B.S. Abdur Rahman
Crescent
Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

REGULATIONS 2017

CURRICULUM AND SYLLABI

For

B.TECH. PROGRAMMES

REGULATIONS - 2017

B.TECH. DEGREE PROGRAMMES

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.Tech. Degree Programme.

ii) **"Branch"** means specialization or discipline of B.Tech. Degree Programmelike Civil Engineering, Mechanical Engineering, etc.,

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

iv) **"Institution"** means B.S.Abdur Rahman Crescent Institute of Science and Technology.

v) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of B.S.Abdur Rahman Crescent Institute of Science and Technology.

vi) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of B.S.Abdur Rahman Crescent Institute of Science and Technology.

vii) **"Controller of Examinations"** means the Controller of Examination of B.S.Abdur Rahman Crescent Institute of Science and Technology who is responsible for conduct of examinations and declaration of results.

2.0 ADMISSION

2.1a) Candidates for admission to the first semester of the eight-semester B.Tech. degree programme shall be required to have passed the Higher Secondary Examination of the (10+2) curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any university or authority accepted by the Institution as equivalent thereto.

2.1b) Candidates for admission to the third semester of the eight-semester B.Tech. programme under lateral entry scheme shall be required to have passed the Diploma examination in Engineering / Technology of the Department of Technical Education, Government of Tamil Nadu or any other examination of any other authority accepted by the Institution as equivalent thereto.

2.2 Notwithstanding the qualifying examination the candidate might have passed, the candidate shall also write an entrance examination prescribed by the Institution for admission. The entrance examination shall test the proficiency of the candidate in Mathematics, Physics and Chemistry on the standards prescribed for Ten plus Two academic stream.

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

3.0 BRANCHES OF STUDY

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

B.TECH. DEGREE PROGRAMMES:

1. Aeronautical Engineering
2. Automobile Engineering
3. Civil Engineering
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering

8. Information Technology

9. Manufacturing Engineering

10. Mechanical Engineering

12. Biotechnology

13. Cancer Biotechnology

14. Food Biotechnology

4.0 STRUCTURE OF THE PROGRAMME

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

i) Basic Sciences (BS)

ii) Humanities & Social Sciences (HS)

iii) Management Sciences (MS)

iv) Engineering Sciences Fundamentals (ESF)

v) Engineering Core Courses (EC)

vi) Professional Electives (PE)

vii) General Electives (GE)

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

4.2 Each course is normally assigned certain number of credits :

- one credit per lecture period per week
- one credit per tutorial period per week
- one credit for two to three periods and two credits for four periods of laboratory or practical sessions

- one credit for two periods of seminar / project work per week
- one credit for two weeks of industrial training.

4.3 Each semester curriculum shall normally have a blend of lecture courses, laboratory courses and laboratory integrated theory courses of total not exceeding 26 credits.

4.4 For the award of the degree, a student has to earn a minimum total credits specified in the curriculum of the relevant branch of study. The minimum credits to be earned will be between 174 and 180, depending on the program.

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

5.0 DURATION OF THE PROGRAMME

5.1 A student is ordinarily expected to complete the B.Tech. programme in eight semesters (six semesters in the case of lateral entry scheme), but in any case not more than 14 continuous semesters reckoned from the date of first admission (12 semesters in the case of lateral entry student).

5.2 Each semester shall consist of a minimum of 90 working days.

5.3 Semester end examination will normally follow within a week after the last working day of the semester.

6.0 CLASS ADVISOR AND FACULTY ADVISOR

6.1 CLASS ADVISOR

A faculty member will be nominated by the HOD as Class Advisor for the class throughout the period of study except first year.

The Class Advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

However, for the first and second semester, the class advisors (First year class advisors) will be nominated by the first year coordinator.

6.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department of the students will attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

7.0 COURSE COMMITTEE

7.1 Each common theory course offered to more than one group of students shall have a "Course Committee" comprising all the teachers teaching the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and

ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

8.0 CLASS COMMITTEE

A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman will be constituted branch-wise and semester-wise

8.1 The composition of class committees for first and second semester will be as follows:

i) The first year coordinator shall be the chairman of the class committee

ii) Faculty members of all individual courses of first / second semester

iii) Six student representatives (male and female) of each class nominated by the first year coordinator

iv) The class advisor and faculty advisors of the class.

8.2 The composition of the class committee for each branch from 3^{rd} to 8^{th} semester will be as follows:

i) One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department

ii) Faculty members of all courses of the semester

iii) Six student representatives (male and female) of each class nominated by the Head of the Department in consultation with the relevant faculty advisors

iv) All faculty advisors and the class advisors.

v) Head of the Department

8.3 The class committee shall meet at least four times during the semester. The first meeting will be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment will be decided for the first and second assessment. The second meeting will be held within a week after the date of first assessment report, to review the students' performance and for follow up action. The third meeting will be held within a week after the second assessment report, to review the students' performance and for follow up action.

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

8.5 The fourth meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

9.0 REGISTRATION AND ENROLMENT

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

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

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

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

10.0 COURSE CHANGE / WITHDRAWAL

10.1 CHANGE OF A COURSE

A student can change an enrolled course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

10.2 WITHDRAWAL FROM A COURSE

A student can withdraw from an enrolled course at any time before the first assessment for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

11.0 TEMPORARY BREAK OF STUDY FROM PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds.A student can avail the break of study before the start of first assessment of the ongoing semester. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 5.1).If any student is debarred for want of attendance or suspended due to any act of indiscipline, it will not be considered as break of study. A student who has availed break of study has to rejoin in the same semester only.

12.0 CREDIT LIMIT FOR ENROLMENT & MOVEMENT TO HIGHER SEMESTER

12.1 A student can enroll for a maximum of 32 credits during a semester including Redo /Pre do Courses

12.2 The minimum earned credit required to move to the higher semester shall be

- Not less than 20 credits, to move to the 3rd semester

- Not less than 40 credits, (20 for lateral entry) to move to the 5th semester
- Not less than 60 credits, (40 for lateral entry) to move to the 7th semester

13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

13.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessment No.	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 6	1.5 hours	25%
Assessment 2	7 to 12	1.5 hours	25%
Semester End Exam	Full course	3 hours	50%

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

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

13.4 For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory component shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical component shall be through continuous assessment.

13.5 The components of continuous assessment for theory/practical/laboratory integrated theory courses shall be finalized in the first class committee meeting.

13.6 In the case of Industrial training, the student shall submit a report, which will be evaluated along with an oral examination by a committee of faculty members, constituted by the Head of the Department. A progress report from the industry will also be taken into account for evaluation. The weightage for report shall be 60% and 40% for Viva Voce examination.

13.7 In the case of project work, a committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student(s), an oral examination (viva-voce) will be conducted as the semester end examination, for which one external examiner, approved by the Controller of Examinations, will be included. The weightage for periodic review will be 50%. Of the remaining 50%, 20% will be for the project report and 30% for the Viva Voce examination.

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

13.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance will be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall be ignored.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. There shall be no arrear or improvement examination for lab component.

14.0 SUBSTITUTE EXAMINATIONS

14.1 A student who has missed, for genuine reasons, a maximum of one of the two continuous assessments of a course may be permitted to write a substitute examination paying the prescribed substitute examination fees. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Dean of School for that purpose. However there is no Substitute Examination for Semester End examination.

14.2 A student who misses any continuous assessment test in a course shall apply for substitute exam in the prescribed form to the Head of the Department / Dean of School within a week from the date of missed assessment test. However the Substitute Examination will be conducted after the last working day of the semester and before Semester End Examination.

15.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

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

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

15.3 A student who has obtained 'I' grade in all the courses in a semester is not permitted to move to next higher semester. Such student shall repeat all the courses of the semester in the subsequent academic year.

15.4 A student should register to re-do a core course wherein "I" or "W" grade is awarded. If the student is awarded, "I" or "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of Head of the Department / Dean of School.

15.5 A student who is awarded "U" grade in a course will have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to redo the course in the evening when the course is offered by the department. Marks scored in the continuous assessment during the redo classes shall be considered for grading along with the marks scored in the semester-end (redo) examination. If any student obtained "U" grade in the redo course, the marks scored in the continuous assessment test (redo) for that course will be considered as internal mark for further appearance of arrear examination.

15.6 If a student with "U" grade, who prefers to redo any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she will not be permitted to write the semester end examination and his / her earlier "U" grade and continuous assessment marks shall continue.

16.0 REDO COURSES

16.1 A student can register for a maximum of two redo courses per semester in the evening after regular college hours, if such courses are offered by the concerned department. Students may also opt to redo the courses offered during regular semesters.

16.2 The Head of the Department with the approval of Dean Academic Affairs may arrange for the conduct of a few courses during the evening, depending on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

16.3 The number of contact hours and the assessment procedure for any redo course will be the same as those during regular semesters except that there is no provision for any substitute examination and withdrawal from an evening redo course.

17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

17.1 All assessments of a course will be made on absolute marks basis. However, the Class Committee without the student members shall meet within 5 days after the semester-end examination and analyze the performance of students in all assessments of a course and award letter grades. The letter grades and the corresponding grade points are as follows:

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

I	0
AB	0

"W" denotes withdrawal from the course.

"I" denotes inadequate attendance and hence prevention from semester-end examination

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester-end examination.

17.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student for improvement of grade.

17.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department/Dean of Schools and it shall be declared by the Controller of Examinations.

17.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester-end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to Controller of Examination. Subsequently the Head of the Department/ Dean of School offered the course shall constitute a revaluation committee consisting of Chairman of the Class Committee as Convener, the faculty member of the course and a senior member of faculty knowledgeable in that course. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

17.5 After results are declared, grade sheets shall be issued to each student, which will contain the following details. The list of courses enrolled during the semester including redo courses, if any, and the grade scored, the Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

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

Where n = number of courses

The Cumulative Grade Point Average CGPA shall be calculated in a similar manner, considering all the courses enrolled from first semester. **"I" and "W"** grades will be excluded for calculating GPA .

"U", "I", "AB" and **"W"** grades will be excluded for calculating CGPA.
The formula for the conversion of CGPA to equivalent percentage of marks shall be as follows:

Percentage Equivalent of Marks = CGPA X 10

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

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the Prescribed period of 8 semester for normal entry and 6 semesters for lateral entry

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

First Class	6.50 and above and completing the programme within a maximum of 10 semester for normal entry and 8 semesters for lateral entry
Second Class	Others

However, to be eligible for First Class with Distinction, a student should not have obtained ‘U’ or ‘I’ grade in any course during his/her study and should have completed the U.G. programme within a minimum period (except break of study). To be eligible for First Class, a student should have passed the examination in all the courses within the specified minimum number of semesters reckoned from his/her commencement of study. For this purpose, the authorized break of study will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

18.0 ELECTIVE CHOICE:

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

18.2 ONLINE / SELF STUDY COURSES

Students are permitted to undergo department approved online/ self study courses not exceeding a total of six credits with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean Academic Affairs during his/ her period of study. In case of credits earned through online mode ratified by the respective Board of Studies, the credits may be transferred following the due approval procedures. The students shall undergo self-study courses on their own with the mentoring of a member of the faculty. The online/ self-study courses can be considered in lieu of elective courses.

19.0 SUPPLEMENTARY EXAMINATION

Final Year students can apply for supplementary examination for a maximum of two courses thus providing an opportunity to complete their degree programme. Likewise students with less credits can also apply for supplementary examination for a maximum of two courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results.

20.0 PERSONALITY AND CHARACTER DEVELOPMENT

20.1 All students shall enroll, on admission, in any of the personality and character development programmes, NCC / NSS / NSO / YRC / Rotaract and undergo practical training.

- **National Cadet Corps (NCC)** will have to undergo specified number of parades.
- **National Service Scheme (NSS)** will have social service activities in and around Chennai.
- **National Sports Organization (NSO)** will have sports, games, drills and physical exercises.
- **Youth Red Cross (YRC)** will have social service activities in and around Chennai.
- **Rotaract** will have social service activities in and around Chennai.

21.0 DISCIPLINE

21.1 Every student is required to observe disciplined and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to affect the prestige of the Institution.

21.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean will be referred to a Discipline and Welfare Committee nominated by the Vice-Chancellor, for taking appropriate action.

22.0 ELIGIBILITY FOR THE AWARD OF DEGREE

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

i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 14 semester (12 semesters for lateral entry) from the date of admission, including break of study

ii) no dues to the Institution, Library, Hostels

iii) no disciplinary action pending against him/her.

