary, O.U.P. Publication.
7. Kirshan Mohan. Speaking English Effectively; Macmillan Publication.
8. Audio-Video Tapes prepared by the British Council, New Delhi and Central Institute of English and Foreign Language, Hyderabad to be used in a Language Laboratory.
9. A. Adivi Reddy. Extension Education, Sree Lakshmi Press, Bapatla (A.P.)
10. G.L. Ray. (2005). Extension Communication and Management, Kalyani Publishers.

FIRST YEAR B.TECH. (II SEMESTER)

BS 121 MATHEMATICS – II

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Differentiation of Vectors: scalar and vector point functions, vector differential operator Del, Gradient of a scalar point function, Divergence and Curl of vector point functions; Directional derivatives; Line, Surface and Volume integrals; Gauss, Stoke's and Green theorems (Statement only) and their applications.

Unit-II

Ordinary Differential Equations: Second order differential equations with variable coefficients; Exact form; Part of complimentary function is known; Change of dependent and independent variables; Method of variation of parameters.

Unit-III

Partial Differential Equations: Formation of partial differential equations; Lagrange's linear equations; Higher order linear partial differential equations with constant coefficients. Standard forms of partial differential equations.

Unit-IV

Matrices: Elementary transformations; Rank of a matrix; Reduction to normal form; Gauss Jordan method to find inverse of a matrix; Consistency and solutions of linear equations; Eigen values and Eigen vectors**;** Cayley-Hamilton theorem.

Text Books/References

1. Y.N. Guar and C.L. Koul. (2005). Engineering Mathematics, (Vols.-I, II), Jaipur Publishing House, Jaipur.
2. J.L. Bansal and H.S. Dhami. (2005). Differential Equation, (Vols.-I), Jaipur Publishing House, Jaipur.
3. N.P. Bali and N.Ch.S.N. Iyengar. (2003). A text book of Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi.

CE 122 CIVIL ENGINEERING

Cr. Hrs. 2 (1 + 1)

	L	T	P
Credit	**1**	**0**	**1**
Hours	**1**	**0**	**2**

(A) SURVEYING AND LEVELING

Unit-I

Principle and purpose of plane surveying.

Chain Surveying : Instrument for chaining, Direct & indirect ranging. Methods of chain along plane & sloping ground, Base line, check line, Tie line, Offset, Chain angle & recording in field book.

Compass Surveying : True & Magnetic meridian, whole circle bearing & quadrantal bearing system, construction & use of Prismatic & Surveyor Compass, Local attraction.

Unit-II

Level and leveling : Definition of various terms used in leveling. Types of Bench mark and their uses. Construction and use of Dumpy and Tilting levels, Leveling staves. Temporary adjustment of Dumpy level. Simple, differential leveling, fly leveling, longitudinal and cross sectioning, plotting of profile leveling. Determination of level by line of collimation and rise and fall method, Arithmetical checks. Level book and record keeping, leveling difficulties and errors in leveling.

(B) BUILDING MATERIAL

Unit-III

Stones: Different types, properties of good building stones, common testing of stones, Dressing of stones and use of stones in construction.

Bricks: Types, raw materials, identification, composition. Properties and uses of ordinary bricks, fire resistant and chemical resistant bricks.

Limes: Definition, sources of lime, slaking of lime, ISI classification of lime.

Unit-IV

Cement: Chemical composition, types of cement, properties, uses and tests on cement.

Mortars: Proportioning, properties of ingredients and use of lime, cement and gauge mortars.

Cement Concrete: Ingredients, common proportions, properties of fresh hardened concrete,Water cement ratio, curing and consolidation of concrete.

Practicals

1. Study of accessories used in measurement of distances.
2. Ranging Direct and indirect and use of chain and tape.
3. Chining along sloping ground.
4. Chain surveying, field book recording and taking offsets for location details
5. Study of prismatic and surveying compass and taking bearings..
6. Study of Dumpy level, temporary adjustment and R.L. calculations.
7. Study of Tilting level, temporary adjustment and R.L. calculations
8. Simply and differential leveling operation, record in level book, practice for staff reading line of collimation and Rise and fall method calculations.
9. L-section and cross sectioning, fly leveling operation.
10. Plotting of working profile.

Text Books/References

1. S.C. Rangwala. Engineering Materials, Charotar Book Stall, Anand.
2. B.C. Punmiya. Surveying & Field Work (Vol. I), Laxmi ublications, New Delhi.

ME 123 MACHINE DRAWING – I

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**0**	**3**

Introduction, conventional representation of different materials used in machine drawing, Introduction to BIS codes.

Orthographic Projection: First and third angle methods of projection. Preparation of working drawing from models and isometric views. Drawing of missing views.

Dimensioning: Different methods of dimensioning.

Sectional Views: Concept of sectioning. Revolved and oblique section. Sectional drawing of simple machine parts

Riveted and Welded Joints: Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints.

Screw Fastenings: Nomenclature, thread profiles, multistart threads, left and right hand threads. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts.

Different types of joints: Knuckle joint, cotter joint and universal joint.

Text Books/References

1. N. D. Bhatt. Machine Drawing, Charotar Book Stall, Anand.
2. V. Laxminarayan and ML Mathur. A Text Book of Machine Drawing, Jain Brothers, New Delhi.
3. P. S. Gill. Machine Drawing: S. K. Kataria & Sons, New Delhi.

ME 124 WORKSHOP TECHNOLOGY

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**3**

Unit-I

Welding: Introduction to welding, types of welding. Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Soldering and Brazing.

Unit-II

Lathes: Classification, constructional details of centre lathe. Main operations and tools used on centre lathes.
Shaper: Types of shapers. Constructional details of standard shaper, shaper tools and main operations.

Unit-III

Drilling Machines: Types of drilling machines. Constructional details of pillar type, and radial drilling machines. Main operations. Twist drills, drill angles and sizes.
Measurement and Inspection: Classification of measuring instruments, linear and angular measurement, comparators.

Unit-IV

Forming: Basic descriptions and applications of hot and cold working processes, forging, bending, shearing, drawing and forming operations.
Foundry: Moulding tools and equipments. Moulding sands, properties of moulding sand, sand mould making process.

Practicals

Practical exercises on welding, pattern making, foundry and machining operations.

Text Books/References

1. S.K. Hajra Choudhury and A.K. Hajra Choudhury. Elements of Workshop Technology (Vol. I and II), Media promoters & Publishers Pvt. Ltd., Bombay.

SECOND YEAR B.TECH. (III SEMESTER)

BS 211 (All Branches) MATHEMATICS – III

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Interpolation: Finite differences, various difference operators and their relationships, factorial notation. Interpolation with equal intervals; Newton's forward and backward interpolation formulae, Lagrange's interpolation formula for unequal intervals.

Unit-II

Gauss forward and backward interpolation formulae, Stirling's and Bessel's central difference interpolation formulae.

Numerical Differentiation: Numerical differentiation based on Newton's forward and backward, Gauss forward and backward interpolation formulae.

Unit-III

Numerical Integration: Numerical integration by Trapezoidal, Simpson's rule.

Numerical Solutions of Ordinary Differential Equations: Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta methods.

Unit-IV

Laplace Transform: Laplace transforms of elementary functions; Basic properties of Laplace transform; Initial value theorem, final value theorem and convolution property of Laplace transform; Inverse Laplace transforms. Applications of Laplace transform to solve ordinary differential equations.

Text Books/References

1. H.C. Saxena. Text Book of Finite Differences and Numerical Analysis, S. Chand and Co.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain. Numerical Methods for Scientific and Engineering computation, New Age International (P) Ltd.
3. N.P. Bali and Manish Goyal. A Text book of Engineering Mathematics, Laxmi Publication Pvt. Ltd., New Delhi (VII Edition).
4. S.P. Goyal and A.K. Goyal. Integral Transforms, Jaipur Publishing House, Jaipur.

ME 211 MECHANICS OF SOLIDS-I

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**1**	**2**

Unit-I

Fundamentals: Stress and strain, engineering stress and strain, true stress and strain. Saint-Venant's principle. Stress-strain diagrams, mechanical properties of materials, elasticity and plasticity. Shear stress and strain, pure shear, complementary shear. Linear elasticity and Hooke's law. Poisson's ratio, volumetric strain, bulk modulus of elasticity. Elastic constants and relation between elastic moduli. Stress and strain in axially loaded members. Temperature and prestrain eff-ects, statically indeterminate problems. Composite bars. Dynamic loading. Strain energy.

Unit-II

Analysis of Stress and Strain: Stress at a point, stress components, stresses on inclined planes. Plane stress and strain. Mohr's circle representation of plane stress and strain. Principal stresses and strains, maximum shear stresses. Hooke's law for plane stress, strain energy for plane stress. Application to components under combined loading, thin spherical and cylindrical shells, shafts under bending. Triaxial and spherical state of stress. Generalised Hooke's law.

Stresses in thin cylindrical and spherical shells subjected to internal and external pressures. Thick cylinders, compound cylinders, stresses due to rotation.

Unit-III

Beams under Flexural Loads: Bending moment and shear force, relation between load, shear force, and bending moment. Bending moment and shear force diagrams for simply supported, cantilever, fixed and overhang beams under static loading of different types viz. point loads, uniformly distributed loads, linearly varying loads, and couples. Pure bending. Theory of simple bending of initially straight beams. Flexural stresses in beams. Built up and composite beams. Shear stresses in beams of rectangular, circular and I-section. Shear formula, effect of shear strain. Bending of curved bars.

Unit-IV

Torsion: Torsion of solid and hollow circular shafts. Non-uniform torsion. Statically indeterminate torsional members. Torsion in composite shafts and thin walled tubes. Combined bending and torsion, effect of end thrust. Keys and couplings.

Columns: Buckling and stability, critical load. Euler's theory for initially straight column with different end conditions, equivalent length, limitation of Euler's formula. Rankine's formula. Columns under eccentric loading. Secant, Perry's and Indian Standard formulae.

Practicals

Tension test on UTM and determining mechanical properties. Compression test. Charpy test. Izod test. Hardness testing. Performance of torsion test, bending test.

Text Books/References

1. James M. Gere and Stephen P. Timoshenko. 2nd Edition. CBS Publishers & Distributors, Delhi.
2. B. C. Punmia. (1988). Strength of Material and Mechanics of Structures (Vol. I). 8th Edition Standard Publishers Distributors.
3. S. H. Crandall, N. C. Dahl and S.J. Iardner. An Introduction to Mechanics of Solids, TMH.
4. E.P. Popov. (2000). Introduction to Mechanics of Solids, PHI.

ME 212 MATERIALS SCIENCE

Cr. Hrs. 2 (2 + 0)

	L	T	P
Credit	**2**	**0**	**0**
Hours	**2**	**0**	**0**

Unit-I

Engineering Materials: Effects of alloying elements in steel. Low alloy steels, stainless steel, magnetic steels, tool steels, materials for high and low temperature service. Brasses and Bronzes. Aluminium base alloys. Bearing Materials. Engineering Plastics.

Crystalline Nature of solids: Crystal structure, space lattice and constants, Miller indices, allotropy. Imperfection in crystals, point and line defects, grain boundary and its effect on properties.

Unit-II

Plastic Deformation of Metals: Mechanism of plastic deformation, role of dislocation, slip and twining. Work hardening, theories of recrystallisation and grain growth. Elementary treatment of creep, fatigue and fracture. Methods of studying macro and microstructure.

Unit-III

Phase Transformation in Alloys: Mechanism of solidification in pure metals, free energy, critical size of nucleus. General principles of phase transformation in alloys, phase rule and equilibrium diagrams, relationship with structure and properties. Equilibrium diagrams of common binary systems. Equilibrium diagram of iron-carbon alloys, allotropic forms of iron and various forms of carbon in iron-carbon alloys.

Unit-IV

Heat Treatment of Steels and Cast Irons: Phase transformations in steel, S-curves, ageing. Detailed study of various heat treatment processes- hardening, tempering, annealing, precipitation, and surface hardening. Chemical heat treatment of steel, carburising and nitriding. Hardenability. Heat treatment of cast irons. Heat treatment furnaces.

Text Books/References

1. V. Raghvan. Physical Metallurgy. Principles and Practice, PHI.
2. Rajan et al. Heat Transfer. Principles and Technology, PHI.

3. Y. Lakhtin. Engineering Physical Metallurgy, MIR Publishers.

ME 213 FOUNDRY AND WELDING TECHNOLOGY

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Foundry: Classification of casting processes. Patterns- types, materials, methods of construction and allowances. Core prints and core boxes. Colour coding for patterns and core boxes. Moulding materials. Types and properties of moulding sands, sand additives, sand preparation, testing of moulding sands. Sand moulding processes. Special moulding processes viz. carbon dioxide moulding, shell moulding, ferro-silicon moulding, dicalcium moulding, cement-sand moulding, foam moulding, hot and cold box moulding methods, plaster moulding, ceramic moulding. Core materials, core sands and binders, types of cores, core making, core testing.

Foundry Mechanisation: Moulding and core making machines, patterns for machine moulding, sand preparation and material handling systems. Cupola furnace, electric arc and induction furnaces.

Unit-II

Solidification of casting and flow properties of liquid metals. Design principles of gating and risering systems, different types of gates and risers, riser location. Use of padding and chills, exothermic and insulating sleeves applications.

Principle of casting design. Cleaning and finishing of castings, casting defects and methods of casting inspection.

Other Casting Processes: Permanent mould casting, investment casting, centrifugal and semi-centrifugal casting methods, centrifuging, continuous casting, die casting, die casting machines.