22.2 The award of the degree must have been approved by the Institution.

23.0 POWER TO MODIFY

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

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

B.TECH. MECHANICAL ENGINEERING

CURRICULUM & SYLLABUS, REGULATIONS 2017

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC 1181	Differential Calculus and Geometry	3	1	0	4	
2.	HS	ENC 1181/ ISC 1181/ LNC 1181/ LNC 1182 / LNC 1183	English / Arabic / Mandarin / German / Japanese	3	0	0	3	
3.	BS	PHC 1181	Physics	3	0	2	4	
4.	BS	CHC 1181	Chemistry	3	0	2	4	
5.	ESF	GEC 1101	Engineering Graphics	2	0	2	3	
6.	ESF	GEC 1102	Engineering Design	2	0	0	2	
7.	ESF	GEC 1103	Basic Engineering Practices Laboratory	0	0	2	1	
8.	ESF	GEC 1104	Computer Programming I	1	0	2	2	**23**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 1281	Advanced Calculus	3	1	0	4
2.	BS	-	Physics Elective	2	0	2	3
3.	BS	-	Chemistry Elective	2	0	2	3
4.	ESF	GEC1211	Basic Engineering Mechanics	3	1	0	4
5.	BS	GEC 1212	Environmental Studies	2	0	0	2
6.	ESF	GEC 1213	Computer Programming II	1	0	2	2

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
7.	EC	MEC1211	Material Science	3	0	0	3	
8.	EC	MEC1212	Design Appreciation Lab	0	0	3	1	
9.	ESF	EEC 1283	Basic Electrical Engineering	2	0	0	2	
10.	ESF	EEC 1284	Electrical Engineering Laboratory	0	0	3	1	**25**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC2181	Partial Differential Equations and Transforms	3	1	0	4	
2.	HS	-	Humanities Elective I	2	0	0	2	
3.	HS	ENC 2181	Oral Communication	0	0	2	1	
4.	EC	MEC2101	Manufacturing Processes	3	0	0	3	
5.	EC	MEC2102	Engineering Metallurgy	3	0	0	3	
6.	EC	MEC2103	Engineering Thermodynamics	3	1	0	4	
7.	EC	MEC2104	Solid Mechanics	3	1	0	4	
8.	EC	MEC2105	Manufacturing Processes Lab	0	0	3	1	
9.	EC	MEC2106	Material Testing and Metallurgy Lab	0	0	3	1	
10.	EC	MEC2107	Part Modeling Lab	0	0	3	1	**24**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	-	Mathematics Elective I	3	1	0	4
2.	HS	-	Humanities Elective II	2	0	0	2
3.	HS	ENC2282	Written Communication	0	0	2	1

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
4.	EC	MEC2211	Kinematics of Machinery	3	0	0	3	
5.	EC	MEC2212	Fluid Mechanics and Machinery	3	1	0	4	
6.	EC	MEC2213	Metal Cutting and Machine Tools	3	0	0	3	
7.	EC	MEC2214	Machining Lab	0	0	3	1	
8.	EC	MEC2215	Product Modelling Lab	0	0	3	1	
9.	EC	MEC2216	Fluid Mechanics and Machinery Lab	0	0	3	1	**20**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	MS	MSC 3181 MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3	
2.	GE	-	General Elective I	3	0	0	3	
3.	HS	ENC3181	Communication and soft skill I Career Choice	0	0	2	1	
4.	EC	MEC3101	Dynamics of Machinery	3	1	0	4	
5.	EC	ECC3181	Electronics for Mechanical Systems	2	0	0	2	
6.	EC	MEC3102	Thermal Engineering (Integrated Lab)	3	0	3	4	
7.	EC	MEC3103	Mechanics Lab	0	0	3	1	
8.	EC	ECC3182	Electronics Lab	0	0	3	1	
9.	PE		Programme Elective ##				6**	**25**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	MS	MSC 3181 MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3	
2.	BS	-	Mathematics Elective II	2	0	0	2	
3.	HS	ENC3281	Communication and soft skill II – Confidence Building	0	0	2	1	
4.	EC	MEC3211	Machine Design	3	1	0	4	
5.	EC	MEC3212	Metrology and Mechanical Measurements (Integrated Lab)	3	0	3	4	
6.	EC	MEC3213	Heat and Mass Transfer	3	0	0	3	
7.	EC	MEC3214	Heat and Mass Transfer Lab	0	0	3	1	
8.	EC	MEC3215	CNC Lab	0	0	3	1	
9.	PE		Programme Elective ##				6**	**25**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	GE	-	General Elective II	3	0	0	3	
2.	EC	MEC4101	Finite Element Analysis (Integrated Lab)	3	0	3	4	
3.	EC	MEC4102	Mechatronics (Integrated Lab)	3	0	3	4	
4.	EC	MEC4103	Design of Transmission Systems	3	0	0	3	
5.	EC	MEC4104	Simulation Lab	0	0	3	1	
6.	EC	MEC4105	Automobile Lab	0	0	3	1	
7.	PE		Programme Elective ##				6**	
8.	EC	MEC4106	Internship				1	**23**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	MEC4211	Project Work	0	0	24	12	12

Total credits – 177

* Industrial training will be undertaken during Third year summer vacation. The credit will be awarded in the 7th Semester.

PROGRAMME ELECTIVES

DESIGN ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	MECX01	Advanced Strength of Materials	3	0	0	3
2.	PE	MECX02	Composite Materials for Manufacture	3	0	0	3
3.	PE	MECX03	Design of Hydraulics and Pneumatics	3	0	0	3
4.	PE	MECX04	Noise, Vibration and Harshness	3	0	0	3
5.	PE	MECX05	Design of Jigs, Fixtures and Press Tools	3	0	0	3
6.	PE	MECX06	Industrial Problem Solving Techniques	3	0	0	3
7.	PE	MECX07	Geometric Modelling	2	0	0	2
8.	PE	MECX08	Reverse Engineering	2	0	0	2
9.	PE	MECX09	Reliability Engineering	2	0	0	2
10	PE	MECX10	Micro Electro Mechanical Systems (MEMS)	2	0	0	2
11	PE	MECX11	Geometric Dimensioning and Tolerancing	1	0	0	1
12	PE	MECX12	Tool and Die Design	1	0	0	1

THERMAL ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	MECX21	Refrigeration and Air Conditioning	3	0	0	3
2.	PE	MECX22	Advanced I.C. Engines	3	0	0	3
3.	PE	MECX23	Nuclear Engineering	3	0	0	3
4.	PE	MECX24	Gas Dynamics and Jet Propulsion	3	0	0	3
5.	PE	MECX25	Energy Conversion	3	0	0	3
6.	PE	MECX26	Turbomachinery	3	0	0	3
7.	PE	MECX27	Energy Conservation and Management	3	0	0	3
8.	PE	MECX28	Computational Flow and Heat Transfer	3	0	0	3
9.	PE	MECX29	Renewable Sources of Energy	3	0	0	3
10	PE	MECX30	Solar Engineering	3	0	0	3
11	PE	MECX31	Design of Thermal Systems	3	0	0	3
12	PE	MECX32	Automobile Engineering	3	0	0	3
13	PE	MECX33	Automotive Pollution and Control	2	0	0	2
14	PE	MECX34	Fuels and Combustion	2	0	0	2
15	PE	MECX35	Alternate Fuels	1	0	0	1

MANUFACTURING AND MATERIALS ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	MECX41	Modern Manufacturing Systems	3	0	0	3
2.	PE	MECX42	Process Planning and Cost Estimation	3	0	0	3
3.	PE	MECX43	Production Planning and Control	3	0	0	3
4.	PE	MECX44	Statistics and Quality Control	3	0	0	3
5.	PE	MECX45	Modern Production Management	3	0	0	3
6.	PE	MECX46	Advanced Optimisation Techniques	3	0	0	3
7.	PE	MECX47	Mechanical Maintenance	2	0	0	2
8.	PE	MECX48	Robotics and Automation	2	0	0	2
9.	PE	MECX49	Advanced Production Process for Automotive Components	2	0	0	2
10	PE	MECX50	Plant Layout and Material Handling	2	0	0	2
11	PE	MECX51	Industrial Safety Engineering	2	0	0	2
12	PE	MECX52	Operations Research & System Analysis	2	0	0	2
13	PE	MECX53	Nano Materials & Fabrications	2	0	0	2
14	PE	MECX54	Advanced materials	2	0	0	2
15	PE	MECX55	Prototyping Techniques	2	0	0	2
16	PE	MECX56	Industrial Marketing	1	0	0	1
17	PE	MECX57	Entrepreneurial Development	1	0	0	1

18	PE	MECX58	Digital Manufacturing	1	0	0	1
19	PE	MECX59	Additive Manufacturing	1	0	0	1
20	PE	MECX60	Failure Analysis and techniques	1	0	0	1
21	PE	MECX61	Advanced System Simulation (1D Modeling)	1	0	0	1
22	PE	MECX62	Project Management	1	0	0	1
23	PE	MECX63	Internet of Things for Manufacturing	1	0	0	1

Physics Elective Courses

I Semester
(Common to all branches)

Course code	Name of the Course	L	T	P	C
PHC1182	Physics	3	0	2	4

II Semester
(Compulsory Elective Courses)

Course code	Name of the Courses	L	T	P	C
PHCX 01	Fundamentals of Engineering Materials	2	0	2	3
PHCX 02	Heat and Thermodynamics	2	0	2	3
PHCX 03	Introduction to Nanoscience and Technology	2	0	2	3
PHCX 04	Lasers and their applications	2	0	2	3
PHCX 05	Materials Science	2	0	2	3
PHCX 06	Non-Destructive Testing	2	0	2	3
PHCX 07	Properties of Matter and Acoustics	2	0	2	3
PHCX 08	Properties of Matter and Nondestructive Testing	2	0	2	3
PHCX 09	Semiconductor Physics and Optoelectronics	2	0	2	3

Chemistry Courses for B.Tech students

Ist Semester common for all branches

Course code	Name of the Courses	L	T	P	C
CHC1181	Chemistry	3	0	2	4

IInd Semester Chemistry Courses

Course code	Name of the Courses	L	T	P	C
CHCX01	ANALYTICAL INSTRUMENTATION	2	0	2	3
CHCX02	CORROSION AND ITS CONTROL	2	0	2	3

CHCX03	ELECTRICAL MATERIALS AND BATTERIES	2	0	2	3
CHCX04	ENGINEERING MATERIALS	2	0	2	3
CHCX05	FUELS AND COMBUSTION	2	0	2	3
CHCX06	FUNDAMENTALS OF PHYSICAL CHEMISTRY	2	0	2	3
CHCX07	GREEN TECHNOLOGY	2	0	2	3
CHCX08	ORGANIC CHEMISTRY OF BIOMOLECULES	2	0	2	3
CHCX09	POLYMER SCIENCE AND TECHNOLOGY	2	0	2	3

IIIrd and IVth Semester Chemistry Courses

Course code	Name of the Courses	L	T	P	C
GEC 1212	ENVIRONMENTAL STUDIES	2	0	0	2

Maths Elective Courses

(To be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 01	Discrete Mathematics And Graph Theory	3	1	0	4
2.	MACX 02	Probability And Statistics	3	1	0	4
3.	MACX 03	Random Processes	3	1	0	4
4.	MACX 04	Applied Numerical Methods	3	1	0	4

Maths Elective Courses

(To be offered in VI Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 05	Mathematical Programming	2	0	0	2
2.	MACX 06	Statistical Methods for Data	2	0	0	2

		Analysis				
3.	MACX 07	Numerical Methods for Integral and Differential Equations	2	0	0	2
4.	MACX 08	Mathematical Modelling	2	0	0	2
5.	MACX 09	Graph Theory	2	0	0	2

Humanities Elective I

(To be offered in III Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX01	Fundamentals of Economics	2	0	0	2
2.	SSCX02	Principles of Sociology	2	0	0	2
3.	SSCX03	Sociology of Indian Society	2	0	0	2

Humanities Elective II

(To be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX04	Economics of Sustainable Development	2	0	0	2
2.	SSCX05	Industrial Sociology	2	0	0	2
3.	SSCX06	Law for Engineers	2	0	0	2

General Elective
Group I Courses
(To be offered in V semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX101	Disaster Management	Civil
2.	GECX102	Total Quality Management	Mechanical
3.	GECX103	Energy Studies	Mechanical
4.	GECX104	Robotics	Mechanical
5.	GECX105	Transport Management	Automobile
6.	GECX106	Control Systems	EEE
7.	GECX107	Introduction to VLSI Design	ECE
8.	GECX108	Plant Engineering	EIE
9.	GECX109	Network Security	CSE
10.	GECX110	Knowledge management	CSE
11.	GECX111	Cyber security	IT
12.	GECX112	Genetic Engineering	LS
13.	GECX113	Fundamentals of Project Management	CBS
14.	GECX114	Operations Research	Mathematics
15.	GECX115	Nano Technology	Physics / Chemistry
16.	GECX116	Vehicle Maintenance	Automobile
17.	GECX117	Fundamentals of Digital Image Processing	ECE

Group II Courses

(To be offered in VII semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX201	Green Design and Sustainability	Civil
2.	GECX202	Appropriate Technology	Civil / Mechanical
3.	GECX203	Engineering System Modelling and Simulation	Mechanical
4.	GECX204	Value Analysis and Engineering	Mechanical
5.	GECX205	Industrial Safety	Mechanical
6.	GECX206	Advanced Optimization Techniques	Mechanical
7.	GECX207	Mat Lab Simulation	EEE
8.	GECX208	Embedded Systems Hand its Applications	ECE
9.	GECX209	Usability Engineering	CSE
10.	GECX210	Supply Chain Management	CBS
11.	GECX211	System Analysis and Design	CA
12.	GECX212	Advanced Materials	Physics & Chemistry
13.	GECX213	National Service Scheme	School of Humanities
14.	GECX214	Automotive Pollution and Control	Automobile
15.	GECX215	Motor Vehicle Act, Insurance and Policy	Automobile
16.	GECX216	Principles of Communication Systems	ECE
17.	GECX217	Lean Management	Civil
18.	GECX218	Spatial Data Modeling & Analysis	Civil

SEMESTER I

MAC 1181	DIFFERENTIAL CALCULUS AND GEOMETRY	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to

- Introduce eigen values and eigenvectors of matrix algebra
- Make the student knowledgeable in the area of Three Dimensional Analytical Geometry
- Demonstrate the application of Differential Calculus
- Familiarize the student with the functions of several variables
- Develop the use of ODE solvable techniques necessary for engineering applications
- Motivate the students with some basic engineering application problems in ODE

MODULE I MATRICES 8+2

Characteristic Equation- Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

MODULE II THREE DIMENSIONAL ANALYTICAL GEOMETRY 7+3

Direction cosines and ratios – angle between two lines – equations of a plane – equations of a straight line, coplanar lines - shortest distance between skew lines - sphere – tangent plane – plane section of a sphere – orthogonal spheres.

MODULE III DIFFERENTIAL GEOMETRY 7+3

Curvature – Cartesian and polar coordinates – centre and radius of curvature – circle of curvature – involutes and evolutes – envelopes.

MODULE IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 8+2

Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobian - Taylor's series expansion – Optima of two variables – Lagrange's multiplier method.

MODULE V ORDINARY DIFFERENTIAL EQUATIONS 8+2

Linear equations of second order with constant and variable coefficients – Simultaneous first order linear equations with constant coefficients – homogeneous equations of Euler's type – method of undetermined coefficients, method of variation of parameters

MODULE VI APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS 7+3

Solution of Ordinary Differential Equation Related to Electric Circuits – Bending of Beams- Motion of a Particle in a resisting medium – Simple harmonic motion.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2006.
2. Grewal B.S., "Higher Engineering Mathematics" (43rd edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
4. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
5. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
6. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
7. James Stewart ".Calculus" (7th edition),Brooks/Cole cengage learning, UK

OUTCOMES:

After completing the course, student will be able to

- Understand the matrix techniques and compute eigen values and eigenvectors of a given matrix.
- Do the problems based on three dimensional analytic geometry.
- Apply differential calculus in engineering problems.
- Differentiate more than one variable and their applications.
- Solve the differential equations with constant coefficient and variable coefficient.
- Form and solve differential equations.