Unit-III

Welding: Classification of welding processes, metallurgy of weld. Oxyacetylene gas welding, equipment and tools used, types of flames, types of joint, various position welding. Oxyacetylene torch cutting of metals. Principle of arc welding, AC and DC arc welding machines and tools, arc characteristics and control. Manual metal arc welding electrodes, classification and applications. Other arc welding methods

like carbon arc, metal inert gas (MIG), tungsten inert gas (TIG), atomic hydrogen, plasma, submerged, flux-cored, and electro slag arc welding.

Unit-IV

Other welding and related methods: Resistance welding. Thermal spraying, thermit welding, pressure welding, solid state welding methods. Brazing and soldering.

Newer welding methods: Electron beam welding, laser beam welding.

Welding defects and remedies. Destructive and non-destructive testing methods for welded joints.

Practicals

Pattern making, moulding and casting exercises involving cores and considering allowances. Study of cupola and induction furnaces. Experiments on foundry sand testing like moisture, green strength, etc. Exercises/demonstration on advanced metal arc (TIG, MIG, etc.), oxyacetylene welding and cutting, resistance welding and metal spraying.

Text Books/References

1. SK Hajra Choudhury and AK Hajra Choudhury. Elements of Workshop Technology, Vol. I, Media Promoters & Publishers Pvt. Ltd., Bombay.
2. JS Campbell. Principles of Manufacturing Materials and Processes, TMH.
3. Richard L. Little. Welding and Welding Technology, TMH Co. Ltd., New Delhi..
4. R. K. Purohit. Mechanical Engineering, Scientific Publishers, Jodhpur.

ME 214 KINEMATICS OF MACHINES

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Mechanisms: Kinematic pairs, kinematic chains, and mechanisms, limits and disguise of pairs, equivalent linkages. Mobility, Grübler's and Kutzbach's criteria. Four bar chain, slider crank chain, and double slider crank chain and their inversions. Various mechanisms viz. Pantograph, straight line mechanisms, steering mechanisms, Hooke's joint, Geneva mechanism.

Kinematic Analysis of Plane Mechanisms: Instantaneous centres, Aronhold-Kennedy's theorem, angular velocity ratio theorem, velocity analysis using instant centres. Velocity and acceleration using graphical method, Coriolis component of acceleration. Algebraic method for velocity and acceleration analysis of four bar chain and slider crank chain.

Introductory concepts of complex algebra and vectorial methods of analysis, loop closure equation and numerical solutions using computers (No numerical problems).

Unit-II

Kinematic Synthesis of Planar Mechanisms: Steps and classes of synthesis. Dimensional synthesis, precision points, structural error, Chebychev spacing. Freudestein's methods of synthesis and application to simple function generation problems for four-bar chain.

Cams: Classification of cams and followers. Radial cam nomenclature. Analysis of basic follower motions viz. uniform velocity, simple harmonic, uniform acceleration and retardation, and cycloidal motions. Synthesis of cam profile using graphical approach for roller, flat faced, and knife edged followers. Analysis of follower motion for tangent came with roller follower and circular arc cam with flat faced follower.

Unit-III

Gear: Law of gearing, velocity of sliding between teeth in mesh. Involute and cycloidal profile for gear teeth and their characteristics.

Interchangeable gears, tooth systems. Spur gears, spur rack, arc and path of contact, contact ratio. Interference and undercutting, minimum number of teeth to avoid interference. Parallel axis helical gears. Tooth proportions, equivalent spur gear. Herringbone gears. Crossed axis helical (spiral) gears, velocity ratio and efficiency. Straight bevel gears, tooth proportions, velocity ratio, equivalent spur gear, other types of bevel gears. Worm and worm gear, nomenclature, velocity ratio and efficiency.

Gear Trains: Simple, compound, reverted, and epicyclic trains. Gear train applications, gear boxes and differentials. Determining velocity ratio by numerical and tabular methods.

Unit-IV

Drives with Flexible Connectors: Types of belts and belt drives, Slip and creep. Centrifugal tension, condition for maximum power, initial tension. V belt and rope drives. Chain drives, types of power transmission chains, velocity ratio.

Brakes and Dynamometers: Block brake, band brake, band and block brake. Braking action, Braking system of automobiles. Absorption and transmission type dynamometers.

Text Books/References

1. P. L. Ballaney. Theory of Machines, Khanna Publishers, Delhi.
2. Joseph E. Shigley and John J. Uicker, Jr. Theory of Machines and Mechanisms (International Edition), McGraw Hill Inc.
3. R. S. Khurmi and J. K. Gupta. Theory of Machines, Eurasia Publishing House (Pvt.) Ltd., New Delhi.
4. H. H. Mabie and C. F. Reinholtz. Mechanisms and Dynamics of Machinery. John Wiley & Sons.

ME 215 MACHINE DRAWING – II

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**0**	**3**

Pipes and Pipe joints: Standard conventional symbols for pipe joints and fittings, piping diagrams.

Bearing: Ball, roller, and needle bearings.

Valves: Stop, gate, globe, check, buterfly and needle type valves, safety valves.

Limits, fits, tolerances, conventional symbols, surface finish, etc. Familiarisation with various BIS and other codes currently in vogue.

Preparation of assembly and production drawings indicating tolerances, surface finish, etc. in detail of simple machine components and assemblies like couplings, clutches, gear assemblies, tool post, reciprocating engine components, viz. piston, connecting rod, cross head, etc.

Text Books/References

1. N. D. Bhatt. Machine Drawing, Charotar Book Stall, Anand.
2. V. Laxminarayan and ML Mathur. A Text Book of Machine Drawing, Jain Brothers, New Delhi.
3. P. S. Gill. Machine Drawing: S. K. Kataria & Sons, New Delhi.

EE 213 (AE, ME, MI) ELECTRICAL ENGINEERING – II

Cr. Hrs. 3 (2 +1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

Unit-I

D.C. Machines: Characteristics curves of d.c. generators and motors, application of motors for different uses, starting and speed control of motors.

Unit-II

Transformers: Phasor diagram and equivalent circuits, regulation efficiency and their determination. Open circuit, short circuit and Sumpner's test.

Unit-III

Induction Motors: Polyphase induction motors – starters, equivalent circuit, effect of rotor resistance, toruqe-slip curves, speed control by rotor resistance, pole changing and cascading, use in industry. Single phase induction motor – starting methods.

Unit-IV

Alternators: Elementary idea of armature winding. Calculation of induced e.m.f., factors affecting generating e.m.f. Open circuit, short circuit and load characteristics. Voltage regulation and its determination by synchronous impedance methods. Synchronising.

Synchronous Motors: Methods of starting. Power angle characteristics of cylindrical rotor machine, operation of synchronous motor as a condenser and as a reactor. Applications in industries.

Practicals

Lab practicals will be as per the theory syllabus.

Text Books/References

1. Nagrath and Kothari. Electrical Machines,
2. Ashfaq Hussain. Fundamentals of Electrical Engineering,

BS 221 (EC, EE, ME, MI) MATHEMATICS – IV

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Fourier Series: Fourier series, even and odd functions; Half range series; Change of interval; Exponential form of Fourier series; Harmonic analysis.

Unit-II

Roots of Nonlinear (Algebraic and Transcendental) Equations: Bisection method, False position method, Newton Raphson method; Convergence of False position and Newton Raphson method. Complex roots of polynomials by Bairstow's method.

Unit-III

Partial Differential Equations: Classifications of partial differential equations; Method of separation of variables to solve Heat equation, Wave equation and Laplace's equations.

Unit-IV

Statistics: Correlation and regression; Principle of least square method and curve fitting.

Probability Distribution Functions: Random variable; Mathematical expectations; Moment generating functions; Discrete and continuous distribution functions; Binomial, Poisson and Normal distributions.

Text Books/References

1. J.L. Bansal and H.S. Dhami. (2005). Differential Equations (Vols.-II), Jaipur Publishing House, Jaipur.
2. N.P. Bali and Manish Goya. A Text book of Engineering Mathematics (VII Edition), Laxmi Publication Pvt. Ltd., New Delhi.
3. S.C. Gupta and V.K. Kapoor. Mathematical Statistics, Sultan Chand & Sons, New Delhi.

ME 221 MECHANICS OF SOLIDS – II

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Deflection of Beams: Differential equations of deflection curve, sign convention. Moment curvature relation. Transverse deflection of beams under static loading. successive integration methods, conjugate beam method, superposition method, area-moment method, methods using discontinuity functions. Deflection of simple non prismatic beams. Strain energy in bending.

Unit-II

Deflection of Statically Indeterminate Beams: Statical indeterminacy. Superposition, moment-area, and successive integration methods. Continuous beams, use of three-moment equations.
Springs: Close coiled helical spring subject to axial load and couple. Open coiled helical spring subjected to axial pull and torque. Springs in series and parallel. Thin flat spiral spring. Leaf springs, quarter elliptical springs. Stresses and defections in leaf springs.

Unit-III

Members Subjected to Combined Loads: Short struts subjected to eccentric loads, shafts subjected to combined bending and twisting loads, equivalent twisting moments and equivalent bending moments. Members subjected to combined axial, bending and torsional loads.
Theories of Elastic Failure: The necessity for theory, different theories, significance and comparison.

Unit-IV

Energy Methods: Principal of virtual work, reciprocal theorems, unit load method. Strain energy and complementary strain energy. Strain energy due to axial, bending and torsional load. Castigliano's theorems. Application of energy methods for determination of deflections of simple structural members and structures, defection of beam due to shear.

Text Books/References

1. James M. Gere and Stephen P. Timoshenko: 2nd Edition. CBS Publishers & Distributors,Delhi.
2. B. C. Punmia. (1988). Strength of Material and Mechanics of Structures (Vol. I). 8th Edition Standard Publishers Distributers.
3. S. H. Crandall, N. C. Dahl and S.J. lardner. (2000). An Introduction to Mechanics of Solids, TMH.

5. E.P. Popov. Introduction to Mechanics of Solids, PHI.

ME 222 ENGINEERING THERMODYNAMICS

Cr. Hrs.	**3 (3 + 0)**		
	L	**T**	**P**
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Introduction: Microscopic and macroscopic points of view, limits of Thermodynamics. Homogeneous and heterogeneous systems, thermodynamic properties and state, heat and work.

Zeroth Law of Thermodynamics: Thermodynamic equilibrium, thermodynamic and international practical temperature scales.

First Law of Thermodynamics: Application to non-steady flow processes. Comparison of SFEE and Bernoulli's equation. Variable specific heat, processes involving variable specific heat, energy charts.

Unit-II

Second Law of Thermodynamics: Equivalence of Kelvin-Planck and Claussius statements. Reversible and irreversible cycle. Carnot cycle. Corollaries of second law and entropy, Claussius inequality, principle of increase of entropy. Availability, irreversibility and efficiency. Second law analysis of systems.

Thermodynamic Relations: Differential relationship for systems of constant composition. Helmoltz and Gibbs function. Variable specific heat. Joule-Kelvin coefficient, Clausius-Clapeyrnon equation.

Unit-III

Properties of Pure Substances: Ideal gas, PVT surfaces, equation of state, Vander Wal's equation. Beatic-Bridge equation and other equations of state. Virial coefficients. Law of corresponding states, use of generalized compressibility charts. Development of table for thermodynamic properties. Phase diagrams. Pressure, volume, temperature, entropy, enthalpy-entropy, pressure-enthalpy - entropy pressure enthalpy diagrams. Representation of processes in various phase diagrams.

Unit-IV

Mixture of Gases and Vapours: Vapour mixture. Mixture of ideal gases, Dalton's law, Amagat-Ledue law, Gibb's Law. Irreversible mixing process for ideal gases, mixture of ideal gases and vapour. Gravitational and volumetric analysis.

Chemical Equilibrium: Thermodynamics of combustion, internal energy and enthalpy of formation, first and second law analysis.

Text Books/References

1. P. K. Nag. Engineering Thermodynamics, TMH.
2. C. P. Arora. Engineering Thermodynamics, TMH.
3. E. Rathakrishnan. Fundamentals of Engineering Thermodynamics, PHI.

4. Y. Cenegel and M. Boles. Thermodynamics : An Engineering Approach, McGraw Hill.

ME 223 MANUFACTURING PROCESSES

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Metal Working: Hot and cold rolling, continuous rolling. Drop forging, drop hammers, dies for drop forging, upset and press forging, forging presses, forging rolls, forging defects. Hot and cold extrusion including impact extrusion and extrusion cold forging. Seamless tubes manufacturing processes, swaging. Wire, bar and tube drawing.

Unit-II

Sheet Metal Working: Classification of processes. Process capabilities, process planning and elements of tooling of shearing (blanking, piercing, trimming, shaving, notching), drawing and forming processes. Sheet metal presses. Punch and die sets. Compound, progressive, and combination dies. Drop hammer forming, Guerin process, bulging, stretch forming, spinning and explosive forming. High velocity forming of metals.

Unit-III

Powder Metallurgy: Introduction, production of powder, manufacturing of parts by powder metallurgy and their applications.

Moulding and extrusion of plastic, forming and drawing of plastic sheets.

Production of screw threads, rolling, milling, and uses of dies. Production of gears, milling, shaping, and hobbing, finishing of gears.

Unit-IV

Abrasive Machining: Types and classification. Surface, cylindrical, and centreless grinding. Tool and cutter grinders. Grinding wheels, abrasives, bonding processes, selection of grinding wheels. Honing, lapping, and superfinishing methods, polishing and buffing.

Unconventional Machining Methods: Abrasive jet, electric discharge, electrochemical, ultrasonic, electron beam, plasma arc and laser beam machining. Electrolytic grinding, chemical milling.

Practicals

Demonstration/exercises related to forging and sheet metal working. Exercises/study on grinding machines. Exercises/study on non-traditional machining processes.

Text Books/References

1. J.S. Campbell. Principles of Manufacturing Materials and Processes, Tata McGraw-Hill Company Ltd, New Delhi.
2. P.C. Sharma. A Text Book of Production Technology, S. Chand & Co., New Delhi.
4. S.K. Hajra Choudhury and A.K. Hajra Choudhury. Elements of Workshop Technology, Vol. I. Media Promoters & Publishers Pvt. Ltd., Bombay.
5. Pandey and Shan. Modern machining Process, TMH.
6. Amitabha Bhattacharyya. New Technology, Published by the Institution of Engineers, India

ME 224 DYNAMICS OF MACHINES

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Static Force Analysis: Conditions for equilibrium, free body diagrams. Static force analysis of simple four-bar linkages, slider crank mechanisms, cam-follower systems, and gear systems with graphical and analytical methods. Consideration of friction.
Dynamic Force Analysis: Inertia force and torque, D' Alembert's principle, principle of superposition. Graphical and analytical dynamic force analysis of four bar mechanism and slider crack mechanism. Shaking forces and moments. Dynamically equivalent systems, application to single cylinder reciprocating engines. Gas force, bearing loads, shaft torque, shaking forces and moments determination.

Unit-II

Flywheel: Turning moment diagrams, coefficient of fluctuation of speed and energy, mass of flywheel, flywheel applications.
Gyroscopic Forces: Precessional motion, gyroscopic couple. Effect on stability of ships and aeroplanes, effect on four wheeled and two wheeled vehicles negotiating a curve, gyroscopic stabilisation of ships.

Unit-III

Friction and lubrication: Dry friction, static and dynamic friction. Friction on inclined plane, friction of pivots and collars, single and multiple disc clutches. Friction circle of turning pair and friction axis of a link. Rolling friction, antifriction bearings. Viscous and greasy friction. Film lubrication, Tower's experiment, Brone Reynold's theory, Sommerfeld diagrams. Hydrostatic lubrication.

Governor: Types of governors. Analysis of Watt, Porter, Proell and spring loaded governors. Effect of friction, controlling force curves, sensitiveness, stability, hunting, isochronism, and effort of governor. Inertia governors.

Unit-IV

Balancing: Static and dynamic unbalance. Balancing of rotating masses in one and different planes, analytical and graphical methods. Balancing of reciprocating engines, primary and secondary inertia forces. partial primary balancing of locomotives, variation of tractive effort, swaying couple, hammer blow. Balancing of coupled locomotives. Balancing of multicylinder inline and radial engines, direct and reversed crank method, balancing of V engines. Balancing machines.

Text Books/References

1. Joseph E. Shigley and John J. Uicker, Jr. Theory of Machines and Mechanisms, McGraw Hill Inc.
2. P. L. Ballaney. Theory of Machines, Khanna Publishers, Delhi.
3. R. S. Khurmi and J. K. Gupta. Theory of Machines, Eurasia Publishing House (Pvt.) Ltd., New Delhi.
4. H. H. Mabie and C. F. Reinholtz. Mechanisms and Dynamics of Machinery. John Wiley & Sons.
5. Amitabha Ghosh and A. K. Mallik. Theory of Mechanisms and Machines, Affiliated East West Press Pvt. Ltd., Delhi.

ME 225 CAD LAB – I

Cr. Hrs. 2 (0 + 2)

	L	T	P
Credit	**0**	**0**	**2**
Hours	**0**	**0**	**4**

Introduction to Computer Aided Drafting using popular softwares like AutoCad. Drawing entities. Drawing, modifying, viewing, printing, and dimensioning commands. Drawing aids, coordinate systems, layers, hatching, etc. Blocks. Simple 2-D drawing and dimensioning exercises.

Text Books/References

1. AutoCad. Reference Manual
2. George Omura. Mastering AutoCad.

ME 226 STEAM POWER ENGINEERING

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Steam Generators: Natural circulation and forced circulation high pressure boilers viz. Lamont, Loeffler, and Benson boilers. Introduction to super critical pressure boilers. Testing of boiler. Heat balance sheet, problems involving combustion.

Boiler Draught: Boiler draught. Natural draught, height of chimney. Artificial draught, fans. Equivalent evaporation, efficiency and heat balance.

Unit-II

Vapour Power Cycles: Rankine cycle, effect of thermodynamic variables on its efficiency. Reheat cycle. Regenerative cycle, efficiency, disposal of bled steam, condensate. Regenerative water extraction cycle. Binary vapour cycle. Steam for heating and process work, back pressure turbine, pass out or extraction turbine, mixed pressure turbine. Second law analysis of steam power plant.

Unit-III

Condensers: Elements of condensing plant, advantages. Jet, surface, and evaporative condensers. Air in condenser and methods of extraction. Vacuum and condenser efficiency, cooling water requirement, capacity of air pump.

Steam Nozzles: Type of nozzles, steam flow through nozzles, application of SFEE, critical pressure, throat and exit areas for optimum discharge, friction effect. Super saturation phenomenon, effect of variation of back pressure. Theory of steam injectors.

Unit-IV

Steam Turbines: Types and classification. Impulse and reaction turbines. Flow of steam through turbine, blade sections and height. Velocity diagrams, application of SFEE. Diagram, stage and other efficiencies, condition for maximum efficiency. Methods of reducing rotor speed for turbines. Reheating and bleeding of turbines, reheat factor. Turbine

characteristics and performance. Methods of governing, emergency governors.

Turbine Construction Details: Steam turbine components description. Nozzles, rotors, blades and their attachment, turbine glands, couplings. Balancing of axial thrust.

Practicals

1. Study of high pressure boilers.
2. Study of steam turbines.
3. To determine dryness fraction of steam.
4. Study of condensers.
5. Test on steam nozzle. To obtain *P-T* relationship for saturated steam by Mercet boiler.
6. To conduct boiler trial test and obtain its efficiency.
7. Volumetric analysis of dry flue gases by Orsat apparatus.
8. To determine calorific value of coal by Bomb calorimeter.

Text Books/References

1. ML Mathur and FS Mehta. Thermal Engineering, (Vol. I & II, SI Edition), Jain Brothers, New Delhi.
2. R. Joel. Basic Engineering Thermodynamics: Pearson Education.
3. G. Rogers and Y. Mayhew. Engineering Thermodynamics Work and Heat Transfer, Pearson Education.
4. R. K. Purohit. Mechanical Engineering (SI Units), Scientific Publishers, Jodhpur.

ME 311 MECHANICAL VIBRATIONS

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Vibrations: Types of vibrations. Degrees of freedom, continuous and lumped systems, natural frequency, resonance. Simple harmonic motion, vectorial and complex number representation. Fourier series and harmonic analysis.
Undamped Free Vibrations: Formulation of equations of motion for single degree of freedom system by Newton's law, D'Alembert's principle, and by energy approach. Solutions for given initial conditions for simple systems. Free flexural and torsional vibrations. Equivalent stiffness.

Unit-II

Damped Free Vibrations: Types of damping, free damped vibrations of single dof system with viscous damping. Damping coefficient and factor. Overdamped, critically damped, and underdamped systems. Logarithmic decrement. Viscous dampers. Frequency and rate of decay of amplitude with Coulomb damping.
Forced Vibrations: Forced vibrations with constant harmonic excitation, transient and steady state solutions. Magnification factor and phase difference. Forced vibrations with rotating unbalance, reciprocating unbalance, and with motion excitation of support. Non harmonic excitation. Vibration isolation and transmissibility, material for vibration isolation. Principles of vibration measuring instruments.

Unit-III

Multi Degrees of freedom Systems: Introduction to concepts of coupling of equations of motion, principal modes, orthogonality of modes, mode shapes, modal matrix. Free vibrations of simple two degrees of freedom rectilinear and torsional systems. Undamped vibration absorbers.

Approximate and numerical method for multi degrees of freedom systems-Rayleigh's method, Dunkerley's method, and Holzers's method. Application to simple systems. Geared systems.

Unit-IV

Continuous Systems: Discrete vs. continuous systems. Free vibrations of strings, longitudinal and transverse vibrations of beams, torsional vibrations of shafts.

Critical Speeds of Shafts: Whirling of shafts, critical speed of light shaft having single rotor with and without damping, critical speeds of shaft with two rotors. Secondary critical speed.

Practicals

Experimental verification of gyroscopic effect, Experiment on Governors, Balancing experiment, Whirling of shafts, Experiments on single and multiple degrees of freedom systems.

Text Books/References

1. G. K. Grover. Mechanical Vibrations, Nem Chand & Bros., Roorkee.
2. Francis S. Tse, Iwan E. Morse and Rolland T. Hinkle. Mechanical Vibrations, CBS Publishers & Distributors, Delhi.
3. Leonard Merovitch. Elements of Vibrations Analysis (International Edition), McGraw Hill Inc, Singapore.
4. W. T. Thomson. Theory of Vibrations and Applications, Prentice Hall.

ME 312 FLUID MECHANICS

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Introduction: Continuum concept. Viscosity, effect of temperature and pressure. Incompressible and compressible fluids, Newtonian and Non Newtonian fluids, ideal fluid. Surface tension, capillarity, vapour pressure and cavitation.

Fluid Statics: Pressure, units and scales of measurement, general differential equation, manometry. Fluid forces on submerged

surfaces. Buoyant force, stability of floating and submerged bodies, metacentric height.

Governing Equations of Fluid Flow: Flow classifications, stream, streak and path lines. Generalised continuity equation, Euler's equation of motion, Bernoulli's equation, momentum equation, angular momentum equation, and their application to fixed and moving blades, vanes, jets, etc.

Flow Measurement: Free orifice, jet, vena contracta. Orifice in pipes. Mouthpiece, venturimeter, notches and weirs.

Unit-II

Ideal Flow: Irrotational flow, velocity potential, Laplace's equation, stream function. Flow net, vortex and circulation. Potential flow solution for two dimensional problems, superposition, half body, Rankine body, circular cylinder and circular cylinder with circulation. Tormado Method of images, additional methods for obtaining potential flow solution.

Viscous Flow: Equation of motion for viscous fluid, Navier Stokes equations. Laminar and turbulent flow, Reynold's experiment. Simple solution of Navier Stokes equations for laminar flow between parallel plates, circular and annular tubes. Hagen-Poiseuille flow, plane Poiseuille flow and Couttee flow. Turbulent flow, mixing length hypothesis applied to pipe flow, velocity distribution in smooth and rough pipes.

Unit-III

Flow Through Pipes: Head loss and friction in rough and smooth pipes, Darcy-Weisbach equation, variation of friction factor with Reynold's number, Prandtl number. Universal pipe friction flows, Colebrook formula. Loss of head due to sudden enlargements, contraction, entrance, exit, obstruction, bend, pipe fittings. Total energy and Hydraulic gradient lines. Flow through pipe line, pipes in series and parallel. Transmission of power through pipes.

Dimensional Analysis and Dynamic Similitude: Buckingham's theorem, Superfluous and omitted variables. Dimensionless ratios. Reynold, Froude, Mach, Weber, and Euler numbers, and their applications. Similitude, model studies, undistorted model, distorted model, scale effect.

Unit-IV

Boundary Layer: Description of boundary layer, boundary layer thickness, boundary layer separation and control. Prandtl boundary layer equation and solution. laminar boundary layer, momentum equation for the boundary layer on flat plate in uniform free stream with no pressures gradients; Approximate momentum analysis -Laminar boundary layer, Turbulent boundary layer, Viscous sublayer, combined Laminar and turbulent boundary layers.

Flow Round a Body: Drag, skin friction drag, pressure drag, Combined skin friction and pressure drag (profile drag),wave drag, lift induced drag. Flow past sphere and cylinder.

Practicals

Verification of Bernoulli's theorem. Measurement of flow through venturimeter, orifice, notches and mouthpieces, and determining their coefficient of discharge. Flow through pipes and measurement of fluids.

Text Books/References

1. Victor L. Streeter. Fluid Mechanics, McGraw Hill Book Co., Singapore.
2. R. K. Rajaput. Fluid Mechanics and Machines, S. Chand & Co.
3. R. K. Bansal. Fluid Mechanics and Machines,
4. Irving Shames. Mechanics of Fluids, McGraw Hill.
5. R.K. Purohit. Fundamentals of Fluid Mechanics, Scientific Publishers, Jodhpur.

ME 313 MACHINE TOOLS

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Lathes: Classification. Constructional details of centre lathe and its principal parts, accessories, attachments, and work holding devices. Main operations including taper turning and thread cutting, change gear calculation. Lathe tools.

Batch and Mass Production Machines:. Capstan and turret lathes. Automatic machine tools- Single and multispindle automats, their operation and tool layout. Hydraulic tracer controlled machine tools.

Unit-II

Shaper: Classification. Constructional details and principal parts of standard shaper, quick return and feed mechanisms, hydraulic shaper. Shaper tools, work holding devices and main operations.

Planer Machines: Classification, principal parts of standard double housing planer, table drive and feed mechanisms. Main operations, tools, and work holding devices.

Unit-III

Drilling Machines: Classification. Constructional details of sensitive, pillar and radial drilling machines. Work and tool holding devices. Main operations. Tools, twist drill, reamer and tap.

Boring Machines: Classification. Horizontal and vertical boring machines. Precision boring machines, jig boring machines. Principal operations, boring tools, work holding devices.

Broaching Machines and tools.

Unit-IV

Milling Machines: Types and classification. Constructional details and principle of operation of horizontal, vertical, and universal milling machines. Work and cutter holding devices, attachments. Milling cutters. Milling operations and processes. Indexing methods and gear cutting.

Introduction to principles and operations of numerically controlled machine tools, machining centre, transfer machines and methods.

Practicals

Exercises on lathe, shaper, planer, and milling machines.