ENC 1181	ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop students' listening skill for comprehending and analyzing information.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I 8

L: Listening for general information

S : Self Introduction, Introducing one another.

R: Predicting the content

W: Paragraph Writing

Language Focus: Affixes, Simple Present tense, Connective & Prepositions.

MODULE II 8

L: Listening for specific information (from dialogues)

S: Exchanging opinion.

R: Skimming technical Passages

W: Argumentative Writing (using the concept of Flipped Learning), Letter to the Editor.

Language Focus: Idioms, use of Modals, Simple Past tense & use of "Wh" and question tags.

MODULE III 7

L: Learning the ways of describing images and presenting specific information (focusing on note making)

S: Making Presentations using visuals.

R : Scanning short texts for gist of information

W: Letter of Invitation, Expository Writing

Language Focus: Homophones, Homographs, Simple Future & Collocations.

MODULE IV **7**

L: Understanding prepared presentation techniques through videos

S: Short Presentations.

R: Reading for coherence and cohesion

W: Letter seeking permission for Industrial Visit

Language Focus: S-V agreement, Euphemism

MODULE V **8**

L : Understanding Non- Verbal Communications while listening to narration of incidents.

S: Narrating an expereince

R: Inferential Reading

W: Process Description – Transcoding a Flow chart.

Language Focus: Interchange of Active & passive voice, Impersonal Passive voice.

MODULE VI **7**

L: Learning Story telling techniques (stories & visuals) through audio files

S: Discussion in groups

R: Reading for critical appreciation

W: Developing an idea, Slogan writing, Interpreting a Bar Chart.

Language Focus: If clause and phrasal verbs.

Total Hours:45

REFERENCES:

1. Carol Rosenblun perry (2011). The Fine Art of Technical Writing. Create Space Independent Publishing Platform, New Delhi.
2. Dutt, P.K. Rajeevan. G and Prakash, C.L.N. (2007) A course in Communication Skills. Cambridge Univesity Press, India.
3. Kala, Abdul & Arun Tiwari (2004). Wings of Fire: An Autobiography (Simplified and A bridged by Mukul Chowdhri). Hyderabad Univeristy Press.
4. Sen, Leena. (2004) Communication Skills. Prentice Hall, New Delhi.
5. Matt Firth, Chris Sowton et.al. (2012). Academic English: An Integrated Skills Course for EAP. Cambridge University Press, Cambridge.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

ISC1181	ARABIC	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To read and write in Arabic language.
- To learn vocabulary of different fields
- To develop situational communication skills.

MODULE I PREPARATORY ARABIC **7**

Introducing Arabic Alphabets.

Listening and Reading.

Audio & Video aided listening, Tajweed listening,

Writing Arabic Alphabets (connected & unconnected).

Introducing words.

Reading simple sentences.

Learning names of the things in and around the class room.

Exercises.

MODULE II FUNCTIONAL ARABIC **7**

Listening Arabic texts, stories and action verbs

Communicating Simple sentences.

Jumla' Ismiyya and Jumla' Fi'liyya

Situational Conversation:

Greetings, Introduction.

Classroom, College, Picnic.

Dining and Kitchen.

Reading skills.

Exercises

MODULE III FUNCTIONAL ARABIC **8**

Implication of effective listening.

Audio aids.

Writing Simple sentences.

Communicating ordinal and cardinal numbers.

Situational communication:

Playground, library.

Forms of plural – Sample sentences.

Introduction to tenses.

Exercises.

MODULE IV FUNCTIONAL ARABIC 8

Communication:

Family, travel

Market, Prayer hall

Writing skills:

Note making.

Sequencing of sentences.

Developing answers from the questions.

Exercises.

MODULE V TECHNICAL ARABIC 8

Importance of technical communication.

Reading and writing skills.

Audio & Video aided listening.

Introduction to Arabic terms related to administration.

Situation communication:

Air travel, Office administration, passport, visa.

Exercises

MODULE VI TECHNICAL ARABIC 7

Situation communication:

Contractual work, machineries and equipment.

Computer, internet browsing.

Banking,

Exercises.

Total Hours:45

TEXT BOOKS:

1. Arabic for professionals and employees, Kilakarai Bukhari Aalim Arabic College, Chennai, India, 2013.

REFERENCES:

1. Arabic Reader for Non Arabs (Ummul Qura University, Makkah), Kilakarai Bukhari Aalim Arabic College, 2005.

OUTCOMES:

On successful completion of the course, the student will be able to:

- Write correct sentences in Arabic.
- Communicate in Arabic at primary level in working situations in the fields of engineering and administration.

LNC1181	**MANDARIN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To improve the proficiency of students in Mandarin language.
- To develop their knowledge of vocabulary.
- To train them in using appropriate grammatical forms during communications.
- To empower them for successful communication in social and academic contexts.
- To make them appreciate the language usage in real life situations.

MODULE I **8**

General Introduction to Chinese • Pinyin and Tones • Introduction to the Writing System: basic strokes and stroke order · Numbers 1-100, song · Days of the Week · Months of the Year

MODULE II **8**

Chinese names and related culture · Chinese family structures and values · Greetings · Introducing Yourself · Family members · Occupations

MODULE III **7**

Languages and Nationalities · Daily Routine · Chinese breakfast · Negative Sentences and Interrogative Sentences · Asking for Personal Information · The Verb *shi* and Basic Sentence Structures

MODULE IV **7**

Answering an Affirmative-negative Question · Food and drinks Transportation · Likes and dislikes · Adverbs *bu*, *jiu* and *dou* · Verb-absent Sentences

MODULE V **8**

Jisui and *duoda* Questions · S+V+O Construction · Routines and Daily Activities ·*Haishi* Questions · Modal Verbs · Hobbies and Habits

MODULE VI **7**

Making Suggestions with *haoma* ·Colors · Clothing · Body parts · Talking about Likes and Dislikes · Measurement Words in Chinese

Total Hours:45

TEXT BOOKS:

1. Ma, Yanmin, and Li, Xinying. Easy Steps to Chinese, Vol. 1 Textbook. Beijing: Beijing Language and Culture University Press, 2006. Print.
2. Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol. 1 Workbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.

OUTCOMES:

On completion of the course, students will be able to

- Exhibit proficiency in Chinese Language.
- Use vocabulary in appropriate contexts.
- Use appropriate grammatical forms effectively.
- Use the language in social and academic contexts.
- Appreciate the use of language forms.

LNC1182	GERMAN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in German language.
- To create awareness of using vocabulary among students.
- To expose them to correct grammatical forms of the language.
- To empower them for successful communication in social and academic contexts.

MODULE I **8**

Introduction to German alphabets, phonetics and pronunciation- Introducing themselves and others using simple sentences and answer to some basic personal questions-: Introduction to different types of articles and verbs, Nouns

MODULE II **8**

Understanding and responding to everyday queries like instruction, questions, - number & gender, pronouns, present and past tense.

MODULE III **7**

Short telephone messages, requests etc., if spoken slowly and clearly-- Detailed overview of articles, adjectives with/without articles, Prepositions

MODULE IV **7**

Ask and giving directions using simple prepositions- Ability to fill basic information on forms while registering for courses / classes.

MODULE V **8**

Ability to extract and understand relevant information in a public announcement, broadcast, newspaper, radio etc-- dative & accusative

MODULE VI **7**

Ability to describe about people, work, immediate environment, education and other topics related to personal needs in a concise manner- Understanding of matters that are familiar and are encountered regularly like instances at school, work, at public places, places of leisure etc.

Total Hours:45

TEXT BOOKS:

1. Course book : Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr, Hueber Publisher, ISBN 978-3-19-001801-7
2. Practice book: Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr, Hueber Publisher, ISBN 978-3-19-001801-7.

REFERENCES:

1. NETZWERK A1 TEXTBOOK, Deutsch als Fremdsprache, Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, Langenscheidt and Klett, ISBN : 9788183076968
2. STUDIO D A1 (SET OF 3 BOOKS + CD), Hermann Funk. Cornelsen, ISBN: 9788183073509
3. Willkommen! Beginner’s course. Paul Coggle, Heiner Schenke. 2nd edition. (chapter 1 - 6) ISBN: 9781444165159 –
4. Willkommen! Beginner’s course. Paul Coggle, Heiner Schenke. ISBN: 978-1-444-16518-0
5. An Introduction to the German Language and Culture for Communication, Updated Edition Lovik, Thomas A., J. Douglas Guy & Monika Chavez. Vorsprung -. New York, Houghton Mifflin Company, 1997/2002. ISBN 0-618-14249-5.

OUTCOMES:

On completion of the course, students will be able to

- Show their proficiency in German Language.
- Use appropriate vocabulary in real life contexts.
- Use appropriate grammatical forms while communicating with people.
- Effectively use the language in social and academic contexts.

LNC1183	JAPANESE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I **7**

Introduction of the Japanese writing system, i.e. *Hiragana*, *Katakana* and *Kanji*, word-building, writing foreign names and loan words in Katakana.

MODULE II **8**

Oral practice of pronunciation and intonation of Japanese sounds, Japanese greetings, self introduction, identifying things, time of the day, calendar; counting using Japanese numerical classifiers; describing things;

MODULE III **7**

Making comparisons; talking of daily activities, kinship terms used for address and reference, seasons, giving and receiving, shopping; making requests, talking of one's likes and dislikes.

MODULE IV **8**

Extensive practice of basic patterns at the lower intermediate level through drills and exercises.

MODULE V **7**

Comprehension of passages in simple Japanese and writing of composition in Japanese applying lower intermediate grammatical patterns.

MODULE VI **8**

Diverse texts based on Japanese culture, customs, history, food habits, and science etc, for the development of communicative competence of students; skimming, scanning of texts with emphasis on advanced sentence patterns, grammatical structures and idiomatic phrases, reading and writing of approximately

Total Hours:45

REFERENCES:

1. Nihongo I, Kokusaigakuyukai, and other supplementary material
2. Exersice book 1of Nihongo 1, and other supplementary material
3. Nippon, the Land and its People & Encyclopedia of Contemporary Japanese
4. Japani: Japanese Conversation for Improving Spoken Proficiency, By P.A. George, Inoue Yoriko and Itsuko Nandi, Books Plus.
5. Chukyu Nihongo, Tokyo Gaikokugo Daigaku; Nihongo II, Kokusaigakuyukai, and other supplementary material.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

PHC 1181	PHYSICS	L	T	P	C
		3	0	2	4

OBJECTIVES:

To make students conversant with the

- basic concepts of crystal physics and its structures
- production and applications of ultrasonic waves
- study of thermal conductivities of good and bad conductors
- phenomenon of wave optics and its applications
- principle of fibre optic communication and its applications to sensors
- wave mechanics principle and its applications in electron microscopy
- green energy physics and its environmental impacts to society

MODULE I CRYSTAL PHYSICS 8

Crystalline and amorphous solids – Unit Cell – Seven Crystal Systems – Bravais Lattice – Miller Indices – Interplanar Spacing – Characteristics of Unit Cell - Calculation of Number of atoms per unit cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP and Diamond structures –Defects in crystals-Point defects –Edge and screw dislocations and their significance - Surface Defects.

MODULE II ULTRASONICS AND THERMAL PHYSICS 8

Introduction to Ultrasonics - Properties - Production methods - Magnetostriction Oscillator method- Piezoelectric Oscillator method – Detection of Ultrasonics – Thermal method – Piezoelectric method – Kundt's tube method – Applications of Ultrasonics – Acoustic Grating – SONAR – Depth of sea – Velocity of blood flow, Ultrasonic Flaw detector (qualitative).

Transmission of heat – Conduction, Convection and Radiation – Thermal Conductivity of good Conductor – Forbe's method- Thermal Conductivity of bad Conductor – Lee's Disc method.

MODULE III APPLIED OPTICS 8

Interference – Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet.

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: He-Ne laser, CO2 laser and Nd:YAG laser - Applications : Laser Materials Processing .

MODULE IV FIBRE OPTICS 7

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers - Applications – Fibre optic communication system (block diagram only)- Fibre optic sensors - displacement and pressure sensors (qualitative) - Medical endoscope.

MODULE V QUANTUM MECHANICS 7

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jean's law from Planck's theory –Dual nature of matter – de Broglie's wavelength- Physical significance of wave function – Schrodinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box – Harmonic oscillator(qualitative).

MODULE VI RENEWABLE ENERGY SOURCES 7

Present Energy sources and sustainability - Solar energy - Solar photovoltaics - Solar cells – Bioenergy - Biomass – production of liquid fuels from biomass – Wind energy – Wind turbines – energy and power from wind turbines - Geothermal energy - Ocean energy: Wave energy – Wave energy conversion devices – Tidal energy – Tidal power basics – power generation –Tidal energy potential – Environmental benefits and impacts of renewable energy sources

PRACTICALS **Total Hours** :45

1. Determination of Velocity of Ultrasonic waves in a given liquid using Ultrasonic Interferometer.
2. Determination of wavelength of ultrasonic waves using Kundt's tube method.
3. Determination of thickness of a thin wire using Air Wedge method.
4. Determination of wavelength of light using spectrometer diffraction grating.
5. Determination of angle of divergence of a laser beam using He-Ne laser.
6. Determination of particle size of lycopodium powder using semiconductor laser.
7. Determination of wavelength of laser light using semiconductor laser diffraction.
8. Determination of Acceptance angle and Numerical Aperture using

fiber optic cable.

9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Determination of thermal conductivity of a bad conductor by Lee's disc method.
11. Determination of solar cell characteristics.

L – 45; P – 15; Total Hours : 60

REFERENCES :

1. Gaur R.K. and Gupta S.L., "Engineering Physics'', 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
2. Palanisamy P.K., Physics for Engineers, Vol 1 & Vol 2, 2nd Edition, Scitech Publications, 2003.
3. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co., 2010.
4. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics", W.H. Freeman, 2007.
5. Markert J.T., Ohanian. H. and Ohanian, M. "Physics for Engineers and Scientists". W.W. Norton & Co. 2007.
6. Godfrey Boyle, "Renewable Energy: Power for sustainable future", 2nd edition, Oxford University Press, UK, 2009.