Text Books/References

1. S.K. Hajra Choudhury and A.K. Hajra Choudhury. Elements of Workshop Technology, Vol. II, Media Promoters & Publishers Pvt. Ltd., Bombay.
2. R.K. Jain & SC Gupta. Production Technology, Khanna Publishers, New Delhi.
3. J.S. Campbell. Principles of Manufacturing Materials and Processes, Tata McGraw-Hill Company Ltd, New Delhi.
4. H.M.T. Publication, Production Technology, Tata McGraw Hill.

ME 314 IC ENGINES

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Introduction: Classification, various engine efficiencies and performance parameters. Basic air cycles, deviations from ideal cycles.

Combustion in S.I. Engines: Ignition limits. Stages of combustion, effect of engine variables on flame propagation, rate of pressure rise. Abnormal combustion, detonation or knocking, effects and control of detonation, theories and chemistry of detonation, effect of engine variables on detonation. Abnormal combustion.

Carburetion: Properties of air-fuel mixtures, mixture requirements for different engine conditions. Transient mixture requirements. Elementary carburettor, calculation of air-fuel ratio. Description of important carburettors. Petrol injection, electronic fuel injection.

Ignition System of SI Engines: Types of basic ignition systems. Firing order, ignition timings, ignition advance mechanisms. Spark plugs. Electronic ignition system.

Unit-II

Combustion in CI Engines: Stages of combustion. Air-fuel ratio in CI engines. Variables affecting delay period. Diesel knock, effect of engine variables, control of diesel knock. Cold starting of CI engines.

Combustion Chambers: Requirements and design principles of combustion chambers, main features of widely used combustion chambers for SI and CI engines.

Fuel injection: Heat release pattern, types of injection systems. Types of fuel pumps, injectors, and injector nozzles. Injection timing.

Unit-III

Engine fuels and Combustion: Fuels for SI engines, gasoline, requirements of ideal gasoline. Effect on engine performance. Knock rating of SI fuels, HUCR, Octane number, research and motor octane numbers. Important properties of diesel fuel. Cetane number, diesel index, Aniline point. Fuel additives or dopes. Exhaust gas analysis.

Two Stroke Engines: Introduction, valve timings. Scavenging processes and parameters, scavenging systems, scavenging pumps.

Introduction to free piston, rotary combustion, dual fuel, and multi-fuel engines. Effect of atmospheric conditions on performance of I.C. Engines. Supercharging, methods and types of super charging.

Unit-IV

Engine Friction, Lubrication and Cooling: Break up of total engine friction, effect of engine variables on engine friction. Lubrication systems. Lubricating oils, classification, properties and service ratings. Oil pumps and filters. Crankcase ventilation. Areas of heat flow and temperature distribution, necessity of cooling. Types of cooling systems, air and water cooling. Thermostatic control. Radiators and cooling fans.

Performance and Testing: Performance parameters. Measurement of speed, fuel and air consumption, brake horse power. Friction horse power measurement methods. Indicated power measurement, high speed indicators. Performance of SI and CI engines, heat balance sheet.

Air Pollution: Introduction to air pollution, causes and control of air pollution.

Practicals

1. Study of 4 stroke and 2 stroke petrol engine.
2. Study of 4 stroke and 2 stroke diesel engine.
3. Study of various types of carburettors.
4. Study of various type of combustion chambers for SI and CI engines.
5. Study of ignition systems for SI engines.
6. Study of fuel injection system of CI engines.
7. Morse test on 4 cylinder petrol engine.
8. Performance test on an automobile engine under variable speed.
9. Study of lubrication system.
10. Study of cooling system.
11. Study of Wankel rotary engine.
12. Study of gas turbine. Exhaust gas analysis.

Text Books/References

1. M. L. Mathur and R. P. Sharma. A Course in Internal Combustion Engines, Dhanpat Rai & Sons, Delhi.
2. Ganesan. IC Engines, TMH.
3. J. Heywood. Internal Combustion Engine Fundamentals, McGraw Hill.

ME 315 MACHINE DESIGN – I

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**1**	**0**

Unit-I

Introduction: Meaning and phases of design, design process, design considerations. Engineering materials and their mechanical properties, BIS designation of materials. Preferred numbers. Factor of safety, selection of allowable stresses. Types of load and stresses, impact loads, theories of failure. Stress concentration, theoretical stress concentration factors and charts. Stress intensity factor and fracture toughness. Fatigue, S-N diaigram, endurance limit and modifying factors, fatigue stress concentration factor, design for fatigue, fluctuating stresses, Soderberg, Goodman and modified Goodman formulae. Surface endurance shear.

Design of Beams and levers.

Unit-II

Design of Detachable Joints: Cottered joints, pinned joints and turnbuckle. Design of bolted joints with and without preload, gasketed joints, design under fatigue loading. Bolted joints subjected to eccentric loading. Design of nuts, types of locking devices.

Design of Curved Members: Design of crane hooks, circular rings, chain rings, chain links, etc.

Unit-III

Design of Permanent Joints: Design of riveted joints, structural and pressure vessel (boilers) riveted joints, joints under eccentric loading. Design of welded joints. Eccentric loading on riveted and welded joints.

Design of columns.

Unit-IV

Design of Shafts, keys, couplings. Design of helical and laminated springs. Fatigue considerations.

Text Books/References

1. V. B. Bhandari. Design of Machine Elements, TMH.
2. Joseph Edward Shigely. Mechanical Engineering Design, McGraw Hill Book Company, Singapore.
3. R. S. Khurmi and J. K. Gupta. A Text Book of Machine Design, Eurasia Publishing House (Pvt.) Ltd., New Delhi.
4. N. C. Pandya and C. S. Shah. Elements of Machine Design, Charotar Book Stall, Anand.

ME 316 INDUSTRIAL ENGINEERING – I

Cr. Hrs. 2 (2 + 0)

	L	T	P
Credit	**2**	**0**	**0**
Hours	**2**	**0**	**0**

Unit-I

Introduction: Historical development, functional areas of business and the need for integrating these through the development of business goals.

Organisation: Meaning of organisation, administration and management. Ownership. Forms of business organisation, sole proprietorship, partnership, joint stock companies, cooperative societies, public enterprises.

Principles of organisation, types of organisation structures. Forms of organisation, line, functional, line and staff, and committee. Authority and responsibility, delegation of authority, span of control. Organisation charts.

Unit-II

Management: Principles and elements of management. Functions of management, planning, organisation, staffing, directing, coordination, and control. Types and levels of management, management structure. Scientific management, development of management thought with reference to the work of Taylor, Gilberth, Mayo and Kurt Lewin.

Unit-III

Personnel Management: Objectives, organisation, functions and responsibilities of personnel management, relationship with other departments. Brief idea about motivation, morale, perception, leadership attitudes, frustration, fatigue, accidents, values, opinion.

Man power Planning, recruitment, selection, job specification and job qualification. Training and placement.

Wage payment System: Job evaluation, merit rating, methods of wage payment, time wages, piece wage system, incentive schemes.

Industrial Relations and Labour legislation: Management union relations, trade union movement, collective bargaining, employees participation in management. Brief ideas about various labour acts.

Unit-IV

Elements of costing and Financial statements: Classification of costs, direct and indirect cost, labour, material and over-head, Prime cost, factory cost, fixed cost, variable cost, increment cost, Allocation of over

head costs. Analysis of Break even chart. Depreciation of plant, building and facilities. Method of computing depreciation.

Text Books/References

1. Banga and Sharma. Engineering Economics and Industrial Organisation. Khanna Publishers, New Delhi.
2. Kumar Surendra. Personnel Management and Industrial Relations. Satya Prakashan, New Delhi.
3. S. Eilon. Elements of Production Planning and Control. Universal Book Corporation Bombay.
4. R Lal. Essentials of Industrial Management. Bhatia Bhawan, Patna.
5. Philippo. Personnel Management.
6. M. Mahajan. (2000). Industrial Engineering & Production Management. Dhanpat Rai & Co. Delhi,

ME 317 CAD LAB – II

Cr. Hrs. 2 (0 + 2)

	L	T	P
Credit	**0**	**0**	**2**
Hours	**0**	**0**	**4**

Solid modeling using popular software like Mechanical Desktop, Inventor, CATIA, Pro-Engineer, or Ideas.

Drawing curves and surfaces. Extruded solids. 3-D primitives. 3-D operations like union, intersecting, etc. 3-D transformation. Making a part from sketch, Assembling different parts. Simple 3-D modeling exercises.

The students is expected to master modeling simple parts using any one of the packages as per availability.

Text Books/References

Reference Manuals of the relevant software.

ME 321 HEAT TRANSFER

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Introduction: Modes and mechanism of heat transfer, basic laws. Conductivity, heat transfer coefficients.

Conduction: General differential equation of conduction. Steady state one dimensional conduction through plane and composite slabs, cylinders and spheres with and without heat generation including viscous heating, dielectric heating and linearly varying heat generation. Electrical analogy.

Insulation: Selection of insulation material and thickness of insulation. Factors influencing conductivity. Critical thickness of insulation. Thickness of insulation to prevent freezing/condensation in pipes.

Unit-II

Fins: General equation for fin. Heat transfer through fins of rectangular, triangular and parabolic profile. Effectiveness and efficiency of fin, Biot number, optimum dimensions and arrangement of fins. Thermometer well, related applications of fin theory in heat transfer from pipe flow, different temperature heat sources at ends of rods with heat generation and convection, etc.

Unsteady State Unidirectional Conduction: Newtonian heating and cooling, response of thermocouple.

Unit-III

Forced Convection: Introduction, equation of laminar boundary layer on a flat plate and in a tube, laminar forced convection on a flat plate and in a tube. Reynold's analogy. Dimensional analysis, empirical relationships.

Natural Convection: Dimensional analysis. Convection with phase change, empirical relationships, description of condensing flow, theoretical model of condensing flow. Boiling heat transfer.

Heat Exchangers: Types of heat exchangers. Log Mean Temperature Difference (LMTD). Overall heat transfer coefficient, fouling factor.

Condensers and evaporators. Heat exchanger performance, effectiveness and Number of Transfer Units (NTU). LMTD and NTU methods, analysis restricted to parallel and counter flow heat exchangers.

Unit-IV

Radiation: Theories of radiant heat exchange. Absorption, transmission, and reflection of radiant energy. Emission, black body and monochromatic radiation, Planck's law, total emissive power and Stefan Boltzman's law. Grey bodies, Kirchoff's law, Wien's law. Solid angle and intensity of radiation, Lambert's cosine law. Radiation exchange between black surfaces, geometric configuration factor and its determination for simple geometries. Grey body radition exchange between surfaces. Electrical analogy and its application to simple problems. Non luminous gas radiation. Errors in temperature measurement due to radiation. Combined heat transfer coefficient with radiation and convection.

Practicals

1. To measure thermal conductivity of metal bars.
2. To measure thermal conductivity of insulating powders.
3. To study temperature distribution along the length of fin in natural and forced convection.
4. Experiment on heat transfer in forced convection.
5. Experiment on heat transfer in natural convection.
6. To determine emissivity of given surface.
7. To determine Stefan-Boltzman constant and verify the law.
8. To determine rate of heat transfer, LMTD and overall heat transfer coefficient for parallel flow heat exchanger.
9. To determine rate of heat transfer, LMTD and overall heat transfer coefficient for counter flow heat exchanger.
10. To study response of thermocouple.

Text Books/References

1. S. Domkundwar. A Course in Heat & Mass Transfer, Dhanpat Rai & Sons, Delhi.
2. J. P. Holman. Heat Transfer, McGraw Hill.
3. S.P. Sukhatme. A Text Book on Heat Transfer, Orient Longman.
4. Y. Cenegel. Heat Transfer - A Practical Approach, Mcgraw Hill.

ME 322 FLUID MACHINES AND SYSTEMS

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit -I

Introduction: Application of momentum and moment of momentum equations to flow through hydraulic machinery, Euler's fundamental equation. Classification of machines.

Hydraulic Turbines: Classification of turbines. Impulse turbine, constructional details, velocity triangles, power and efficiency , governing of Pelton wheels. Reactions turbines, Francis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculation, degree of reaction, draft tube, cavitation.

Principles of Similarity: Unit and specific quantities, performance characteristics, Selection of Water turbines. Thomas cavitation factor.

Unit-II

Reciprocating Pumps: Reciprocating pump, theory, indicator diagram, slip, effect of friction and acceleration, theory of air vessel.

Rotodynamic Pumps: Classification. Centrifugal pumps, vector diagrams, specific speed, head, power, and efficiency calculations. Model testing and performance characteristics. Selection of pumps.

Unit-III

Miscellaneous Fluid Machines: Gear Pumps, vane pumps, hydraulic ram, jet pumps, well pumps, deep well pumps, pumps of hydraulic pumped storage plants, air lift pump. Reversible hydraulic machines (pump turbines), types, construction and their characteristics.

Hydraulic Power Transmission: Hydro-kinetic system, function, methods of control, constant and variable delivery systems, common uses of hydrostatic systems. Hydro kinetic transmission systems, theory of hydraulic couplings and torque converters, operating characteristics, common uses of hydro kinetic systems.

Unit-IV

Experimental determination of pump characteristics, pump characteristics curve from specific speed. Parallel and series connection

of pumps to common pipe line. Cavitation and abrasive wear of pumps. Non Stable operation of pump.

Fluidics: Common terms, writing the logic functions in the form of algebra, The basic principle and working of devices in common use, wall attachment, jet interaction, laminar turbulent effect, vortex effect and moving part devices. Applications.

Practicals

Study of and obtaining various characteristic curves of Pelton, Francis, and Kaplan turbines.

Study of and obtaining performance curves for centrifugal and reciprocating pumps.

Text Books/References

1. Victor L. Streeter. Fluid Mechanics, McGraw Hill.
2. R. K. Rajaput. Fluid Mechanics and Machines, S. Chand & Co.
3. R. K. Bansal Fluid Mechanics and Machines,
4. Jagdish Lal. Fluid Machines
5. Irving Shames. Mechanics of Fluids, McGraw Hill.
6. R.K. Purohit. Fundamentals of Fluid Mechanics, Scientific Publishers, Jodhpur.

ME 323 INDUSTRIAL INSPECTION AND QUALITY CONTROL

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Interchangeable Manufacture: Deviations, limits of size, tolerances, allowances, types of fits, hole basis and shaft basis systems, BIS system of limits and fits. Design of limit gauges and gauge materials, numerical problems.

Non-destructive Testing: Radiography, magnaflux and fluorescent penetrant inspection, eddy current and ultrasonic tests

Alignment testing of lathes. Acceptance testing of machine tools.

Unit-II

Metrology: Dimensional and geometrical accuracy of machined surface, types of errors. Standards of measurement. Gauge blocks. Mechanical, electrical, optical and pneumatic type comparators. Auto-collimators, optical interferometry, measurement of screw threads and gears. Surface roughness specification and methods of measurement

Unit-III

Quality Control: Quality improvement, need of Control, process capability analysis, quality capability study. Statistical quality control; objective, applications, organization, cost aspects, theory of statistical tolerances.

Quality circles. Introduction to TQM; introduction to international quality certifications.

Unit-IV

Statistical Quality Control: General theory of control charts, group control charts, control charts with variable sub-group *size,* moving average and moving range charts, acceptance control charts cumulative sum control charts and difference control charts.

Sampling Plans: Acceptance sampling, single, multiple and sequential sampling plans, multi-level continuous sampling, acceptance sampling by variables, sampling plans using different criteria, comparison of various types of sampling plans.

Practicals

Exercises/study on linear and angular measurements using slip gauges and sine bar.

Measurement of screw threads and gears. Experiments on ultrasonic flaw detection and measurement. Surface roughness measurement, comparators, etc. Drawing of control charts.

Text Books/References

1. E. L. Grant. Statistical Quality Control.
2. H.M.T. Publication, Production Technology, Tata McGraw Hill.
3. R.K. Jain. Engineering Metrology, Khanna Publishers, New Delhi.
4. A. Mitra. Quality control and improvement, Pearson Education, Delhi.

ME 324 REFRIGERATION AND AIR CONDITIONING

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Refrigeration: Principles of refrigeration, ice refrigeration, freezing mixtures, cooling by gas, reversible expansion, evaporation. Units of refrigeration, coefficient of performance. Heat pump.

Air Refrigeration Systems: Second law of thermodynamics applied to the refrigeration. Reversed Carnot cycle, Bell-Coleman cycle, Aircraft refrigeration.

Mechanical Vapour Compression Systems: Theoretical vapour compression system, undercooling, dry and wet compression. Deviation of actual cycle from ideal cycle. Volumetric efficiency of compressor and its effect on refrigeration cycle. Flash chambers and precoolers, Compound compression with intercooling, water intercooling and flash intercooling.

Unit-II

Vapour Absorption Systems: Vapour absorption cycle. Simple and practical vapour absorption system, Electrolux refrigerator.

Water vapour, steam jet, and thermo-electric refrigeration systems.

Low Temperature Refrigeration: Cascading and liquification of gases.

Unit-III

Refrigerants: Desirable properties of refrigerants, comparative study of the properties of important refrigerants. Eco-friendly refrigerants.

Refrigeration Equipment: Discussion of compressors, condensers, evaporators, expansion devices, cooling towers.

Unit-IV

Psychrometry: Thermodynamic properties of moist air, perfect gas relationship for approximate calculation. Adiabatic saturation process, psychrometric chart and its use, elementary psychrometric processes.

Air Conditioning: Types of airconditioning, Evaluation of comfort, comfort charts. Estimation of airconditioning load. Outside and inside design conditions, condition line, sensible heat factor. Cooling and humidification, Apparatus Dew Point and bypass factor. Humidification and dehumidification methods, air washers. Air conditioning systems, plant layout, controls, transmission and distribution of air.

Practicals

1. Study of vapour compression and vapour absorption systems.
2. Study of Electrolux refrigerator.
3. Study of refrigeration accessories.
4. Study of window airconditioner.
5. Study and determining COP of ice plant.
6. Study and determining of COP of water cooler.
7. To determine COP of vapour compression refrigeration rig.
8. Study of charging of vapour compression refrigeration system.
9. Study of leak detection devices.
10. Study of domestic refrigerator.
11. Study of evaporative cooling system.
12. Study and test on heat pump.

Text Books/References

1. S Domkundwar and S C Arora. Refrigeration and Air Conditioning, Dhapat Rai & Sons, Delhi.
2. JL Threlkeld. Thermal Environmental Engineering, Prentice Hall.
3. Arora. Refrigeration and Air-conditioning, TMH.
4. W. Stoecker. Refrigeration and Air-conditioning, McGraw Hill.

ME 325 MACHINE DESIGN – II

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**1**	**0**

Unit-I

Design of IC Engine Components: Design of crank shaft, connecting rod, piston.

Design of clutches and brakes.

Unit-II

Design of Power Transmission Elements: Rope and chain drives, flat and V belt drives, Gear transmission systems using spur, helical, bevel and worm gears.

Unit-III

Design of screw motion mechanisms, screw jack, toggle jack, lead screw etc.
Bearings: Design of journal bearings. Selection of ball and roller bearings.

Unit-IV

Design of pressure vessels: Thin cylinders and spheres. Design of thick cylindrical shells subjected to internal and external pressures. Compound cylinders. Design of cylinder heads and cover plates.

Design of flywheels and rotating discs.

Text Books/References

1. V. B. Bhandari. Design of Machine Elements, Tata McGraw Hill, New Delhi.
2. Joseph Edward Shigely. Mechanical Engineering Design, McGraw Hill Book Company, Singapore.
3. R. S. Khurmi and J. K. Gupta. A Text Book of Machine Design, Eurasia Publishing House (Pvt.) Ltd., New Delhi.
4. N. C. Pandya and C. S. Shah. Elements of Machine Design, Charotar Book Stall, Anand.

ME 326 INDUSTRIAL ENGINEERING – II

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

Unit-I

Plant Location: Major factors, influencing the location of an industry and choice of site.
Plant Layout: Principles of plant layout, use of travel charts. Flow Pattern, Process Layout and Product Layout and combination, Line balancing.

Unit-II

Materials Management: Field and scope of material management. Material Planning and programme. Types of inventories. Inventory control. Vendor development, rating, standardisation and coding. Procedure for purchase and storage.
Materials Handling: Functions, engineering and economic factors, relationship to plant layout. Selection, operation and maintenance of material handling equipment. Types of equipment

Unit-III

Plant Maintenance: Maintenance polices, preventive, Breakdown and corrective.

Production Planning and Control: Types of production, Function of production planning and control, planning. Pre-planning, sales forecasting, routing. scheduling, despatching and control, Gantt charts. Project planning. Introduction to network techniques, CPM and PERT, time estimates.

Unit-IV

Work Study: Concept of productivity, method study, motion economy, process chart symbols. Flow diagram, operation analysis and operation chart, SIMO charts. Work measurement, use of stop watch procedure for time study data. Use of time study data with practical applications. Performance rating.

Value engineering: Value engineering and value analysis, product enrichment.

Practicals

Stop watch time study- determining standard time. Performance rating. Bolt and washer assembly experiment. Pegging board experiment.

Text Books/References

1. Memoria and Agarwal. Business Organisation
2. Buffa. Operations management. John Wiley, New York.
3. R.M. Barnes. Time and Motion Study, Asia Publication.
4. Starr & Miller. Inventory Control - Theory & Practice. Prentice Hall India.

ME 327 COMPUTER APPLICATIONS IN MECHANICAL ENGINEERING

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**0**	**2**

Writing Programmes in C and/or MATLAB for numerical solutions of problems related to mechanical engineering. Use of statistical packages, data presentation packages, etc.

Text Books/References

Reference Manuals of the relevant software.

FOURTH YEAR B.TECH. (VII SEMESTER)

ME 411 CAD/CAM

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Design process, application of computers for design, benefits of CAD. CAD system components.

Computer graphics: Software configuration of a graphics systems, function of a graphic package, constructing the geometry, transformations. Wire frame versus solid modelling.

Introduction to numerical control, basic components of NC system. Numerical control, computer numerical control and direct numerical control. Mechanical design of CNC machine tools. MCU configuration.

Unit-II

NC coordinate system, Tooling for CNC. Motion control systems, drives, encoders, etc.. Point to point, straight cut and contouring mode. Adaptive control machining systems.

Part programming: Fundamentals, punched tape in NC, tape coding and format. Manual part programming using G & M codes for – drilling, milling and turning; computer assisted part programming- APT language structure; simple exercises.

Unit-III

Group technology: Part families, part classification and coding systems, group technology machine cells, benefits of group technology.

Flexible manufacturing systems: Introduction, components of FMS, application work stations. Computer control and functions –planning, scheduling and control of FMS.

Unit-IV

Robot technology: Robot physical configurations, basic robot motions, actuators, end effectors and robot sensors. Robot programming, work cell design, control and interlocks,

Computer-integrated manufacturing: Types of manufacturing systems, machine tools and related equipment, material handling system, benefits of CIMS.

Practicals

Use of popular analysis and simulation packages (for example ANSYS, CATIA, etc.) for engineering analysis related to mechanical engineering. Use/Demonstration of CNC programming and simulation software. The students will be required to undertake a couple of minor projects in analysis and design using computers.

Texts/References

1. Steven Harrington. Computer Graphics- A Programming Approach, McGraw Hill.
2. D.F. Rogers and A. Adams. Mathematical Elements for Computer Graphics, McGraw Hill Inc., New York.
3. I.D. Faux and M.J. Pratt. Computational Geometry for Design.
4. M. P. Groover and E.W. Zimmers: CAD/CAM- Computer Aided Design and Manufacturing, PHI, New Delhi.
5. Surendra Kumar and A.K. Jha: Technology of Computer Aided Design and Manufacturing CAD/CAM, Dhanpat Rai & Sons, Delhi.

ME 412 INSTRUMENTATION AND CONTROL

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Measurement: Generalised measurement system, instrument classification, standards of measurement, calibration.

Static and Dynamic Characteristics: Static performance parameters. Impedance loading and matching. Types of errors and uncertainties, propagation of uncertainties, statistical treatment of uncertainties, single sample and multi sample data, goodness of fit, dynamic response. Compensation.

Transducer and Signal Conditioning Elements: Various Primary and secondary transducers. Digital transducers. Introduction to signal conditioning elements.

Terminating Devices: Analog electric meter indicators, electronic counters, digital multimeters, cathode ray oscilloscope, oscillographs, galvanometric type and servo type potentiometric recorders, x-y plotters, single point and multi-point recorders.

Unit-II

Strain and Stress Measurement: Resistance strain gauges, backing materials, bonding materials and methods, gauge factor, gauge configuration, strain gauge bridge circuits, temperature compensation, calibration, semiconductor (piezo-electric) strain gauge. Indicating device. Use of strain gauges on rotating shafts. Strain gauge rosettes.

Force and Torque Measurement: Hydraulic and pneumatic load cells. Strain gauge and piezo-electric based load cells. Separation of force components, calibration. Torque transducers.

Pressure Measurement: Bourdon type gauge, Low and high pressure measurement, Mcleod gauge, thermal conductivity gauge, ionisation gauge, strain gauge, pressure cells. Dynamic pressure measurement. Calibration and testing.

Unit-III

Temperature Measurement: Bimetallic, pressure, metal resistance thermometers. Thermisters, thermo-electric thermometering. Thermocouple, laws of thermocouple, calibration. Error compensation. High speed temperature measurement. Pyrometry, optical pyrometers.
Displacement Measurement: Transducers for displacement measurement, LVDT, resistance strain gauge. Angular velocity measurement, photocell method, Stroboscope.
Vibration Measurement: General theory of seismic instruments. Vibration pick-ups, accelerometers, transducers for vibration pickups and accelerometers, calibration. Frequency measurement, FFT analyser.

Unit-IV

Flow Measurement: Positive displacement and obstruction meters, measurement by drag effects. Hot wire and magnetic flow meters. Flow visualisation methods - Schileren technique, pressure probes.
Miscellaneous Measurement: Water level measurement. Acoustic measurement, sound level meter.
Control Systems: Concept of open and closed loop system. Feedback. Servomechanisms and servosystems. Representation of control systems, block diagrams. Hydraulic, electric, and pneumatic systems. Concept of stability.

Practicals

Experiment on temperature measurement using thermocouple and calibration. Temperature measurement using RTD and thermisters. Water level measurement using capacitive transducer, strain measurement, characteristics of LVDT, vibration measurement, pressure gauge calibration, force measurement.

Text Books/References

1. B.C. Nakra and K. K. Chaudhry. Instrumentation Measurement and Analysis, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. D. S. Kumar. Mechanical Measurements and Control, Metropolitan, New Delhi.
3. Thomas G Beckwith, N. Lewis Buck, and Roy D Marangoni. Mechanical Measurements, Narosa Publishing House, New Delhi.
4. K. Ogate. Modern Control Engineering, Prentice Hall of India.

ME 413 PRODUCTION ENGINEERING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Mechanics of Metal Cutting: Geometry of single point and multi point cutting tools, tool signature systems. Orthogonal and oblique cutting. Mechanism and geometry of chip formation, types of chips. Forces on chips. Velocity, stress, strain and strain rate, power, and energy relationships in orthogonal cutting. Theories on metal cutting. Friction and thermal aspects, measurement of cutting force and chip-tool interface temperature. Mechanics of multipoint cutting tools viz. milling, drilling and broaching tools.