OUTCOMES:

At the end of the course, students will be able to

- understand the different types of crystal structures
- apply the concept of ultrasonic principle in engineering and medical field
- calculate thermal conductivities of good and bad conductors
- differentiate the various laser systems and its applications in engineering and medical field
- apply the principle of fibre optics for communication and sensor applications
- formulate wave mechanics principle for applications in electron microscopy
- Correlate the different renewable energy sources for societal needs.

- To complement the knowledge acquired in the theory class.
- To correlate the experimental results for application.

CHC1181	CHEMISTRY	L	T	P	C
		3	0	2	4

OBJECTIVES:

The students should be conversant with

- the basic problems like hardness, alkalinity, dissolved oxygen associated with the water used for domestic and industrial purpose and treatment process involved.
- the synthesis, properties and applications of nanomaterials.
- the importance of renewable energy sources like solar, wind, biogas, biomass, geothermal, ocean and their limitations.
- the basic analytical techniques like UV-Visible, FT-IR, NMR, AAS, AES, Circular Dichroism and XRD etc.
- photochemistry concepts related to physical processes and chemical reactions induced by photon absorption and their applications.
- basic principles of electrochemistry, cell construction and evaluation and to understand general methodologies for construction & design of electrochemical cell

MODULE I WATER TECHNOLOGY 9

Impurities present in water, hardness : types of hardness, demerits of hard water in boilers, estimation of hardness by EDTA method (problems) – alkalinity : estimation of alkalinity (problems) – dissolved oxygen: estimation of dissolved oxygen – conditioning methods : external treatment method: – lime soda and zeolite process (principle only), Ion exchange process – Internal treatment : colloidal, carbonate, phosphate and calgon methods – drinking water: standards (BIS), treatment of domestic water {screening, sedimentation, coagulation, filtration, disinfection }– desalination: electrodialysis, reverse osmosis.

MODULE II NANOCHEMISTRY 6

Introduction – distinction between molecules, bulk materials and nanoparticles – classification based on dimension with examples – synthesis (top-down and bottom-up approach} : sol-gel, thermolysis (hydrothermal and solvothermal), electrodeposition, chemical vapour deposition, laser ablation – properties and applications (electronic, magnetic and catalytic) – risk factors and future perspectives.

MODULE III ENERGY SOURCES 8

Energy: past, today, and future – a brief history of energy consumption – present energy scenario of conventional and renewable energy sources –

renewable energy : needs of renewable energy, advantages and limitations of renewable energy – solar energy: basics, solar energy in the past , photovoltaic, advantages and disadvantages – bioenergy: conversion, bio degradation, biogas generation, biomass gasifier, factors affecting biogas generation, advantages and disadvantages – geothermal energy: geothermal resources (hot dry rock and magma resources, natural and artificial), advantages and disadvantages – wind energy: wind resources, wind turbines, advantages and disadvantages – ocean energy: wave energy, wave energy conversion devices, ocean thermal energy, advantages and disadvantages.

MODULE IV PHOTOCHEMISTRY 7

Introduction: absorption and emission, chromophores, auxochromes – laws of photochemistry: Grotthus-Draper law, Stark Einstein law – quantum yield (problems) –photo physical processes: fluorescence and phosphorescence - Jablonski diagram (electronic states and transitions) – quenching, annihilation – photosensitization: principle and applications – chemiluminescence, bioluminescence.

MODULE V ANALYTICAL TECHNIQUES 7

Spectroscopy: electromagnetic radiation and spectrum – types of transitions – types of spectra (atomic and molecular with their chemical usefulness) – Beer-Lamberts law (problems) – principles, instrumentation and applications of: Colourimetry – UV-Vis spectrophotometer – atomic absorption spectroscopy – atomic emission spectroscopy – principles and applications of: IR, NMR, mass and X-ray diffraction analysis.

MODULE VI ELECTROCHEMISTRY 8

Electrochemistry - types of electrodes (principle and working) : gas (SHE), metal/metal ion electrode, metal-metal insoluble salt (calomel electrode), ion-selective (glass electrode and fluoride ion selective electrode) – Electrolytic and galvanic cells, construction of cell, EMF measurement and applications (problems), standard cell (Weston-cadmium), reversible and irreversible cell, concentration cell. Determination of fluoride ion using fluoride ion selective electrode – Chemically modified electrodes (CMEs): concept, approaches and applications.

PRACTICALS

1. Estimation of hardness in given water sample.
2. Estimation of the alkalinity of the given water sample.
3. Estimation of strong acid by conductometry.
4. Estimation of Fe^{2+} present in the given sample by potentiometry.
5. Verification of Beer-Lamberts law and estimation of Cu^{2+} present in unknown sample.
6. Estimation of sodium and potassium present in the given sample by flame photometry.
7. Determination of molecular weight and degree of polymerisation of a polymer by viscosity method.
8. Synthesis of thermosetting polymer.

L – 45; P – 15; Total Hours : 60

REFERENCES:

1. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India Ltd., New Delhi, 2011.
2. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, Thomas Graham House, Cambridge, 2005.
3. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.
5. G.D.Rai, “Non conventional energy sources,” Khanna Publishers, New Delhi, 2011.
6. John Twidell and Tony Weir, “Renewable Energy Resources, Taylor & Francis Ltd, London, United Kingdom, 2005
7. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V. Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

OUTCOMES:

The students will be able to

- solve problems related to hardness, alkalinity, dissolved oxygen associated with the water and describe the treatment processes.
- classify nanomaterials and apply the nanochemistry approach to synthesize the nanomaterials.
- explain the principle and enumerate the advantages and disadvantages of various renewable energy sources.
- state the principle and illustrate the instrumentation of various analytical techniques.
- apply the concepts of photochemistry to elaborate various photo-physical and photochemical reactions.
- construct a electrochemical cell and describe the various types of electrodes and determine the fluoride content.

GEC 1101	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To introduce the students of all engineering programs, the basic concepts of engineering drawing, which is the basic communication medium for all engineers
- To provide practical exposure on important aspects like drawing analytic curves, orthographic projections, section of solids, development of surfaces, isometric projection, perspective projection and free hand drawing.
- To introduce computerized drafting.

MODULE I BASICS AND ENGINEERING CURVES 10

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions.

Conic sections: ellipse, parabola, hyperbola.

Special curves: cycloid, epicycloid, hypocycloid and involutes.

MODULE II ORTHOGRAPHIC PROJECTION 8

Orthographic projection – first angle, second angle, third angle and fourth angle projections –setup - assumptions, principle. Free hand sketching of orthographic views of simple machine parts as per first angle projection. Orthographic projection of points in all quadrants. Some commands and demonstration of drafting packages.

MODULE III PROJECTION OF STRAIGHT LINES AND PLANES 10

Projection of straight lines in first quadrant – true length and true inclinations – Rotating line and trapezoidal methods –traces of straight line.

Projection of plane lamina in first quadrant and its traces

MODULE IV PROJECTION OF SOLIDS 10

Projection of solids in first quadrant: Axis inclined to one reference plane only- prism, pyramid, cone, cylinder – change of position and auxiliary projection methods.

MODULE V SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Section of solids: prism, pyramid, cone, cylinder, and sphere – sectional view – true shape of section Solids in simple position and cutting plane inclined to one reference plane only.

Development of surface of truncated solids: prism, pyramid, cone cylinder – frustum of cone, pyramid and simple sheet metal parts.

MODULE VI PICTORIAL PROJECTIONS 10

Isometric projection: Isometric scale – isometric axes- iso sheet - Isometric projection and view of prism, pyramid, cylinder, cone, frustums, truncated solids and simple products

Perspective projection: station point – vanishing point – Perspective projection and views of prism, pyramid, cylinder and frustums by Visual ray method.

L – 30; P – 30; Total Hours :60

TEXT BOOKS:

1. N.D. Bhatt, 'Engineering Drawing' Charotar Publishing house, 53rd Edtion, (2014)

REFERENCES:

1. K.V. Natarajan, 'A text book of Engineering Graphics', Dhanalakshmi publishers, Chennai. (2009)
2. Venugopal. K, and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd., Publication, Chennai. (2011)

OUTCOMES:

- Students should be able to read the specifications and standards of technical drawing and able to draw conic sections and special curves.
- Students should be able to understand the insight of orthographic projection and to draw the various views of orthographic projection of a point and various components.
- Students should be able to draw the orthographic views of straight lines and plane figures.
- Students should be able to draw the orthographic views of simple solids.
- Students should be able to draw the sections of solids and development of solid surfaces.
- Students should be able to draw the isometric and perspective projection of simple solids and components.

GEC 1102	ENGINEERING DESIGN	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To understand the role of design in Engineering
- To understand the basic design concepts
- To understand the role of innovation in design

MODULE I DESIGN AS A CENTRAL ACTIVITY IN ENGINEERING 08

Product design – products and processes – product design methodology Design of systems; Software design

MODULE II NEED ANALYSIS AND CONCEPT DEVELOPMENT 07

Voice of customers – product specification - need analysis Bench marking Product architecture – concept generation and evaluation;

MODULE III CASE STUDIES IN ENGINEERING DESIGN 08

Product design – process design; system design; software design -Ergonomics – usability

MODULE IV INNOVATION AND DESIGN 07

Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – case studies.

Total Hours : 30

REFERENCES:

1. Clive L. Dym and David C. Brown,“Engineering Design: Representation and Reasoning”, 2nd Edition, Cambridge University Press, New Delhi, 2011.
2. Daniel G. Dorner, G. E. Gorman and Philip J. Calvert, “Information Needs Analysis: Principles and practice in information organizations”, Published by Faced Publishing, London. 2015.
3. Cliff Matthews, “Case Studies in Engineering Design”, John Wiley & Sons Pvt. Ltd, New York, 1998.
4. Bengt-Arne Vedin, “The Design-Inspired Innovation Workbook”, World Scientific, 2011.
5. Navi Radjou, Jaideep Prabhu and Simone Ahuja, “Jugaad

Innovation”, Published by Random House India, 2012.

OUTCOMES:

The students will be able to

- Apply the basic knowledge of design in engineering products / process / service.
- Analyse the problems and give innovative solutions.
- Correlate the basic knowledge of design in the real world problems.
- Apply innovative approaches to engineering design.

GEC1103	BASIC ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide a practical exposure to basic engineering practices like carpentry, fitting, plumbing, welding and making of simple electrical and electronic circuits
- To have an understanding on the use of various tools, instruments and methods
- To enable the students to appreciate the practical difficulties and safety issues

CIVIL ENGINEERING PRACTICE

1. Study of plumbing in general household and industrial systems
2. Making a small window frame with Lap and Mortise & Tenon Joints
3. Introduction to power tools

MECHANICAL ENGINEERING PRACTICE

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints
2. Machining of a simple component like a table weight using lathe
3. Mold preparation for simple component

ELECTRICAL ENGINEERING PRACTICE

1. Comparison of incandescent, Fluorescent, CFL and LED lamps.
2. Study of Protection Circuits (small relay, fuse, MCB, HRC, MCCB, ECCB).
3. Familiarization of households Electrical Gadgets (Iron Box, Wet Grinder).
4. Understanding of Domestic and Industrial wiring.
5. Earthing and its significance.
6. Troubleshooting in Electrical Circuits.
7. Study of inverter fed UPS/Emergency lamp

ELECTRONICS ENGINEERING PRACTICE

1. Identifications symbolic representation of active and passive electronic components
2. Soldering and tracing of electronic circuits and checking its continuity
3. Assembling of A.C. to D.C, D.C to A.C. Circuits in bread Board and Mini project.

Total Hours : 30

OUTCOMES:

Upon the completion of the course, students should be able to

- Appreciate the practical skills needed even in making of simple objects, assemblies and circuits
- Attend minor defects especially in items used in day to day life
- Aware of the safety aspects involved in using tools and instruments

GEC 1104 COMPUTER PROGRAMMING I

L	T	P	C
1	0	2	2

OBJECTIVES:

- To identify the hardware and software components of the computer.
- To know the basic concept of operating system and get knowledge about different operating systems.
- To learn various database concepts and operations
- To develop efficient algorithms for solving a problem.
- To implement the algorithms in C language.
- To use arrays in solving problems.

MODULE I COMPUTER FUNDAMENTALS 7

Introduction -. Number System - Planning the computer program - Computer Software - Basic operating system concepts - Database Operations

MODULE II PROGRAMMING IN C 8

Introduction to C Programming Language – Operators - Control statements - Iterative statements - Arrays.

LIST OF EXPERIMENTS:

1. Computer organization –Hardware in a typical computer Identification – Booting- error messages and what it means
2. Types of Operating systems – Windows and Linux
3. Structure of a basic program - Hello world program – Debugging it
4. Data types: Type conversions
5. Input / Output: Formatted functions – Unformatted functions – Library functions
6. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
7. If – if else- nested if else- goto- switch case – nested switch case – for loops – nested for loops – while loop – do-while loop – break and continue statement
8. Arrays – Operation with arrays
9. Sorting and searching.

L – 15; P – 15; Total Hours : 30

REFERENCES:

1. Ashok N Kamthane, "Computer Programming", Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012
2. Paul J. Deitel, Deitel & Associates, "C How to Program", Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012

OUTCOMES:

Students who complete this course will be able to

- Recognize Modular design, logic flow, data abstraction
- Analyze the working of the programming constructs, functions, and I/O.
- Write down programs for sorting and searching algorithms
- Write down programs developing cycle for different applications
- Debug the programs and solve some practical problems in programming
- Develop programs using arrays.

SEMESTER II

MAC 1281	ADVANCED CALCULUS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to

- Train the students in solving problems using multiple integration.
- Provide knowledge in using special functions to find out the area and volume of a region.
- Acquire knowledge in tangent and normal vectors.
- Gain knowledge in finding the areas of a curve and surface using vector integration.
- Learn about the analytic functions and their properties along with bilinear transformation.
- Know complex integration using Cauchy's theorems.

MODULE I MULTIPLE INTEGRATION AND ITS APPLICATIONS 8+2

Multiple integrals– Cartesian and Polar coordinates – change of order of integration – Multiple integral to compute area and volume.

MODULE II TRANSFORMATION OF COORDINATES AND SPECIAL FUNCTIONS 7+3

Change of variables between Cartesian, polar, cylindrical and spherical coordinates - Beta and Gamma functions – Properties and applications.

MODULE III VECTOR DIFFERENTIATION 7+3

Operations on vectors – Scalar Product, Vector Product, Projection of Vectors - Angle between two vectors - Gradient, divergence and curl

MODULE IV VECTOR INTEGRATION 8+2

Line, surface and volume integrals – Green's Theorem, Gauss Divergence Theorem and Stokes Theorem (statement only) – verification and evaluation of integrals.