Unit-II

Theory of Machinability: Evaluation of machinability, tool life, tool failure. Mechanisms of tools wear, effect of cutting parameters, surface finish. Economics of machining, optimum cutting speed. Cutting tool materials and their characteristics, chip breakers, cutting fluids and their applications.

Unit-III

Metal Working Analysis: Fundamentals of theory of plasticity, flow conditions, plane strain criterion, friction in metal working. Elementary analysis of wire drawing, tube drawing, rod and strip drawing. Theory of forging. Elementary theory of rolling, Nadai's theory of rolling, rolling power requirement calculation.

Unit-IV

Tool Design: Design Principles of forging and sub-setting dies, elements of design of sheet metal press tools and dies. Design of single point cutting tools, form tools, and milling cutters.

Jigs and Fixtures: Introduction, design considerations and materials. Principles of location. Clamping and locating devices. Drilling jigs and bushes. Classification and types of milling fixtures.

Safety Engineering: Safety devices in production shops, safety codes.

Text Books/References

1. PC Pandey and CK Singh. Standard Publishers Distributors, Delhi.
2. R.K. Jain & SC Gupta. Production Technology, Khanna Publishers, New Delhi.
3. H.M.T. Publication, Production Technology, Tata McGraw Hill.
4. R.V. Rao. Metal Cutting and Machine Tools, S.K. Kataria & Sons, Delhi.

ME 414 POWER PLANT ENGINEERING

Cr. Hrs. 2 (2 + 0)

	L	T	P
Credit	**2**	**0**	**0**
Hours	**2**	**0**	**0**

Unit-I

Introduction: Introduction to generation of electrical power, sources of energy, comparative merits, principal types of power plants. Review of growth of power and development of different types of power plants in India, future possibilities.

Hydro Electric Power Plants: Site selection, classification, different types of hydro electric power plants and their field of use. General layout of storage type of plant. Primemovers, selection of turbine.

Unit-II

Steam Power Plants: Selection of site, general layout of plant. Supply, storage and handling of coal. Coal feeding and burning methods, related equipment, pulverised fuel systems and furnaces. Ash handling and dust collectors. Draught systems, condensers, spray ponds and cooling towers, feed water treatment. Steam pipe materials, types of joints and fittings, expansion joints and pipe lagging. Commissioning and testing of power plants.

Diesel Power Plants: Fields of use, components of diesel electric power plant, types of diesel engines used, performance of diesel electric power plant, comparison with steam power plants.

Unit-III

Gas Turbine Power Plants: Components of gas turbine power plant, open cycle and closed cycle plants, choice of working fluid, arrangement of plant components. Combined gas and steam power plant. Comparison with diesel and steam power plants.

Nuclear Power Plants: Elementary concepts of physics of energy generation by nuclear fission. Nuclear reactor types and classification, boiling water reactor, gas cooled reactor, analysis of steam-gas system, organic cooled moderate reactors, liquid metal cooled reactors. Liquid fuel reactors, breeders and fast reactors. Radiation shielding, radio-active waste disposal, safety aspects. Selection of site. Nuclear fuel production and handling.

Unit-IV

Unconventional Methods of Power Generation: Introduction to solar energy and its utilisation, solar cells, thermo-electric and thermionic

devices, fuel cells, magnetohydrodynamic energy conversion, geothermal, tidal and wind power plants.

Power Plant Economics: Plant costs. Influence of interest rate, depreciation, operating costs on the selection of equipment. Incremental cost. Comparison of operating costs of thermal, hydel and nuclear power plants. Different systems of tariff. Load prediction and curves. Influence of load factor, capacity factor, utilization factor and diversity factor on plant location and selection of unit sizes.

Text Books/References

1. S. Domkundwar and S. C. Arora. A course in power plant engineering, Dhanpat Rai & Sons, Delhi.
2. P.K. Nag. Power Plant Engineering – Steam & Nuclear, TMH.
3. Skrotzki. Power Station Engineering & Economy, McGraw Hill.

ME 415 DESIGN ENGINEERING

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

Unit-I

Introduction to Design Engineering: Morphology of design, need analysis, specification of a problem. Problem formulation and problem analysis, design process and design cycle, creative design and introduction to decision making. Analysis of the product, standardization, simplification. Basic design considerations.

Design for Production: Producibility requirements in the design of machine components. Design for forging, casting, machining ease and powder metallurgical parts.

Unit-II

Strength, stiffness and rigidity considerations in product design.

Design Optimisation: Search for alternative solution and optimization aspects in design, qualitative discussions of various optimisation techniques.

Unit-III

Human factors in engineering design: Aesthetic and ergonomic considerations. Design of controls and displays.

Value Engineering: Nature and measurement of value, maximum value, normal degree of value, importance of value, the value analysis job plan. Steps to problem solving and value analysis, value analysis tests, material and process selection in value engineering.

Unit-IV

Economic Factors Influencing Design: Product value. Design for safety, reliability and environmental considerations. Economic analysis, profit and competitiveness, break-even analysis. Economics of a new product design.

Modern Approaches to Product Design: Concurrent Design, Quality Function Deployment (QFD).

Practicals

Creative Design Project: A comprehensive design of a machine/device to perform a given task and/or a computer aided design of a machine or machine component to be done as a project during the semester.

Text Books/References

1. Chitale and Gupta. Product Design and Manufacturing, Prentice Hall of India.
2. K. T. Ulrich and S.D. Eppinger. Product Design and Development, McGraw-Hill.

ELECTIVE - I

ME 416 (a) FINITE ELEMENT METHOD

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Review of matrix algebra, theory of elasticity, stress-strain relations, strain-temperature relations, plane stress, plane strain, axisymmetric case.

Introduction to FEM with direct or stiffness formulation for bar problem. Element stiffness matrix, assembly, imposition of boundary conditions, solution of global system, stress and support reaction computation.

Computation details, storage schemes for global matrices. Solution of equations in static analysis. Gauss elimination, Cholesky's factorisation.

Unit-II

Principle of stationary (or minimum) potential energy, principle of virtual work. Rayleigh-Ritz method. Galerkin method. Variational formulation of FEM. Piecewise polynomial interpolation. Shape functions, degree of continuity. Shape functions for C^0 and C^1 elements. Lagrangian and Hermite interpolations. General displacement based formulation for structural problems. Consistent element nodal loads. Equilibrium and compatibility in FE model. Convergence requirements.

Finite element formulation for one dimensional bar and heat transfer problems. Linear and quadratic elements. Natural coordinates, isoparametric formulation.

Unit-III

Finite element formulation of one dimensional beam problem from minimum potential energy and Galerkin approach. Beam element. Coordinate transformations, truss and frame elements. Application to simple beam, truss and frame problems.

Unit-IV

Finite element formulation for two dimensional structural and heat transfer problems – minimum potential energy and Galerkin approaches. Natural (area) coordinates. Linear triangular element for structural (CST element) and heat transfer problems. Plane bilinear element. Isoparametric plane bilinear and triangular elements. Numerical integration, Gauss quadrature. Jacobian matrix.. Applications to simple stress analysis and heat transfer problems (restricted to CST element only).

Text Books/References

1. T. R. Chandrupatla and A. D. Belegundu. Introduction to Finite Elements in Engineering, Prentice Hall of India, New Delhi.
2. R. D. Cook, D.S. Malkus and M.E. Plesha. Concepts and Applications of Finite Element Analysis, John Wiley & Sons.
3. P. Sheshu. Text Book of Finite Element Analysis, Prentice Hall of India.
4. K.J. Bathe. Finite Element Procedure, Prentice Hall of India.

ME 416 (b) COMPUTER AIDED DESIGN

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Design process, application of computers for design, definition of CAD, benefits of CAD. CAD system components. Computer hardware for CAD. Display, input and output devices.

Unit-II

Optimisation methods in design. General techniques, exact and iterative techniques. Optimal design of elements and systems. Applications to design of forging, shafts, gears, etc. Role of optimisation techniques and finite element method in CAD.

Unit-III

Computer Graphics: Graphics primitives, display file, frame buffer, display control, display processors. Line generation, graphics software. Points and lines, DDA and Bresenham's line algorithms, antialiasing lines. Polygons, filling of polygons. Bresenham's algorithm for drawing circle and ellipse. Text primitive. Other primitives. Windowing and clipping, viewport. Homogeneous coordinates. Transformations.

Unit -IV

Planar and space curves design. Analytical and synthetic approaches. Parametric and implicit equations. B-spline and Beizer curves. Modelling of biparametric freeform surfaces. Coons and Beizer surface patches. Surface manipulation techniques.

Geometric modelling techniques. Wire frames. Introduction to solid modelling.

Text Books/References

1. D.F. Rogers and A. Adams. Mathematical Elements for Computer Graphics, McGraw Hill Inc., New York
2. I.D. Faux and M.J. Pratt. Computational Geometry for Design and Manufacture, John Wiley & Sons, NY.
3. Steven Harrington. Computer Graphics- A Programming Approach, McGraw Hill.
4. M. P. Groover and E.W. Zimmers. CAD/CAM- Computer Aided Design and Manufacturing, PHI, New Delhi.
5. Surendra Kumar and A.K. Jha. Technology of Computer Aided Design and Manufacturing CAD/CAM, Dhanpat Rai & Sons, Delhi.

ME 416 (c) STRESS ANALYSIS AND EXPERIMENTAL METHODS

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Components of stress and strain, their principal values and invariants. Stress tensor. Stress components along arbitrary plane, state of stress referred to principal axes. Octahedral stresses. Hydrostatic and pure shear states. Mohr's circles for three three-dimensional state of stress. State of strain at a point, strain components. Cubic dilation. Principal axes and strains. Strain deviator and its invariants. Plane stress and strain states. Stress-strain relations for linearly elastic solids, generalised Hooke's law, relation between elastic constants. Differential equations of equilibrium, boundary conditions, compatibility conditions. Equations of equilibrium in cylindrical coordinates, axisymmetric and plane stress.

Unit-II

Airy's stress function. Simple 2-D problems, bending, torsion, and axisymmetric problems.

Complex variable approach, complex representation of stresses, displacements and applied boundary loads. Different methods of solution of 2-D problems for infinite plates with simply connected regions.

Unit-III

Experimental methods of stress analysis. Brittle coating method, crack patterns produced by direct loading, refrigeration method, releasing method, effect of coating thickness and environment.

Photoelasticity methods, behaviour of light, plane polarised and circular polariscope, isochromatic and isoclinic fringe patterns for two dimensional photoelasticity, three dimensional photoelasticity, model slicing and shear difference method, birefringent coating method.

Unit-IV

Strain measurement method, types of gauges, electric strain gauge, strain rosette analysis, three element, delta, four element rosette, strain gauge circuits and recording instrument.

Moire fringe technique, surface strain measurements and flexural studies. Grid analysis. X-ray techniques and holography. Motion measurements.

Text Books/References

1. S. P. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw Hill.
2. N.I. Mushelishvili. Some Basic Problems of Theory of Elasticity, Noordhoof, Netherlands.
3. L.S. Srinath. Advanced Mechanics of Solids, TMH.
4. J.W. Dally and W.F. Riely. Experimental Stress Analysis, McGraw Hill.
5. G.S. Holister. Experimental Stress Analysis, Cambridge University Press.

ME 416 (d) TRIBOLOGY

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit -I

Metrology of surfaces. nature of friction and wear processes. Coatings for wear resistance. Theory, testing and control of corrosion.

Unit-II

Lubricants and bearing materials. Hydrodynamic lubrication. Steady state and dynamically loaded bearing design.

Unit-III

Elastohydrodynamic lubrication, rolling element bearings and gear lubrication.

Unit-IV

Lubrication problems at certain extreme environment conditions, e.g., pressure, temperature and vacuum. Experimental techniques in tribology.

Text Books/References

1. E.R. Braithwaite. Solids, Lubricants and Surface, Pergamon.
2. F.P. Bowden and D. Tabor. Friction and Lubrication of Solids, Oxford University Press.
3. A. Cameron. Principles of Lubrications, Longmans.

ME 416 (e) VIBRATION AND NOISE CONTROL

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Vibration theory, vibration of one degree-of-freedom systems. Two and multi degree of freedom systems. Transient vibrations. Vibration of beams. Langrange's equation.

Unit-II

Basic noise theory, noise and vibration criteria, sound waves and their propagation, acoustic impedance, noise analysis, transmission of noise, human response to noise.

Unit-III

Vibration and noise measuring and analysing instruments. Principle of vibration and noise control.

Unit-IV

Numerical treatment of vibration and noise problems. Analysis of a practical problem.

Text Books/References

1. W.T. Thomson. Theory of Vibration and Applications, Prentice Hall.
2. R.F. Steidl. An Introduction to Mechanical Vibration, John Wiley and Sons.
3. L.L. Beranek. Noise Reduction, McGraw Hill.

ME 416 (f) FRACTURE MECHANICS

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Introduction to Griffth's surface energy and Irwin's stress intensity factor. Stress analysis of fracture, Westegaard's and William's stress functions.

Unit-II

Analytical, numerical and experimental methods of determining stress intensity factors. Macroscopic theories in crack extension. Mixed mode fracture mechanics, fracture mechanics based design and fracture control plans.

Unit-III

Fatigue crack growth. Elastic-plastic fracture- small scale yielding. J-integral. Stationary crack tip fields. J-integral testing.

Unit-IV

Engineering approach to plastic fracture. Ductile fracture criterion. J-controlled crack growth and stability.

Text Books/References

1. D. Broek. Elementary Engineering Fracture Mechanics, Noordhoff.
2. A.P. Parker. The mechanics of fracture and Fatigue, an Introduction, E. and F.N. Spoon Ltd. London.
3. S.T. Rolfe and J.M. Barson. Fracture and Fatigue control in Structures, Prentice Hall Inc., New Jersy.

ME 416 (g) OPTIMIZATION METHODS IN ENGINEERING DESIGN

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Need for optimisation and historical development. Classification and formulation of optimisation problems, classical optimisation methods, differential calculus, Lagrangian theory, Kuhn Tucker condition.

Unit-II

Unconstrained minimisation techniques, one dimensional minimisation techniques Fibonnacci, Goldern section and quadratic interpolation methods.

Unit-III

Multi-dimensional minimisation, Univariate, Conjugate direction, gradient and variable metric methods. Constrained minimisation techniques, penalty function methods, feasible direction and gradient projection methods. Introduction to geometric programming.

Unit-IV

Linear programming and simplex method. Examples and applications of the above methods in the recent engineering design literature.

Text Books/References

1. S.S. Rao. Optimisation-Theory and Applications, Wiley Eastern Ltd.
2. R.L. Fox. Optimisation Methods for Engineering Design, Addison Wesley.
3. W.I. Zangwill. Non-Linear Programming, A Unified Approach, Prentice Hall.

ME 416 (h) DESIGN FOR FATIGUE AND FRACTURE

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Introduction to fatigue and fracture of machine elements, necessity of designs based on fatigue and fracture.
High cycle fatigue and low cycle fatigue, fatigue data representation, parameters influencing fatigue strength and life, fatigue phenomena, various stages of fatigue process.

Unit-II

Designs based on static properties and dynamic properties of materials, fatigue design procedures, preventing fatigue failures.

Unit-III

Brittle fractures, modes of fracture, linear elastic fracture mechanics, determination of stress intensity factor, fracture toughness, testing, elastic plastic fracture mechanics.

Unit-IV

Design for fracture. Fracture mechanics and fatigue crack propagation. Failure analysis, investigation methods.

Text Books/References

1. L. Sors. Fatigue Design of Machine Components, Pergamon Press.
2. S. T. Rolfe and J.M. Barsom. Fracture and fatigue Control in Structures, Prentice Hall.
3. D. Broek. Elementary Engineering Fracture Mechanics, Noordhoff.
4. A.F. Madayag. Metal Fatigue- Design and Theory.

FOURTH YEAR B.TECH. (VIII SEMESTER)

ME 421 GAS DYNAMICS AND TURBINES

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Elementary Gas Dynamics: Integral equation of conservation of mass, momentum, and energy as applied to control volumes. One dimensional flow equation, sonic velocity, Mach number and waves. Isentropic flow of perfect gas, stagnation properties. Isentropic flow through converging and converging-diverging nozzles, critical pressure, choking, operation under varying pressure ratios. Adiabatic flow with friction in constant area ducts, Fanno relations. Normal shock, formation of shockwaves, governing equations.

Unit-II

Gas Turbine Cycles: Carnot cycle, Joule cycle, Sterling cycle, Brayton cycle, Ericsson cycle, Atkinson cycle. Closed and open cycles. Cycles with regeneration, heat exchanger, intercooling and reheating. Deviation from ideal cycle, cycles with multistage compressions, losses in actual cycles. Various efficiencies, polytropic efficiency and turbine performance.

Combustion Systems: Types of combustion chambers, combustion chamber arrangements. Combustion efficiency. Fuel injection systems.

Unit-III

Positive Displacement Air Compressors: Classification of air compressors. Work done, thermal and volumetric efficiency, effect of clearance in reciprocating air compressors. Multistage reciprocating air compressors, intercooling. Positive displacement rotary compressors, roots blower, Lysholm, screw type and vane type.

Centrifugal Compressors: Euler's equation for rotating machines, general thermodynamic energy analysis. Elementary aerofoil theory. Constructional details, method and theory of operation of centrifugal compressors. Energy transfer, velocity triangles. Slip factor, power input factor, pressure coefficient, efficiency. Sizing of inducer section, prewhirl. Impeller types, effect on performance. Diffuser. Losses in compressors, compressor characteristics. Surging and choking.

Axial Flow Compressors: Description, principle of operation. Efficiencies, workdone and torque calculation, velocity triangles. Degree of reaction. Aerofoil blading, drag and lift coefficients. Performance Characteristics. Centrifugal v/s axial flow compressors.

Unit-IV

Axial Flow Gas Turbines: Impulse and reaction turbines, degree of reaction, compounding, reheat factor. Efficiencies, workdone and torque calculation. Velocity triangles.

Jet and Rocket Propulsion: Ram jet, pulse jet, turbo jet, and turbo prop engines. Thrust and efficiencies calculation. Thrust augmentation methods. Classification of rockets. Description of liquid and solid propellant rockets.

Text Books/References

1. P. R. Khajuria and S. P. Dubey. Gas Turbines and Propulsive Systems, Dhanpat Rai & Sons, New Delhi.
2. M. L. Mathur and F. S. Mehta. Thermal Engineering, (Vol. I & II, SI Edition), Jain Brothers, New Delhi.
3. E. Rathakrishnan. Gas Dynamics, PHI.

ME 422 OPERATIONS RESEARCH

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Introduction: Characteristics and scope of O.R., formulations of problem and methodology.

Linear Programming: Mathematical formulation of problem, graphical solution. Simplex and revised simplex methods, unrestricted and bounded variables, degeneracy and cycling, perturbation methods. Duality. Sensitivity analysis.

Unit-II

Transportation, allocation, and assignment problems.

Queuing Theory: Queuing systems and disciplines, arrival and service rate distributions, waiting time and queue length for Poisson queues.

Unit-III

Inventory Models: Elements of costs, lead time, inventory control techniques, ABC analysis. Economic lot size problems with deterministic demand and supply rate including considerations of shortages and price breaks. Buffer stock, reorder level, and reorder point. Economic run length.

Replacement Problems and Reliability: Economics of replacement, replacement of items that deteriorate with time or that break down completely with or without value of money remaining same, group replacement policy. Introductory concepts of system reliability.

Unit-IV

Theory of Games: Two-person zero sum games, saddle point, games without saddle points, dominance property, graphical methods, formulation of game problem as LPP.

Simulation: Event type simulation, generation of random phenomena, Monte Carlo technique, simulation steps, application to queuing problems.

Decision Making: Decision under certainty, under risk, and under uncertainty. Decision trees.

Text Books/References

1. Kanti Swarup, P. K. Gupta, and Man Mohan. Operations Research, Sultan Chand & Sons, New Delhi.
2. S.D. Sharma. Operations Research, Kedar Nath Ram Nath & Co.
3. H.A. Taha. Operations Research- An Introduction, PHI.
4. Hiller & Liberman. Introduction to Operation Research. Holden Day Inc. San Francisco.

ME 428 AUTOMOBILE ENGINEERING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Power Unit: Engine types, classification, cylinder heads, cylinder head gasket, piston rings, carburettors, fuel injection equipment. Multi port fuel injection. Temperature stress in various engine parts. Power and torque, characteristics of power for specific road performance. Rotary Engines and fuel cells.

Chassis and Suspension: Loads on the frame, general considerations of strength and stiffness, engine mountings, various suspension arrangements, leaf and coil springs, shock absorber.

Unit-II

Transmission: Clutches, fluid flywheels, torque converters. Rolling, air and gradient resistance. Propulsive force required. Determination of overall gear ratio, specific performance.
Gear Box: Simple gear box, synchromesh gears, overdrive and flywheel transmission efficiency, Universal joints, types, propeller shaft, differential type of rear and front axles.

Unit-III

Brakes: Servoaction, brake components, Bendix and Gerling system lock-head, Hydraulic brakes, vacuum land air brakes, retarders.

Tyres: Pneumatic tyres, static and rolling proportions, effects of camber, tyre characteristic diagram. Radial and tubeless tyres.

Unit-IV

Steering: Steering geometry, Ackermann and Davis steering mechanisms, steering column, worm and worm wheel, cam and lever steering gears dops and draglink power steering.

Vehicle Dynamics: Longitudinal stability, dynamic stability, directional stability, stability on a curve, effect of braking on the stability.

Electric Car: General discussions on the suitability of electric car.

Text Books/References

1. R. B. Gupta. Automobile Engineering, Satya Prakashan, New Delhi.
2. Kirpal Singh. Automobile Engineering.
3. C. P. Nakra. Basic Automobile Engineering, Dhanpat Rai & Sons, New Delhi.
4. W. H. Crouse. Automotive Mechanics, Tata McGraw Hill.
5. W. H. Crouse. Automotive Transmission and Power Train,McGraw Hill.
6. W. H. Crouse. Automobile Chassis and Body, McGraw Hill.

ELECTIVE - II

ME 423 (a) PLASTICITY AND METAL WORKING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Principal stresses and principal axes of stress, mean stress and stress deviator.

VonMises yield criteria, Tresca's yield criteria. Comparison of yield criteria. Introduction to slip line theory and upper bound analysis. Forging of discs .

Unit-II

Flow through conical converging dies, upper bound and free body equilibrium approach.

Unit-III

Wire and rod drawing and open die extrusion. Tube sinking. Principles of die design.

Unit-IV

Rolling : Theory of Rolling. Determination of rolling loads and torque. Design of rolls and camber. Rolling of strips and plates. Thickness measurement methods.

Text Books/References

1. A. Ghosh and A. K. Mallik. Manufacturing Science.
2. C. K. Singh and Balbir Singh. A Text Book of Production Engineering.
3. P. C. Sharma. A Text Book of Production Engineering, S. Chand & Co., New Delhi.
4. A. Mendelson. Plasticity.

ME 423 (b) RELIABILITY AND MAINTENANCE ENGINEERING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Reliability: Meaning, scope and objectives; reliability function and overall reliability; Availability and system effectiveness. Statistical concepts for reliability: Probability distributions and their use – Normal, Log normal, Poissons,, exponential, Weibull, gamma & binomial.

Reliability of Systems: Models of reliability – series, parallel, redundant & Markov model.

Unit-II

Failure: Classification, causes, factors influencing failures; Failure data analysis; Failure analysis for design. General principles of design for reliability.

Risk Assessment: Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

Reliability Improvement and Simulation: Design and use of simulation models in reliability; Reliability audits.

Reliability Assessment and Testing: Reliability prediction; Reliability of mechanical and electrical systems. Reliability testing – requirement, methods and standards.

Unit-III

Maintenance: Maintenance information system –objectives and design; implementation ; Use of computers in maintenance. Objectives and levels of maintenance

Maintenance practices: Unplanned & planned; Preventive & scheduled; condition based & reliability centered maintenance; Total Productive Maintenance; Maintenance planning and scheduling; Maintainability.

Unit-IV

Organisation for Maintenance: Objectives and functions; types of structures; Manpower planning. Materials for maintenance: planning and control.

Economic aspects of Maintenance: Life cycle costing; costs associated with maintenance and optimisation. Safety and Environmental aspects of maintenance.

Text Books/References

1. R.C. Mishra. Reliability and Maintenance Engineering, New Age International Pub., New Delhi.
2. L.S. Buffa. Modern Production/Operations Management, Wiley Eastern, New Delhi

3. L.S. Shrinath. Mechanical Reliability, Affiliated East-West Press P.Ltd.
4. Modarres. (1993). Reliability and Risk analysis, Mara Dekker Inc.
5. John Davidson. (1988). The Reliability of Mechanical system, Institution of Mechanical Engineers, London.
6. Smith C.O. (1976). Introduction to Reliability in Design, McGraw Hill, London.

ME 423 (c) ADVANCE JOINING TECHNOLOGY

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Analysis of heat sources for material joining. Effects of welding parameters on heat distribution, analysis of flow of heat in weld, heat zones in fusion welding. Welding metallurgy and heat treatment of welding.

Unit-II

Modern welding processes like EBW, LBW, Diffusion bonding, Ultrasonic welding, etc. Brazing, soldering, adhesive bonding and solid state bonding. Pulsed current welding processes.

Unit-III

Stresses in welding, weldmet design for pressure vessels, heavy structures, offshore structures and submarine pipe lines. Welding of ceremics, plastic and composites. Influence of oxides, slag and fluxes on welding of ceramics, plastic and composites.

Unit-IV

Inspection and testing of welds, inspection codes of weldmets, failure of welds. Liquid penetrate inspection, magnetic particle inspection, eddy current, ultrasonic X- ray testing and NDT of welds.

Texts/References

1. M.M. Schwartz: Metal Joining Manual, McGraw Hill, New York.
2. L. P. Connur: Welding Handbook (Vol. I and II), American Welding Society.
3. P.T. HouldCraft: Welding Process Technology, Cambridge University Press.
4. W.J. Paton. The science and practice of welding, Prentice Hall Inc., New Jersy.
5. R.W. Messler. Principles of welding, John Wiley & Sons, New York.

6. Raymonds Sacks. Welding: principles & practices, Chas A. Bennett Co., Illinois.

ME 423(d) MANUFACTURING AUTOMATION

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Product cycle, manufacturing functions. Types of automation, degree of automation. Technical, economic and human factors in automation. Technologies- Mechanical, electrical, hydraulic, pneumatic, electronic, hybrid systems. Comparative evaluation.

Unit-II

Development of small automation systems using mechanical devices. basics of pneumatics. Synthesis of circuits. basics of hydraulics systems, synthesis of hydraulic circuits, elements used for electrical circuits, synthesis, circuit optimisation techniques.

Unit-III

Illustrative examples of the above types of systems as well as hybrid systems used for automation of working cycles of machines, material handling, inspection and assembly systems etc.

Unit-IV

Industrial logic control system. Logic diagraming, Programmable controllers, Applications, Designing for automation, Cost-benefit analysis.

Text Books/References

1. A.N. Gavrilov. Automation and Mechanization of Production Processes in Instrument Industry, Pergamon Press, Oxford.
2. G. Pippengam. Industrial Hydraulics, MGH, New York.
3. F. Kay. Pneumatics for Industry, The Machining Publ. Co., London.
4. Asphal Ray. Robots and Manufacturing Automation,John Wiley, New York.
5. G. Boothroyd and C. Poli. Automatic Assemblt, Marcel Dekkar, New York.