MODULE V ANALYTIC FUNCTION 8+2

Analytic function - Necessary and Sufficient condition (statement only) – Cauchy-Riemann equations in polar coordinates - properties of analytic function – determination of analytic function – conformal mapping (w = z+a, az and 1/z) and bilinear transformation.

MODULE VI COMPLEX INTEGRATION 7+3

Statement and application of Cauchy's integral theorem – Cauchy's integral formula – Taylor's series and Laurent's series expansion – singularities - classification – residues - Cauchy's residue theorem – contour integration – Unit circle and semi circular contours (excluding poles on the real axis).

L – 45; T – 15; TOTAL HOURS – 60

TEXT BOOKS:

1. Veerarajan.T., "Engineering Mathematics "(5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Grewal B.S., "Higher Engineering Mathematics" (43rd edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943

REFERENCES:

1. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
5. Ramana, B.V., "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2006.
6. Venkataraman, M.K., "Engineering Mathematics", Volume 2, 2nd edition, National Publishing Co., Chennai, 2003.
7. James Stewart ".Calculus" (7th edition), Brooks / Cole cengage learning, UK.

OUTCOMES:

After completing the course, student will be able to

- Compute the area and volume using multiple integrals.
- Apply special functions to solve integration problems.
- Apply differentiation in scalar and vector fields.
- Find area and volume of a region using vector integration.
- Verify analyticity, conformity and bilinearity of complex functions.
- Evaluate complex integrals.

GEC 1211	BASIC ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

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

MODULE I VECTOR APPROACH TO MECHANICS 9

Introduction - Units and Dimensions- Vectors – Vectorial representation of forces and moments –Vector Algebra and its Physical relevance in Mechanics - Laws of Mechanics – Parallelogram and triangular Law of forces -Lame’s theorem, Coplanar Forces – Resolution and Composition of forces- Equilibrium of a particle.

MODULE II EQUILIBRIUM OF PARTICLE 10

Forces in space - Equilibrium of a particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

MODULE III EQUILIBRIUM OF RIGID BODY 12

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

MODULE IV PROPERTIES OF SURFACES 12

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

MODULE V FRICTION 08

Introduction to friction- types of friction- Laws of Coloumb friction- Frictional force – simple contact friction – Rolling resistance –ladder friction

MODULE VI LAWS OF MOTION 09

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

L – 45; T – 15; Total Hours : 60

REFERENCES:

1. Beer, F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers, Dynamics & Statics", Third SI Metric Edition, Tata McGraw-Hill International Edition, 2001.
2. Hibbeller, R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
3. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition Pearson Education Asia Pvt. Ltd., 2003.

OUTCOMES:

On completion of this course students should be able

- Analyse and resolve forces, moments and solve problems using various principles and laws of Mechanics
- Apply the concept of equilibrium to particles and solve problems
- Apply the concept of equilibrium to rigid bodies and solve problems
- Analyse and determine the properties of surfaces
- Analyse and evaluate the fractional forces between the bodies
- Apply the laws of motion in solving dynamics problems

GEC 1212	ENVIRONMENTAL STUDIES	L	T	P	C
		2	0	0	2

OBJECTIVES:

The student will be conversant with the

- various natural resources, availability, utilisation and its current scenario
- different ecosystems, energy transfer, values, threats and conservation of biodiversity
- levels of different pollutants and its impact and the causes and effects of natural disasters
- impacts of human population, impact assessment, human rights and environmental acts and sustainable development

MODULE I NATURAL RESOURCES 8

Land resources: land degradation, soil erosion and desertification - Forest resources: use and over-exploitation, deforestation - Water resources: use and over-utilisation of surface and ground water, conflicts over water (inter-state and international), dams (benefits and problems), water conservation (rainwater harvesting and watershed management) - Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, mining - Food resources: world food problems, changes in land use by agriculture and overgrazing, modern agriculture and its effects, fertilizer and pesticide problems, water logging and salinity - Energy resources: increasing energy needs, renewable and non-renewable, use of alternate energy sources.

MODULE II ECOSYSTEM AND BIODIVERSITY 8

Ecosystem- energy flow in the ecosystem - food chains, food webs and ecological pyramids - characteristics, structure and function of (a) Terrestrial ecosystems (forest, grassland, desert) and (b) Aquatic fresh water ecosystems (pond, lake, river) (c) Aquatic salt water ecosystems (ocean, estuary) - ecological succession.

Biodiversity - genetic, species and ecosystem diversity – hot-spots of biodiversity –biogeographic classification of India - endangered, endemic, extinct and invasive species of India - red data book - values of biodiversity: consumptive, productive, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - conservation of biodiversity: in-situ and ex-situ conservation of biodiversity

MODULE III ENVIRONMENTAL POLLUTION AND NATURAL DISASTER 8

Definition, cause, effects and control measures of (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards - ill-effects of fireworks and upkeep of clean environment - solid waste management: types (urban, industrial, biomedical and electronic wastes), collection, processing and disposal (incineration, composting and land-fill) - natural disaster and management: flood, cyclone, drought, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6

Population and population growth, population variation among nations, population explosion, family welfare programme.

Human health: air-borne, water borne diseases, infectious diseases, risks due to chemicals in food and environment.

Sustainable development - environmental legislation and laws: water act, air act, wildlife protection act, forest conservation act, environment protection act - environmental impact assessment, steps in EIA - human rights - women and child welfare.

Case studies related to current situation

Total Hours : 30

TEXT BOOKS:

1. Erach Bharucha, Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education for University Grants Commission, Orient Blackswan Pvt Ltd, Hyderabad, India, 2013.
2. Benny Joseph, Environmental Studies, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, Environmental Science and Engineering, Sri Krishna Publications, Tamil Nadu, India, 2015.
4. Raman Sivakumar, Introduction to Environmental Science and Engineering, McGraw Hill Education, India, 2009.
5. Venugopala Rao P, Principles of Environmental Science and Engineering, Prentice Hall India Learning Private Limited; India, 2006.

6. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International Pvt Ltd., New Delhi, India, 2009.

REFERENCES:

1. Masters G.M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 1997.
2. Henry J.G. and Heike G.W., Environmental Science and Engineering, Prentice Hall International Inc., New Jersy, 1996.
3. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. Boston, USA, 2016.

OUTCOMES:

The student will be able to

- predict the scenario of various natural resources and suggest remedies to curb the exploitation of these resources.
- identify food chain and web and its role in various ecosystems, assess the impacts on biodiversity and provide solutions to conserve it.
- analyse the impacts of pollutants in the environment and propose suitable method to alleviate the pollutants and the natural disasters.
- assess on the impact of human population and the health related issues and the ethics to be followed for sustainable life.

GEC 1213	COMPUTER PROGRAMMING II	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To provide knowledge about the benefits of Object Oriented Programming over Procedure oriented programming.
- To learn various File operations
- To expose fundamental concepts of object-oriented programming in classes, invoking methods and functions.
- To prepare students to get full use of code reusability using object oriented programming.
- To implement the basic concepts of object oriented programming using C++concepts.
- To focus on solving problems based on analyzing, designing and implementing programs in C and C++.

MODULE I PROGRAMMING IN C 7

Functions - Storage Classes - Structures and Unions – Pointers -Self Referential Structures and Linked Lists - File Processing.

MODULE II PROGRAMMING IN C++ 8

Programming in C++ - Overview of OOP in C – Inheritance - Polymorphism - Type Casting – Exceptions.

LIST OF EXPERIMENTS:

1. Functions
2. One dimensional arrays, Pointers
3. Recursion
4. Multi dimensional arrays, Linked lists.
5. Operating on Files.
6. Simple C++ program with Control statements.
7. Getting input from user console.
8. Classes, Object and Constructors.
9. Method overloading.
10. Inheritance

L – 15; P – 15; Total Hours : 30

REFERENCES:

1. Bjarne Stroustrup," The C++ Programming Language", Addison Wesley, 4^{th} edition, ISBN-13: 978-0321563842, 2013.
2. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall, ISBN 0-13-110362-8, 2015.
3. Bjarne Stroustrup, "Programming: Principles and Practice Using C++ ", Addison Wesley, 2^{nd} edition, ISBN-13: 978-0321992789, 2014.
4. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language (Ansi C Version)", Prentice Hall India Learning Private Limited, 2^{nd} edition, ISBN-13: 978-8120305960, 1990.

OUTCOMES:

Students who complete this course will be able to

- Develop efficient algorithms for solving problems
- Handle files in C
- Use simple data structures like arrays and linked lists in solving problems.
- Write simple programs using concepts of object oriented programming.
- Implement algorithms in C++ Language.
- Demonstrate the Object Oriented Programming concepts applied in networking, web development and Database applications.

MEC1211	MATERIAL SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To integrate the materials science, manufacturing, and mechanics knowledge that students have from previous courses and apply it to engineering design.
- To impart knowledge on properties, testing and applications of materials so as to identify and select suitable materials for various engineering applications.
- To Impart knowledge on the various modes of failures and newer materials for engineering uses.

MODULE I CLASSIFICATION OF MATERIALS 10

Historical perspective, Material properties and qualities, Classification of materials: Ferrous (steel) and Non-ferrous (Aluminium, copper)metals, Polymers (PC, PP, PE, PVC, PTFE, Acrylic), Engineering Ceramics (Aliumina, SiC), Composites–Types, Properties and Applications.

MODULE II NEWER/ADVANCED MATERIALS 5

Smart materials, Nano crystalline Materials, Superalloys ,Intermetallics, Biomaterials – Properties and applications

MODULE III TESTING OF MATERIALS 9

Testing of materials under tension, compression and shear loads. Hardness tests (Brinnell, Vickers and Rockwell).Impact test-Izod and Charpy.Tests for Creep and Fatigue.

MODULE IV FAILURE ANALYSIS 6

Wear and Corrosion Failures– Factors influencing failures, Failure analysis techniques, Analysis of failures, Simple case studies.

MODULE V FRACTURE AND ITS PREVENTION 9

Fundamentals, Mechanism of plastic deformation, Slip and Twinning, Types of fracture, Ductile fracture: mechanism and prevention. Brittle fracture: principles of fracture mechanics, Griffith’s theory on fracture, stress intensity factor and fracture toughness. Creep and Fatigue fracture: Mechanism, Factors affecting fracture, Prevention.

MODULE VI MATERIAL SELECTION 6

Steps in materials selection process, Factors influencing materials selection, Case studies

Total Hours : 45

TEXT BOOKS:

1. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised, Indian edition 2007.
2. KennethG. Budinski, MichaelK. Budinski, "Engineering Materials, Properties and Selection", Pearson Education, 8thEdition,2005

REFERENCES:

1. Elements of Material Science and Engineering: Van Vlack, Wesley Pub. Comp.
2. Materials Selection in Mechanical Design Fourth Edition Michael F. Ashby Butterworth – Heinemann 2011.
3. Engineering Materials1 an Introduction to their Properties and Applications Second Edition by Michael F. Ashby and David R.H. Jones Butterworth- Heinemann Reprint 2002.
4. Introduction to Physical Metallurgy by Sydney Avner, McGraw Hill Ltd

OUTCOMES:

Students will be able to

- Classify commonly used engineering materials and to describe the key properties and applications.
- Identify newer materials for engineering applications.
- Evaluate the mechanical properties of materials under different loading conditions using standard testing practices.
- Evaluate failures arising from wear and corrosion.
- Analyze and provide solution for fracture in engineering components.
- Know how to use information sources to select materials for engineering uses.

MEC 1212 DESIGN APPRECIATION LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To disassemble products and understand the interactions between its subsystems and their functionality.
- To appreciate the use of various mechanisms involved in engineering products.
- To gain knowledge through experience in handling of engineering products.
- To kindle own creativity, ideation and realize the importance of team working.

STUDY EXERCISE:

1. Study of Standard Components (Threaded fasteners, Gears, Bearings, Belt / chain drives, etc)
2. Mechanical components in electronic devices (CDD, HDD and Printer)
3. Front axle with Steering and Rear axle with Differential

TEAR DOWN EXERCISE:

Dismantle and assemble the following engineering products to identify the components and its functions

1. Reciprocating pump, axial piston pump and radial piston pump
2. Gear pump and vane pump
3. Centrifugal pump and submersible pump
4. Reciprocating compressor / Blower / Rotary compressor
5. Different type of valves
6. Work holding devices
7. Fixed reduction gear box
8. Internal combustion engine (2 Stroke and 4 Stroke)
9. Fuel feed pump and carburetor
10. Transmission system for diesel engine
11. Braking systems
12. Motors and generators

PROJECT:

Student groups will identify a product and perform a complete tear down and present it to the class.

Total Hours : 45

REFERENCES:

1. Things Come Apart: A Teardown Manual for Modern Living by Todd McLellan, Thames & Hudson Ltd, London, United Kingdom, 2013.
2. Reverse Engineering: Mechanisms, Structures, Systems & Materials by Robert W. Messler, McGraw Hill Professional, 2013.
3. Kevin Otto, Kristin wood, Product Design, Pearson Publishers, 2013.

OUTCOMES:

On completion of the course, the students would be able to

- Understand of engineering systems and their mechanisms
- Understand the importance of design features in various engineering components.
- Develop awareness about single product meets multiple functions.
- Gain interest and ability to dismantle products by preparing tear down plan.
- Enhance team working and technical report writing skills.

EEC 1283	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		2	0	0	2

OBJECTIVES:

To impart knowledge on

- Basic concepts of electrical circuits and their solutions
- Principle of operation and applications of various D.C. and A.C. Machines
- Usage of the machines as drives
- Concepts of Basic Electronics and Devices.

MODULE I DC AND AC CIRCUITS 9

Ohm's law and its limitations. Kirchhoff's laws and its applications. Analysis of series, parallel and series-parallel resistive circuits. Power and Energy in such circuits. Generation of sinusoidal AC voltage-Phase and phase difference of sinusoidal varying voltage and current. Definition of real power, reactive power, apparent power and power factor -. The relationship between line and phase voltage & currents in balanced 3phase Star and Delta connections - Illustrative Examples

MODULE II DC MOTORS AND SPECIAL ELECTRICAL MOTORS 6

Working principle of motor.-Types and constructional feature - DC motor - Characteristics and applications. Principle of operation and constructional features of BLDC motor, Stepper and servo motors.