ME 423(e) TOOL ENGINEERING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Design of Forging and press Working Dies : Tool and die steels, considerations. Design of drop forging dies and upsetting dies press specifications. Design of simple blanking die, progressive die and compound die, Standard die sets. Design of drawing dies.

Unit-II

Design of Metal Cutting Tools: Design of single point cutting tools , Analysis of drilling operation and design of twist drills and reamers, Design of a plain milling cutter, Design of a circular broach.

Unit-III

Production of Metal Cutting Tools: Tool materials ; High carbon steel, High speed steel, Stallite, Tungsten carbide ceramics and borazon, Plan preparation for cutting tools, Production sequence of a carbide tipped a single point cutting tool and a twist drill. Heat treatment of cutting tools and improving their cutting properties.

Unit-IV

Jigs and Fixtures: Principles of Jigs and fixtures design, Principles of location and clamping, Design of drilling, Jigs and lathe and milling fixture, Design of Simple pneumatic Jigs and fixtures.
Tooling Economics: Analysis of small tool costs, tooling economics in combined operations, process cost comparisons.

Text Books/References

1. P. C. Pandey and C. K. Singh. Production Engineering Sciences, Standard Publishers Distributors, Delhi.
2. P. C. Sharma. A Text Book of Production Engineering, S. Chand & Co., New Delhi.
3. G. R. Nagpal. Tool Engineering and Design, Khanna Publishers, New Delhi.

ME 423 (f) PLANT LAYOUT AND MATERIALS HANDLING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Site Selection: Factors affecting the site selection. Types of plant layout. *Process and Product Type Layout:* Types of production activities, job shop, mass production similar products and special product manufacturing.

Unit-II

Factors in Plant Layout: Materials, machinery, man-power, movement, Service building safety, storage and warehouses planning and layout. Process planning, material of building, determination of equipment cost.

Layout Fundamentals: Getting the facts, flow studies. Proximity cross charts, flexibility and layout aids-templates, tapes and production method, evaluation of the layout .

Unit-III

Installing the Layout: Procedure, plant engineering and acceptance

Unit-IV

Materials Handling Equipment: Conveyors, cranes, hoists, mobile equipment. Positioning equipment, container and support equipment. Problem of packing. Cost, size considerations.

Text Books/References

1. G. K. Agarwal. Plant Layout and Material Handling, Jain Brothers, New Delhi.
2. E. S. Buffa. Modern Production Management, Wiley Eastern.
3. Schmid and Puckett. Method Study, Work Measurement, Plant Layout, and Material Handling.
4. S. C. Sharma. Materials Management and Materials Handling, Khanna Publishers, New Delhi.

5. Francis *et. al.* Facility Layout and Location: An Analytical Approach, Prentice Hall of India.

ME 423 (g) PRODUCTION MANAGEMENT

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Modelling problems in design, operation and control of production systems. Comparing decision rules, cost for decision. Multiproduct profit volume analysis. Equipment replacement policies.

Unit-II

Plant location models, CRAFT layout and its limitations. Application of linear programming in capacity planning, and machines allocation. Application of congestion analysis to man-machine systems and material handling systems.

Unit-III

Search for alternatives in process planning. Balancing assembly lines. Control of in process work inventories. two critical level inventory control.

Unit-IV

Forecasting demands with trends and seasonal variations. Aggregate planning. Classification and choice of acceptance sampling plans. system simulation. CPM and PERT techniques.

Text Books/References

1. E.S. Buffa. Modern Production Management, Wiley Eastern.
2. G.K. Groff and J.F. Muth. Operations Management, Selected Readings, Tarporwala.
3. H. Bierman, W.H. Hausman and C.P. Bonini. Quantitative Analysis for Business Decision.
4. S.E. Elmaghraby. Design of Production Systems, Reinhold.

ME 423 (h) QUALITY CONTROL AND RELIABILITY

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Basic Concepts in Assurance Technology: Terminologies, definitions, approaches and important issues.

Product Quality Control: Acceptance sampling methods- Single, multiple and sequential sampling plans. Recent developments in inspection methods.

Unit-II

Process Evaluation and Control by Control Charts: Various control charts including CUSUM charts and multivariate charts.

Process Evaluation and Control by Design of Experiments: Various basic designs. Special methods like EVOP, RSM and ROBUST designs.

Unit-III

Process Capability Studies: Use of control charts, various indices, SPAN PLAN method and use of nomographs.

Reliability Engineering: Statistical analysis of life time data and determination of reliability. Availability and maintainability. Development of applications of fault tree diagrams. Cause and effect diagrams, FMECA and FRACAS.

Unit-IV

Total Quality Management: Perspective, methodologies and procedures.
Road map to TQM: Quality function deployment, ISO 9000, quality cost system, KAIZEN, quality circles, quality policy deployment and models for organisational excellence. Zero error.

JIT, Total productivity. Maintenance and quality perspectives.

Text Books/References

1. A.J. Duncan. Quality Control and Industrial Statistics, Richard D. Irwin Inc.
2. A.V. Feigenbaum. Total Quality Control, McGraw Hill International Editions.
3. S. Halpern. The Assurance Sciences, Prentice Hall India Ltd., New Delhi.
4. D.C. Montgomery. Design and analysis of Experiments, John Wiley & Sons.
5. J.Juran. Quality Control Handbook, McGraw Hill Book Company.

ELECTIVE - III

ME 424 (a) NON-CONVENTIONAL ENERGY SOURCES

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Conventional and Alternative Energy Sources: Effect on environment of fossil, fuels, nuclear energy and hydroelectric power. Alternative energy sources- solar, wind, geothermal, tidal and wave, biomass etc.
Wind Energy: Nature and potential, wind mill types, their merits and demerits, design of wind rotors and control systems. Wind farms.

Unit-II

Solar Energy: The sun and the earth, spectral distribution of extra terrestrial radiations. Solar constant, depiction of solar radiation in the atmosphere. Solar radiation at the earth surface, sun earth angle, derived solar angles, solar time measurement and estimation of solar radiation. Instruments for measurement, radiation properties of gauge material, transmission of radiation through transparent media.

Collection of Solar Energy: Flat place collection construction, types, working, material selection, design considerations and testing procedure. Focussing collectors types, concentration tracking mechanism. Application of solar energy- Solar water and air heaters, distillation, drying of materials, power generation, cookers, solar refrigeration. Photo voltaic technology.

Unit-III

Geothermal Energy: Geological setting, different geothermal systems, utilisation of geothermal energy, its economical and environmental comparison. Brief description of different utilisation techniques for ocean thermal energy, and tidal and wave energy.

Unit-IV

Biomass: Nature and potential, different bio conversion techniques, production of bio solid, liquid and gaseous fuels.

Text Books/References

1. A. N. Mathur and N. S. Rathore. New and Renewable Energy Sources, Bohra Ganesh Publishers, Udaipur.
2. G. D. Rao. Non Conventional Energy Sources, Khanna Publishers, New Delhi.

ME 424 (b) ADVANCED REFRIGERATION

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Brayton refrigeration cycle, regenerative Brayton refrigeration. Martionvsky-Dubinsky cycle, vapour compression cycle.

Unit-II

Multistage and cascade, air liquefaction cycles. Exergy approach for energy efficient design of refrigeration systems.

Unit-III

Theories and methods of chilling, freezing and freeze dehydration.

Unit-IV

Microbiology of foods. Food preservation methods. Design of cold storage.

Text Books/References

1. ASHRAE Handbook- Fundamentals.
2. J.L. Threlkeld. Thermal Enviromental Engineering, Prentice Hall Inc.

ME 424 (c) CRYOGENIC ENGINEERING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Historical background and applications. Gas liquefaction systems. Gas separation and gas purification systems.

Unit-II

Cryogenic refrigeration systems. Storage and handling of cryogens. Cryogenic insulations. Liquified natural gas.

Unit-III

Properties of materials for low temperature. Material of construction and techniques of fabrication. Instrumentation.

Unit-IV

Ultra-low temperature techniques. Applications.

Text Books/References

1. R. Barron. Cryogenic Systems: McGraw Hill.

ME 424 (d) AIR CONDITIONING SYSTEM DESIGN

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Load Estimating: Comfort conditions, weather data, solar heat gain, cooling and heating loads.

Unit-II

Airconditioning Systems: Central and unitary systems, duct design and fan selection, heating and cooling coil design.

Unit-III

Cooling tower design and selection, air cleaners and scrubbers, hydonic heating and cooling systems, humidification and dehumidification equipment, automatic control, noise reduction. Selection of materials.

Unit-IV

Energy conservation and airconditioning for special applications: Waste heat, recovery, cogeneration of power and refrigeration, industrial airconditioning, textile processing, clean spaces.

Text Books/References

1. ASHRAE Handbook- Fundamentals.
2. ASHRAE Handbook: HVAC Systems and Equipment.

ME 424 (e) COMPUTATIONAL METHODS IN THERMAL AND FLUID ENGINEERING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Review of conservation equations, lumped parameter approach leading to non-linear equations, numerical solutions of non-linear equation. Concept of round off error, overflow, propagation of error.

Unit-II

Problems leading to system of linear equations. Techniques for solving system of linear equation (direct and iterative). Scaling and nondimensionalisation.

Unit-III

Linear and nonlinear regression techniques to correlate experimental data. Numerical integration, calculation of shape factor.

Unit-IV

Thermal and fluid problems leading to ODE. Initial, boundary and eigenvalue problems. Solutions of ODE using marching and finite difference methods. Characterisation of partial differential equation, numerical solutions of elliptic, parabolic and hyperbolic equations encountered in heat transfer and fluid flow.

Text Books/References

1. T. Cebeci and P. Bradshaw. Physical and Computational Aspects of convective Heat Transfer, Springer-Verlag.
2.. T. Cebeci and P. Bradshaw. Momentum Transfer in Boundary Layers, McGraw Hill.
3. S.V. Patanker. Numerical Heat Transfer and Fluid Flow, McGraw Hill.
4. C. Hirsch. Numerical Computation of Internal and External Flows (Vols. 1 & 2), John Wiley & Sons.
5. C.A.J. Fletcher. Computational Techniques for Fluid Dynamics (Vols. 1 & 2), Springer Verlag.

ME 424 (f) THEORY AND DESIGN OF FLUID MACHINERY

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

General Classification: Equations of work transfer for rotodynamic type machinery. Operation, performance and similarity laws of rotodynamic type pumps, fan, blower and compressor. Cavitation in pumps.

Unit-II

Hydraulic design of centrifugal type pump and blower.

Unit-III

Positive Displacement type and Jet Pump Type machinery: Impulse type and reaction type hydroturbines; operation, performance, similarity laws, governing, runaway speed.

Unit-IV

Hydraulic design of impulse type and radial flow type hydroturbines.

Text Books/References

1. S. Nagaratnam. Fluid Machines and Systems, Tata McGraw Hill Publishing Co.
2. V.M. Cherkassky. Pumps, Fans, Compressors, MIR Publishers.
3. J. Matley. Fluid Movers: Pumps, Compressors, Fans and Blowers, McGraw Hill Publication.
4. G.I. Krivchenko. Hydraulic Machines: Turbines and Pumps, MIR publishers.

ME 424 (g) TRACTORS AND AGRICULTURAL MACHINERY

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

Unit-I

Farm Tractors: Classification of Tractors, status of tractor and power tiller industry in India. Introduction to tractor systems. Electrical system – battery, starting systems and charging system. Differential, final drive and power take off. Hydraulic system of tractor, automatic position and draft control system. Hitch types and standards.

Mechanics of tractor chassis, weight transfer, weight distribution and stability, grade and non-parallel pull, turning at high speed, centre of gravity determination and numerical problems.

Traction: Traction mechanics and performance of traction devices. Tyre classification, traction aids and numerical problems.

Unit-II

Farm Machinery: Introduction to various farm operations. Implement types, introduction to field capacity and efficiency and simple numerical problems. Tillage objectives, primary tillage implements, desi ploughs, mould board plough and disc plough. Secondary tillage implements – disc and drag harrows.

Unit-III

Crop Planting equipment: Seed cum fertiliser drill, crop planters. Calibration of seed drills and planters, numerical problems on seed drills and planters. Equipment for intercultural operations.

Plant Protection Equipment: Sprayers : Types and construction. Dusters – types and construction. Atomising devices, factors affecting performance, calibration and numerical problems on calibration,

Unit-IV

Harvesting Equipment: Principle of cutting. Mowers – types of mowers, cutter bar. Mower parts, rotary mowers, construction, operation and adjustments.

Grain Harvesting: Types and different functional units if combine, operation, adjustment, different losses and numerical problems on losses.

Threshing: Principles of threshing, types, brief description and operation of threshing mechanism, effect of various parameters of thresher on threshing operation, losses and numerical problems.

Text Books/References

1. B. J. Lilijedahl, P.K. Turnquist, W. D. Smith and Hoki Vaketo. Tractors and their power units. John Wiley & Sons, New York.
2. F.R. Jones. Farm gas engines and tractors, MacGraw Hll Book Co., New York.
3. Rai and Jain. Farm Tractor and repair,
4. R. Bainer, E.L. Barger and R.A. Kepner. Principles of Farm Machinery. John Wiley & Sons, New York.
5. D. Hunt. Farm power and machinery management, Iowa State University Press.
6. H.P. Smith. Farm machinery and equipment, TMH Publishing Co. Ltd., New Delhi.
7. H. Singh and O.S. Bindra. Pesticides and application equipment, Oxford & IBM Publishing Co.
8. FAO Bulletin. (1977). Elements of agricultural machinery, Vol. I and II.

Notes