MODULE III TRANSFORMER AND INDUCTION MOTORS 8

Principle of operation and construction and types of single phase transformers. E.M.F equation, - voltage regulation. Three Phase Induction Motor: Principle of operation, constructional features, types, slip and its significance. Applications of squirrel- cage and slip-ring motors, Star Delta starter. Single phase Induction Motor: Principle of operation and applications.

MODULE IV ELECTRONICS 7

Semiconductor Diode: Operation, characteristics and its applications –Rectifiers and Filters, Zener diode Operation, characteristics and its applications - Regulated power supply using 78XX regulator ICs - Transistor, characteristics, operation and Applications- Transistor based Relay Driver Circuits – opto - isolators and its applications - Basics of Thyristors and applications.

Total Hours : 30

REFERENCES:

1. Edward Hughes, “Electrical and Electronics Technology”, Pearson India, 9th Edition, 2007.
2. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, McGraw Hill Publishing Co. Ltd., 2nd Edition, 2002.
3. Cotton H, Electrical Technology, Pitman, 2004.
4. B L Theraja and A K Theraja, “A textbook of Electrical Technology”, S.Chand, 2005.
5. Tom Denton “Automobile Electrical and Electronic Systems” Elsevier Butterworth- Heinemann, Third edition, 2004

OUTCOMES:

On completion of this course, the student will be familiar with

- Demonstrate the basics of Electrical circuits and their solution methods.
- Understand the working of Thyristors.
- Explain the structure of DC Motors systems.
- Understand the working of Special machines system.
- Demonstrate working of AC DC conversion.
- Explain the operation of Transformers and Induction motors

EEC1284	ELECTRICAL ENGINEERING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To understand, simulate and verify Ohm's Law and Kirchhoff's Laws theorem.
- To understand and verify the characteristics of various Electrical Machines
- To fabricate the interfacing and power supply circuits.
- To understand the battery chargers.

LIST OF EXPERIMENTS:

1. Verification of Ohm's Law and Kirchhoff's Laws using MATLAB.
2. Power and power factor measurement using two wattmeter method.
3. Load Test on DC Shunt Motor.
4. Load Test on DC Series Motor
5. Load Test on Single Phase Transformer
6. Load Test on Three Phase Induction Motor.
7. Three phase transformer connections.
8. Fabrication of IC78XX based Regulated power supply.
9. Fabrication of opto - Isolator based transistor - relay driver circuit.
10. Fabrication of Transistor based Amplifier.
11. Study of battery chargers.

Total Hours: 45

REFERENCES:

1. Mr. M. Ramkumar, Mr. S. Suresh Electrical Workshop Manual, , Department of EEE, BSACU

OUTCOMES:

At the end of the course, the student should be able to

- Construct and simulate any given simple electric circuits and verify theorems using MATLAB.
- Study and understand the performance of Electrical Machines.
- Fabricate the power supplies.
- Design the relay driver stage.
- Implement the amplifier circuits.
- Analyse the battery charging system.

SEMESTER III

MAC 2181 PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS

	L	T	P	C
	3	1	0	4

OBJECTIVES:

The aims of this course are to

- Familiarize in solving partial differential equation of first, second and higher orders.
- Introduce basics and engineering applications of Fourier series, Laplace Transform, Fourier Transform and Z- Transform.

MODULE I PARTIAL DIFFERENTIAL EQUATIONS 8 + 2

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

MODULE II FOURIER SERIES 8+2

Fourier Series and Dirichlet's conditions - General Fourier series - Half range Fourier series - Parseval's identity - Harmonic Analysis.

MODULE III FOURIER TRANSFORMS 7+3

Fourier integral theorem (without proof) - Fourier transform pair - Fourier Inverse Transform – Properties - Convolution theorem - Parseval's identity.

MODULE IV APPLICATIONS OF FOURIER SERIES AND FOURIER TRANSFORMS 7+3

Applications of Fourier series and Fourier Transform to solution of PDEs having constant coefficients with special reference to Heat & Wave equations, Discrete & point Spectrum and Single pulse.

MODULE V LAPLACE TRANSFORM 8+2

Introduction to Laplace transform - Existence of Laplace Transform - Properties of Laplace Transforms - Initial & Final Value Theorems - Inverse Laplace Transform - Convolution Theorem – Circuits to signal square wave: Integral equations with unrepeated complex factors – Damped forced vibrations: repeated complex factors – Resonance - Solution of differential equations

MODULE VI Z – TRANSFORM 7+3

Introduction and Definition of Z-transform - Properties of Z- Transform -

Convolution Theorem of Z-Transform - Inverse Z–transform - Convolution Theorem of Inverse Z-Transform - Formation of difference equations - Solving Difference Equations using Z-Transform.

L – 45; T – 15; Total Hours: 60

TEXT BOOKS:

1. Kreyszig .E., “Advanced Engineering Mathematics“, 10^{th} edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Grewal B.S., “Higher Engineering Mathematics”, 42^{nd} edition, Khanna Publishers, New Delhi, 2012.
3. Ramana, B.V, “Higher Engineering Mathematics” Tata Mc Graw Hill Publishing Co. New Delhi, 2006.

REFERENCES:

1. Veerarajan.T., “Engineering Mathematics“, 5^{th} edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Peter V. O'Neil, “Advanced Engineering Mathematics**”**, 7^{th} edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, “Advanced Engineering Mathematics”, 4^{th} edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, “Advanced Engineering Mathematics”, Academic Press, USA, 2002.

OUTCOMES:

After completing the course, student will be able to

- solve the partial differential equations.
- derive a Fourier series of a given periodic function by evaluating Fourier coefficients.
- apply integral expressions for the forward and inverse Fourier transform to a range of non-periodic waveforms.
- solve wave equation and heat flow equation.
- solve ordinary differential equations using Laplace transform.
- solve difference equation using Z-transform.

ENC 2181 ORAL COMMUNICATION

L	T	P	C
0	0	2	1

OBJECTIVES:

- To expose students to a range of professional contexts through podcasts for learning appropriate expressions.
- To train them in making poster presentations.
- To enable them to make effective business presentations.
- To help them learn persuasive and negotiation skills.
- To train them to debate on issues of current relevance
- To train them to participate in group discussions on current affairs

MODULE I **4**

Orientation to the Importance of Oral Communication -– Verbal and non-verbal communication -Paralinguistic features.

One-minute presentations (using Audacity/Voicethread) – Just a minute (JAM) on random topics

MODULE II **4**

Negotiating and persuading through effective arguments – to arrive at a conclusion (pair-work)

Understanding Negotiation, persuasion and marketing skills through Podcasts

Listening to short conversations and monologues for understanding real life conversations

MODULE III **4**

Making Poster presentations on current issues

Understanding nuances of making effective presentations (TED Videos)

MODULE IV **6**

Deliberation on social and scientific issues – Debates (focus on rebuttal skills and deconstructing arguments)

Viewing videos on debates (NDTV Discussions)

MODULE V **6**

Discussing social issues or current affairs in groups

Viewing group discussions and listening for specific information

MODULE VI **6**

Making full length presentation (through Voicethread) with the focus on one's career plans and prospects (discipline specific)

Listening to interviews for understanding speakers' perception (on industry related issues)

Total Hours: 30

REFERENCES:

1. Hancock, Mark (2012). *English Pronunciation in Use*. Cambridge University Press, UK.
2. Anderson, Kenneth & et.al (2007). *Study Speaking: A Course in Spoken English for Academic Purposes* (Second Edition). Cambridge University Press, UK.
3. Hurlock, B.Elizabeth (2011). *Personality Development*. Tata McGraw Hill, New York.
4. Dhanavel,S.P (2015). *English and Soft Skills*. Orient Blackswan, Chennai.
5. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate.* Cambridge University Press, UK.

OUTCOMES:

On completion of the course, students will be able to

- Listen to business conversations and do related tasks.
- Deliver effective poster presentations.
- Make effective business presentations.
- Use persuasive and negotiating skills for justifying arguments.
- Participate effectively in debates.
- Speak English intelligibly, fluently and accurately in group discussions.

MEC2101	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the principles of various casting processes and their applications
- To learn the features of various types of welding processes
- To study the applications of various metal forming processes
- To describe various types of sheet metal forming process and its application
- To know the various steps required in powder metallurgy for making different components
- To understand the methods used for making plastic components

MODULE I CASTING PROCESSES 8

Sand casting process: Principle, Types of patterns- Pattern materials- Pattern allowance - Moulding sand – moulding sand properties and testing – Core making- Moulding machine types: Jolt and Squeeze- Cupola and Crucible furnace -Steps involved in sand casting-- Sand casting defects –Sand casting inspection methods- Moulding sand –Principle of special casting processes: Shell, Lost wax process, Centrifugal casting, Pressure die casting and Stir casting

MODULE II METAL JOINING PROCESSES 8

Gas welding: Principle, Equipment and types of flames- Arc Welding process: Principle, Equipment- Resistance welding: Principle, Spot, Seam, Percussion- MIG and TIG welding process- Submerged arc welding- Electro slag – Electron beam welding – Brazing and Soldering- Welding defects

MODULE III METAL FORMING PROCESSES 7

Hot and cold working of metals- Forging processes: Principle, Open and closed die forging, Forging operations, Forging machine types- Rolling : Principle, Types of rolling mills, Shape rolling operations, Flat strip rolling- Extrusion: Principle and types- Drawing process: Principle and rod , wire and tube drawing

MODULE IV SHEET METAL FORMING PROCESSES 7

Sheet metal forming operations: Shearing, bending, drawing and Stretching operations- Evaluation of formability of sheet metal: Forming limit diagram and Erichsen cupping tester-Hydro forming – Rubber pad forming- Metal spinning- Explosive forming- Magnetic pulse forming- Peen forming- Super Plastic forming

MODULE V POWDER METALLURGY 7

Principle- Methods of production of metal powders- Mixing of powders – Compaction of metal powders- Sintering- Secondary operations- Selective laser sintering- Applications, Advantages and limitations

MODULE VI MANUFACTURE OF PLASTIC COMPONENTS 8

Types of Plastics: Thermosetting plastics and Thermo plastic – Injection Moulding: Plunger and Screw machines- Blow moulding- Rotational moulding- Film blowing- Extrusion moulding- Compression moulding- Thermoforming- Transfer moulding- Bonding of thermoplsatics

Total Hours: 45

REFERENCES:

1. Hajra Choudhury , Elements of Workshop Technology, Vol I and Vol II, Media Promoters Pvt. Ltd, Mumbai 2007
2. Serope kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 2006.
3. Elements of Manufacturing Processes, B.S. Magendran Parashar & R.K. Mittal, Prentice Hall of India, 2003
4. Manufacturing Technology, P.N. Rao, Tata McGraw- Hill Publishing Limited, II Edition, 2009
5. A text book of production technology, P.C. Sharma, S.Chand and Company, X Edition, 2008
6. Manufacturing Process- Begman, John Wilely & Sons, VIII Edition, 1999.
7. Manufacturing Science, G.S. Sawhney, Vol I & II, I.K. International Publishing House Pvt. Ltd, New Delhi

OUTCOMES:

Students will be able to

- Identify a suitable casting process for making a component
- Select an appropriate welding process for joining of metals
- Choose proper equipment for making components by metal forming processes
- Pick appropriate sheet metal forming process to make a desired shape of component
- Apply the various steps involved in powder metallurgy for making various components
- Elite the process required to fabricate plastic products

MEC2102	ENGINEERING METALLURGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the fundamentals of crystallographic structures
- To learn the different phases of an alloy through phase diagrams
- To educate on different types of ferrous materials, properties and their applications
- To discuss different heat treatment processes and phase transformations
- To instruct the various processing of materials
- To describe the various strengthening mechanisms of materials

MODULE I CRYSTALLOGRAPHY 5

Crystal structures fundamentals, Crystallographic points, directions and planes, Structure of crystalline solids, Imperfection in metal crystals: Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects. Effects of imperfections on metal properties.

MODULE II PHASE DIAGRAM 10

Alloys constitution, Solid solutions: Substitutional and Interstitial, Solubility limit, phase, Importance and interpretation of phase diagram, Cooling curves, Unary & binary phase diagrams, Gibbs's phase rule, eutectic, eutectoid, peritectic and peritectoid systems, iron-Iron carbide phase diagram. Grain size determination. Diffusion Mechanisms, Steady-State and Non-steady-State Diffusion, Factors That Influence Diffusion.

MODULE III FERROUS MATERIALS 8

Ferrous materials, Classification, Specification of steel, Effect of alloying elements in steel (Mn, Si, Cr, Mo, V Ti & W), Stainless steel, Tool steel, Dual phase steels, High strength low alloy (HSLA) Steel, Transformation included plasticity (TRIP) steel, Maraging steel – properties and applications. Cast Irons - Gray, White malleable, Spheroidal graphite – properties and applications.

MODULE IV HEATTREATMENT PROCESSES AND PHASE TRANSFORMATIONS 9

Principles, purpose, Classification of heat treatment processes: Annealing, Normalizing, Hardening, Tempering. Case hardening: Carburizing, Nitriding, Cyaniding, Flame and induction hardening. Phase transformations: basic concepts, Isothermal and Continuous cooling transformation diagrams.

Austempering, Martempering, Hardenability: Jominy end quench test.

MODULE V PROCESSING OF MATERIALS 5

Processing of engineering materials – Primary and Secondary processes – Castability, Weldability, Forgeability and Malleability Criteria – Process induced defects – Monitoring and control.

MODULE VI STRENGTHENING MECHANISM 8

Basic concepts: Dislocations and plastic deformations - Solid solution strengthening, strengthening by grain size reduction, Precipitation hardening, Particle and fiber dispersion strengthening, Strain hardening, Recovery, Recrystallisation and grain growth.

Total Hours: 45

TEXT BOOKS:

1. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised, Indian edition 2007.
2. Kenneth G. Budinski, Michael K. Budinski, "Engineering Materials, Properties and Selection", Pearson Education, 8thEdition,2005

REFERENCES:

1. Raghavan. V. "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd, 5th edition, 2007.
2. George. E. Dieter, "Mechanical Metallurgy", McGraw Hill, 2007.
3. SyndneyHAvner,"IntroductiontoPhysicalMetallurgy",2/ETata McGraw Hill Book Company, 2007.

OUTCOMES:

Students will be able to

- Express the different crystallographic structures
- Interpret the different phases in the phase diagram
- Identify suitable ferrous material for a specific application
- Use a relevant heat treatment process and recognize its transformation
- Categorize the different processing of materials
- Select a suitable strengthening mechanism for various applications

MEC2103	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To study the fundamental concept of thermodynamic systems and energy transfer
- To study and understand zeroth and first laws of thermodynamics
- To analyze second law of thermodynamics
- To learn the principle of steam power cycle and its improvement
- To understand thermodynamic relations and their significance
- To gain knowledge on the properties of moist air and psychrometric processes

MODULE I BASIC CONCEPTS AND PROPERTIES 12

Thermodynamic systems and control volume, Property- pressure, temperature (Zeroth law of thermodynamics),volume, internal energy, specific heat capacities, enthalpy. Concept of Energy- modes of work and heat- P- dV work, Path function - work and its illustrations for simple processes- Quasi-static process -thermal equilibrium, thermodynamic cycle.

Properties of pure substances -vapour, liquid and dryness fraction – Use of Steam Tables Phase rule, P-V, P-T, T-V, PVT surfaces

MODULE II FIRST LAW OF THERMODYNAMICS 10

Cyclic & Non-cyclic processes - Calculations of work done and heat transfer for an ideal gases and pure substances for various processes.

Derivation of Steady Flow Energy Equation (SFEE) for control volume - Steady flow processes including throttling- Examples of steady flow devices- Problems in SFEE for ideal gases and pure substances.

MODULE III SECOND LAW, ENTROPY AND AVAILABILITY 12

Second law of thermodynamics – Kelvin's and Clausius's statements of second law- Reversibility and irreversibility- Carnot cycle, reversed Carnot cycle, efficiency, COP- Thermodynamic temperature scale.

Clausius inequality, concept of entropy, entropy of ideal gases and pure substances-principle of increase in entropy – Carnot theorem, absolute entropy, availability, Concept of Exergy analysis.

MODULE IV STEAM POWER CYCLES 8

Illustration of processes in T-S and H-S diagrams for pure substances - Standard Rankine's cycle, Modified Rankine's cycle, cycle improvements - reheat cycle and regenerative cycle - Simple problems.

MODULE V GAS MIXTURES AND THERMODYNAMIC RELATIONS 8

Gas mixtures – properties of ideal and real gases, equation of state, Vander Waal's equation of state, compressibility factor, compressibility chart – Dalton's law of partial pressure, Amagut's law, T-ds equations, Maxwell's relations, Clausius Clapeyron equation, Joule – Thomson experiment.

MODULE VI PSYCHROMETRY 10

Psychrometry and psychrometric charts, property calculation of air vapour mixtures- Psychrometric process – Sensible heat exchange processes - Latent heat exchange processes - Adiabatic mixing, evaporative cooling - simple problems.

L-45;T-15; Total Hours: 60

REFERENCES:

1. Nag. P.K., "Engineering Thermodynamics", 4^{th} Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Rajput. R.K., "Thermal Engineering", Laxmi publications.
3. Cengel, "Thermodynamics" An Engineering Approach, Third Edition – 2003, Tata Mc Graw Hill, New Delhi.
4. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 5^{th} edition 2000
5. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
6. Holman. J.P., "Thermodynamics", 3^{rd} Ed. McGraw-Hill, 1995.
7. D.B. Spalding and E.H. Cole, "Engineering Thermodynamics", 3^{rd} edition, ELBS 1973.

OUTCOMES:

Students will be able to

- Apply the concept of thermodynamic properties to quantify energy transfer
- Apply and analyse zeroth and first laws of thermodynamics
- Evaluate the second law of thermodynamics applied to heat engines and refrigerators
- Analyse and evaluate vapour power cycles
- Evaluate properties of gas mixtures
- Demonstrate various Psychrometric processes and their relations

MEC2104	SOLID MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To study about stress, strain and deformation of solids
- To learn various loads and stresses in different types of beams
- To educate about torsional effects in different types of shafts
- To study about application of torsion in springs and columns
- To describe the different mathematical models for beam deflection
- To discuss analysis of stresses in two dimensions

MODULE I STRESS, STRAIN AND DEFORMATION OF SOLIDS 10

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

MODULE II BEAMS - LOADS AND STRESSES 12

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

MODULE III TORSION 10

Analysis of torsion in circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts.

MODULE IV SPRINGS AND COLUMNS 10

Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads. Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

MODULE V BEAM DEFLECTION 8

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method and Macaulay Method.

MODULE VI ANALYSIS OF STRESSES IN TWO DIMENSIONS 10

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

L-45; T-15; Total Hours: 60

TEXT BOOKS:

1. Bansal, R.K, "A text book of strenth of material", Laxmi Pulication (P) Ltd., 2010.
2. Ramamrutham, S, strenth of materials, 14th Edition, Dhanth Rai Publication, 2011.

REFERENCES:

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997.
2. Beer F. P. and Johnston R, "Mechanics of Materials", 3rd Edition, McGraw-Hill Book Co, 2002.
3. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.
4. Timoshenko S.P, "Elements of Strength of Materials", Tata McGraw-Hill, New Delhi 1997.
5. Singh D.K "Mechanics of Solids" Pearson Education, 2002.
6. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co, New Delhi, 1981.

OUTCOMES:

The students will be able to

- Demonstrate stress, strain and deformation of solids
- Recognise the various loads and analyse stresses in different types of beams
- Evaluate the torsional effects in different types shafts
- Calculate the various design parameters for springs and columns
- Estimate the beam deflection using various mathematical models
- Express the stresses in two dimensions

MEC2105	MANUFACTURING PROCESSES LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To provide the basic knowledge on different manufacturing techniques
- To experience the various operational activities of basic manufacturing processes including metal casting, metal joining, metal forming and machining
- To enable the students to fabricate simple components through the acquired skills

LIST OF EXPERIMENTS:

- CASTING PROCESS
  - Preparation of green sand mould for dumble and flange
- JOINING PROCESS
  - Preparation of weldments by arc welding and TIG welding
- FORMING PROCESS
  - Forming of hexagonal rod from the round rod
- SHEET METAL OPERATIONS
  - Making of tray and funnel from sheet metal
- OPERATIONS ON PLASTICS
  - Injection moulding by plastics
  - Extrusion / Blow moulding
- BASIC MACHINING
  - Facing, Plain turning, step turning and taper turning on lathe
  - Grooving, external chamfering, single start 'V' thread cutting and knurling on lathe
  - Drilling, boring, internal thread cutting, internal chamfering on lathe
  - Square cut shaping and key way cut by shaper
  - Internal slot / key way cut by slotter
  - Five holes at a given pitch circle on a plate (Boring center hole, drilling and tapping in five holes)
- PROJECT WORK
  - Combined Skill (Each team has to make an engineering component)

Total Hours: 45

REFERENCES:

1. A course manual for the laboratory (prepared by SMS, BSACU) http://home.iitk.ac.in/~vkjain/manual.pdf
2. Hajra Choudhury, Elements of Workshop Technology, Vol. I and II, Media Promotors Pvt. Ltd., Mumbai, 2007.

OUTCOMES:

Students should be able to

- Describe various basic manufacturing processes
- Make the components using moulding, welding, forging and basic machine tools
- Produce a simple component using different manufacturing process

MEC2106	**MATERIAL TESTING AND METALLURGY LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1**

OBJECTIVES:

- To observe the microstructure of various materials
- To study and record the various destructive test methods
- To understand the importance of various metallurgical and mechanical tests

EXPERIMENT

- MATERIAL TESTING LAB EXPERIMENTS
  - Tension test. 1
  - Compression test. 1
  - Torsion test. 1
  - Deflection test. 1
  - Impact test. 1
  - Double Shear test 1
  - Fatigue test 1
- METALLURGYLABEXPERIMENTS
  - Metallographic Examination-Demonstration and Practice 2
  - Study of metallurgical microscope.
  - Specimen preparation for microstructural examination-cutting, grinding, polishing, etching.
  - Selections of etchants for various metals and alloys.
  - Identification of microstructures of Ferrous and Non-ferrous materials. 2
  - Heat treatment: Annealing, normalizing, hardening and tempering of steel- Hardness and its microstructure. 2
  - Study of microstructure of welded (HAZ) and cast component. 1
  - Hardenability test -Jominy End quench test. 1

Total Hours: 45

REFERENCES:

1. ASTME3-01(2007) e1 Standard Guide for Preparation of Metallographic Specimens.
2. ASTM E407- 07Standard Practice for Microetching Metals and Alloys.
3. ASTM E7 – 03 (2009) Standard Terminology Relating to

Metallography.

OUTCOMES:

Students should be able to

- Interpret and analyse the microstructure of various materials
- Test the various mechanical properties of materials
- Correlate the results for applications

MEC2107	PART MODELING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To familiarize with the codes and specifications of BIS, limits, fits and tolerances
- To learn and draw assembly drawing of various machine components using drafting packages
- To generate part and assembly drawings of actual mechanical products

DRAWING STANDARDS & FITS AND TOLERANCES

Introduction – Need of Graphical Language – Importance of Machine Drawing – Tools – Projections – Designation – Relative position of views – Classification of Machine Drawings – Scales as per ISO standards – Importance of Title Block and Part list – Lines types – Sectioning – Principle of Dimensioning – Limits, Fits and Tolerance – Definitions – Classifications of Fits – Method of Indicating Fits on Drawings – Tolerance Grade – Shaft and Hole Terminology – Conventional Representations – Surface finishing & Machining Symbols – Abbreviations and Symbols – Screwed Fastenings – Designation of Bolted Joints – Special Types of Bolts and Nuts – Key Joints – Types of Key joints – Introduction to Rivets and Riveting – Welded Joints – Pipes and Pipe Joints – Pulleys – Couplings.

INTRODUCTION TO 2D DRAFTING

Assembly Drawings – Introduction – Types of Assembly – Importance of BOM – Assembly procedures – Assembly Drawings (Examples) – Assembly of Engine Parts: Assembly of Machine Tools Parts – Production Drawings – Difference with Normal Drawings – Method of amendment of Corrections.

INTRODUCTION TO 3D MODELLING AND ASSEMBLY

Introduction of Solid 3D Modelling – Sketcher – Datum planes – Protrusion – Holes – Part modelling – Extrusion – Revolve – Sweep – Loft – Blend – Fillet – Pattern – Chamfer – Round – Mirror – Section – Assembly

Couplings – Flange, Universal, Oldham's, Muff, Gear couplings

Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints

Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch

Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pumps

Total Hours: 45

TEXT BOOKS:

1. N. D. Bhatt and V.M. Panchal, “Machine Drawing”, 48^{th} Edition, Charotar Publishers, 2013
2. Gopalakrishna K.R., “Machine Drawing”, 22 Edition, Subhas Stores Books Corner, Bangalore, 2013.

REFERENCES:

1. Bertoline, Wiebe, Miller, Nasma., Technical Graphics Communication, IRWIN Graphic Series
2. William P. Spence, Engineering Graphics, Printice - Hall Inc, Engle Wood Cliff
3. S. Bogolyubov. A. Voinov., Engineering Drawing, Van Nostr and Reinhold Company
4. Brain Griffiths., Engineering Drawing for Manufacture, Kogan Page Science, USA
5. Hart. K R, Engineering Drawing with Problems and Solutions, Hodder and Stoughton, London Sydney Auckland
6. David L., Goetsch Williams Chaulk John A., Nelson, Technical Drawing (Drafting and Design) Savee Informatics.
7. D.E. Hewitt., Engineering Drawing and Design for Mechanical Technicians, The Macmillan Press Ltd, London

OUTCOMES:
Students should be able to

- State the codes, standards of BIS, limits, fits and tolerances
- Interpret complex drawings of machine parts and assembly
- Generate components and assembly drawings of actual products

SEMESTER IV

ENC 2282	**WRITTEN COMMUNICATION**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES:

- To help students identify content specific vocabulary and learn its usage.
- To expose them to reading for specific purposes, especially in professional contexts.
- To expose them to the process of different kinds of formal writing.
- To help them learn corporate correspondence for different purposes.
- To train them in preparing effective applications with résumé
- To make them write different types of reports.

MODULE I **4**

Introduction - process of writing – Fundamentals of academic and professional writing – Understanding short, real world notices, messages, etc.

MODULE II **4**

Reading industry related texts (ex. Manufacturing, textile, hospitality sector etc.) for specific information.

Writing Instructions and recommendations

MODULE III **6**

Understanding format and conventions of writing email, memo, fax, agenda and minutes of the meeting.

Writing email, memo, fax, agenda and minutes of the meeting for various purposes (industry specific)

MODULE IV **6**

Viewing letter of application and Résumé, letter calling for an interview, letter of inquiry and Promotional letter

Writing Functional résumé and letter of application using Edmodo,

MODULE V **6**

Viewing a Video and reading a case study (industry specific) – collaborative writing using Edmodo –reading and information transfer

Writing reports- Survey, feasibility and progress – exposure to discipline specific reports

MODULE VI **4**

Writing Statement of purpose (Higher Education)-- Justifying and writing about one's preparedness for job (Statement of Purpose highlighting strengths and weaknesses) – Peer evaluation skills through Edmodo.

Total Hours: 30

REFERENCES:

1. Riordan,D (2013). *Technical Report Writing Today*. Cengage Learning, 10th edition. USA.
2. Oliu, W. E., Brusaw, C.T., & Alred, G.J. (2012). *Writing that Works: Communicating Effectively on the Job* . Bedford/St. Martin's. Eleventh Edition.
3. Garner, B.A. (2013). *HBR Guide to Better Business Writing (HBR Guide Series)*. Harvard Business Review Press. USA.
4. Sharma, R.C. & Krishna M. (2002). *Business Correspondence and Report Writing*. Tata MacGraw – Hill Publishing Company Limited, New Delhi.
5. Macknish, C. (2010). *Academic and Professional Writing for Teachers*. McGraw-Hill Education. USA.
6. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate.* Cambridge University Press, UK.

OUTCOMES:

On completion of the course, the students will have the ability to

- Identify content specific vocabulary and also use them in appropriate contexts.
- Demonstrate reading skills with reference to business related texts.
- Draft professional documents by using the three stages of writing.
- Create different types of documents for various corporate correspondences.
- Write effective letter of applications, résumé and statement of purpose.
- Write business related reports efficiently.

MEC2211	KINEMATICS OF MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various simple mechanisms
- To analyse the velocity of different mechanisms
- To acquire knowledge on acceleration analysis of different mechanisms
- To educate the kinematics of cams
- To study the different types of gears and gear trains
- To understand the various friction drives

MODULE I BASICS OF MECHANISMS 7

Terminology and Definitions- Description of common Mechanisms-Four Bar Mechanism-Single and double slider crank mechanisms - Kinematic Inversions of 4-bar and slider crank chains-– Indexing Mechanisms - Rocking Mechanisms - Straight line generators- Ratchets and escapements - Design of Mechanisms – Mobility - Grubler's criterion - Grashoff's law- Mechanical Advantage-Transmission angle.

MODULE II VELOCITY ANALYSIS OF MECHANISMS 7

Displacement and velocity analysis in mechanisms - Graphical Method – Velocity polygons – Kinematic analysis by Complex Algebra methods - Vector Approach - Instantaneous Centre method - Kennedys Theorem.

MODULE III ACCELERATION ANALYSIS OF MECHANISMS 7

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

MODULE IV KINEMATICS OF CAM 7

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

MODULE V KINEMATICS OF GEARS 10

Spur gear Terminology and definitions - Fundamental Law of toothed gearing and involute gearing - Inter changeable gears - gear tooth action – Terminology -

Interference and undercutting – Non standard gear teeth- Helical, Bevel, Worm, Rack and Pinion gears (Basics only) - Gear trains - Parallel axis gear trains - Epicyclic gear trains – Differential mechanism.

MODULE VI FRICTION IN MACHINERY 7

Friction drives - Belt and rope drives, Friction in clutches - Friction aspects in Brakes – Friction in vehicle propulsion and braking.

Total Hours: 45

REFERENCES:

1. Rattan S.S, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.
2. Shigley J.E and Uicker J.J, “Theory of Machines and Mechanisms”, McGraw- Hill, Inc. 1995.
3. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.
4. Ghosh A and A.K. Mallick, “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
5. Rao J.S and Dukkipati R.V, “Mechanism and Machine Theory”, Wiley-Eastern Ltd., New Delhi, 1992.
6. John Hannah and Stephens R.C, “Mechanics of Machines”, Viva Low-Prices Student Edition, 1999.

OUTCOMES:

The students will be able to

- Describe various simple mechanisms
- Construct the velocity diagram and predict the velocities of mechanisms
- Draw the acceleration diagram and predict the acceleration of mechanisms
- Create various types of cam profiles with different follower motions
- Analyse the kinematics of gears and gear trains
- Solve simple application problems on frictional drives

MEC2212	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To learn the fundamental concepts and properties of fluids
- To study the governing equations for fluid flow
- To educate different types of flow and its losses
- To understand boundary layer concepts and dimensional analysis
- To impart knowledge on hydraulic turbines
- To acquire knowledge on hydraulic pumps

MODULE I FUNDAMENTALS OF FLUID MECHANICS 10

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

MODULE II FLUID KINEMATICS AND FLUID DYNAMICS 12

Fluid Kinematics – Flow visualization – Lines of flow – types of flow – velocity field and acceleration–continuity equation (one and three dimensional forms) Equation of stream line-stream function-velocity potential function–circulation–flow net – fluid dynamics – equation of motion – Euler's equation along streamline – Bernoulli's equation – applications - Venturimeter, Orificemeter, Pitot tube

MODULE III INCOMPRESSIBLE FLUID FLOW 10

Viscous flow - Navier's Stoke equation (statement only)–Shear stress ,pressure gradient relationship- Laminar flow between parallel plates- Laminar flow through circular tubes (Hagen poiseulle's law)–Hydraulic and energy gradient – Flow through pipes–Darcy's Weisback's equation–Pipe roughness–friction factor – Moody's diagram minor losses- Flow through pipes in series and in parallel power transmission.

MODULE IV BOUNDARY LAYER & DIMENSIONAL ANALYSIS 10

Boundary Layer theory, Boundary layer separation – drags and lifts coefficients. Buckingham's pi-Theorem – applications - similarity laws and models

MODULE V HYDRAULIC TURBINES 8

Hydraulic machines: Definition and classification- exchange of energy- Euler's equation for turbo machines–Construction of velocity vector diagrams head and specific work–components of energy transfer–degree of reaction. Hydro turbines: Pelton turbine – Francis turbines – working principles – velocity triangle – work done–specific speed–efficiencies–performance curve for turbines

MODULE VI HYDRAULIC PUMPS 10

Pumps, definition and classifications: - Centrifugal pump: classifications and velocity triangles, specific speed, efficiency and performance curves. Reciprocating pumps: Classification, working principle, indicator diagram, work saved by air vessels and performance curves.

L-45; T-15; Total Hours: 60

REFERENCES:

1. Bansal.R.K "Fluid Mechanics and hydraulics Machines", (5thedition), Laxmi Publications (P) Ltd, New Delhi, 1995.
2. Kumar.K.L., "Engineering Fluid Mechanics ", Eurasia Publishing House(P) Ltd, New delhi, (7thedition), 1995.
3. Vasandani. V.P "Hydraulic Machines–Theory and design", Khanna Publishers
4. Kumar DS, "Fluid Mechanics and Fluid Power Engineering", Kataria SKand Sons, NewDelhi, 1997.
5. Streeter V. Land Wylie, E.B "Fluid Mechanics", Mc. Grath-Hill, 1983.
6. White, F.M., Fluid Mechanics", Tata McGrawhill, 5th Edition, NewDelhi.-2003.
7. John.D.Anderson, "Computational Fluid Dynamics–The Basics with Applications", Mc Graw Hill, New Delhi, 1995.
8. Robert W Fox, "Introduction to Fluid Mechanics", Fourth Edition, John Wiley and sons, Singapore, 1994.

OUTCOMES:

Students will be able to

- Apply the fundamental concepts in the design of flow measuring devices
- Apply the governing equation in flow through conduits

- Analyze incompressible fluid flow through pipes
- Measure Boundary layer friction and establish expression for any measurable parameter from the dependent variables
- Demonstrate and analyze the performance of hydraulic turbines
- Describe and analyze the performance of hydraulic pumps

MEC2213	METAL CUTTING AND MACHINE TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various material removal process
- To learn the functions of centre lathe and special purpose lathes
- To acquire knowledge about reciprocating machines and milling machines
- To understand the principle of drilling, broaching and gear cutting
- To gain knowledge about finishing and super finishing processes
- To educate the working principle of CNC machine tools and non-traditional machining processes

MODULE I THEORY OF METAL CUTTING 7

Introduction: material removal processes, types of machine tools – theory of metal cutting, geometry of single point cutting tool, mechanism of chip formation, types of chips, orthogonal metal cutting, machining forces and Merchant's Circle Diagram - cutting tool materials, tool wear, tool life, cutting fluids.

MODULE II CENTRE LATHE AND SPECIAL PURPOSE LATHES 7

Centre lathe, constructional features, cutting tools, various operations, special attachments, machining time and power estimation - Capstan and turret lathes – automatic lathes: semiautomatic, automats – kinematics – single spindle : cutting off, swiss type, automatic screw type – multi spindle; cutting off, bar type

MODULE III RECIPROCATING MACHINES AND MILLING MACHINES 7

Reciprocating machine tools: shaper, planer, slotter - milling: types, milling cutters, plain milling cutter- nomenclature - operations.

MODULE IV DRILLING, BROACHING AND GEAR CUTTING 7

Hole making: drilling, reaming, boring, tapping – Deep hole Drilling – Broaching machines: broach construction – push, pull, surface and continuous broaching machines - Gear cutting: forming, generation, shaping, hobbing – Mechanics of processes.

MODULE V FINISHING AND SUPER FINISHING PROCESSES 10

Abrasive processes – Mechanics: grinding wheel – specifications and selection, types of grinding process – centreless grinding, cylindrical grinding, surface grinding– honing, lapping, super finishing, polishing and buffing

MODULE VI CNC MACHINE TOOLS AND MODERN MACHINING 7

METHODS

Numerical control (NC) machine tools – CNC: types, construction details, special features - Advantages and limitations : Abrasive Jet Machining- Ultrasonic Machining - Electron Beam and Laser Beam Machining

Total Hours: 45

REFERENCES:

1. Rao, P.N. “Manufacturing Technology”, Metal Cutting and Machine Tools, Tata McGraw–Hill, New Delhi, 2008
2. Richerd R. Kibbe, John E. Neely, Roland O. Merges and Warren J. White, “Machine Tool Practices”, Prentice Hall of India, 2003
3. HMT – “Production Technology”, Tata McGraw-Hill, 2001
4. P.C. Sharma, “A Text Book of Production Engineering”, S. Chand and Co. Ltd, X edition, 2008
5. Hajra Choudry, “Elements of Work Shop Technology – Vol. II”, Media Promoters. 2007
6. Geofrey Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, McGraw Hill, 2006

OUTCOMES:

Students will be able to

- Describe the various material removal process
- Discuss the various types of lathe and its operations
- Illustrate the operations in reciprocating machines and milling machines
- Explain drilling, broaching and gear cutting operations
- Exhibit the various finishing and super finishing processes
- Deliberate the functions of CNC machine tools and non-traditional machining processes

MEC2214	MACHINING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:
- To gain knowledge in various mechanisms of special machine tools
- To learn the functions of various machines such as milling, shaping and grinding
- To acquire knowledge on producing various assembly components such as bushes, shafts, bolts and nuts

LIST OF EXPERIMENTS:
- SPECIAL MACHINES
  - Milling machines
  - Spur gear milling
  - Milling polygon surfaces
  - Reciprocating machines
  - Making of ‘V’ Block for work holding device
  - Super finishing machine
  - Surface grinding
  - Cylindrical grinding
- MACHINING IN LATHE
  - Bush and shaft
  - Bolt and nut
  - Double start ‘V’ thread
  - Eccentric turning and coupling
- MACHINING IN SEMI-AUTOMATIC LATHE
  - Machining in capstan and turret lathes
- PROJECT WORK
  - Combined Skill (Each team has to make a working model)

Total Hours: 45

REFERENCES:
1. A course manual for the laboratory (prepared by SMS, BSACU)
2. http://home.iitk.ac.in/~vkjain/manual.pdf
3. HMT – “Production Technology”, Tata McGraw-Hill, 2001.

OUTCOMES:
Students will be able to
- Demonstrate the different mechanisms involved in special machine tools
- Perform operations in various machines such as in milling, shaping and grinding
- Produce various assembly components such as bushes, shafts, bolts and nuts

MEC2215 PRODUCT MODELLING LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To understand the fundamentals of CAD systems
- To create a 3D model of the component given
- To familiarize students with the assembly of various machine components

OVERVIEW OF CAD SOFTWARE

Create 3D models of standard machine components by reading orthographic views of Brackets, V Blocks, Stop Block.

ASSEMBLY DRAWING

Create part model, assembly, exploded view, sectional views and detail drawings of Joints: Cotter joints, knuckle joints, Hook's joint.

Shaft Couplings: rigid, flexible.

Bearings: Journal, footstep, thrust or collar bearing, Plummer block.

Engine parts: Stuffing box, connecting rod.

Machine tool components: Drill jig, tool post, machine vice, screw jack.

Valves: Safety valve, relief valve, non-return valve.

PARAMETRIC MODELLING

Modelling of screw threads, threaded fasteners, gears & pulleys.

PROJECT

Create CAD models of real time components.

Total Hours: 45

TEXT BOOKS:

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers, 2013
2. Gopalakrishna K.R., "Machine Drawing", 22 Edition, Subhas Stores Books Corner,Bangalore, 2013.

REFERENCES:

1. Bertoline, Wiebe, Miller, Nasma., Technical Graphics Communication, IRWIN Graphic Series
2. William P. Spence, Engineering Graphics, Printice - Hall Inc, Engle Wood Cliff
3. S. Bogolyubov. A. Voinov., Engineering Drawing, Van Nostr and Reinhold Company

4. Brain Griffiths., Engineering Drawing for Manufacture, Kogan Page Science, USA
5. Hart. K R, Engineering Drawing with Problems and Solutions, Hodder and Stoughton, London Sydney Auckland
6. David L., Goetsch Williams Chaulk John A., Nelson, Technical Drawing (Drafting and Design) Savee Informatics.
7. D.E. Hewitt., Engineering Drawing and Design for Mechanical Technicians, The Macmillan Press Ltd, London

OUTCOMES:

Students should be able to

- Describe the fundamentals of CAD systems
- Create a 3D model of the given component
- Perform virtual assembly of various machine components

MEC2216	FLUID MECHANICS AND MACHINERY LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To learn about the flow measuring instruments.
- To verify the laws of fluid mechanics.
- To study the performance of various pumps and turbines.

LIST OF EXPERIMENTS:

1. Comparison of coefficient of discharge of given orifice meter and Venturi meter.
2. Calibration of Rotameter.
3. Determination of various losses for the given set of pipes.
4. Performance study of centrifugal pumps / Submersible pumps.
5. Determination of maximum efficiency for the given reciprocating pump.
6. Characteristic curves for Gear pump / Vane pump.
7. Determination of maximum power at constant speed / constant load for an impulse turbine.
8. Performance characteristic of reaction turbine.
9. Impact of jet on flat and curved vanes.
10. Verification of Bernoulli's theorem.
11. Performance test on a jet pump.
12. Flow visualization: Laminar and Turbulent flows.

Total Hours: 45

REFERENCES:

1. Bansal.R.K "Fluid Mechanics and hydraulics Machines", (5th edition), Laxmi Publications (P) Ltd, New Delhi, 1995.
2. Kumar.K.L., "Engineering Fluid Mechanics", Eurasia Publishing House(P) Ltd, New delhi, (7thedition), 1995.
3. Vasandani. V.P "Hydraulic Machines–Theory and design", Khanna Publishers
4. Kumar DS, "Fluid Mechanics and Fluid Power Engineering", Kataria SKand Sons, NewDelhi, 1997.
5. Streeter V. Land Wylie, E.B "Fluid Mechanics",Mc. Grath-Hill,1983.
6. White, F.M., Fluid Mechanics", Tata McGrawhill, 5th Edition, NewDelhi.-2003.

7. John. D. Anderson, “Computational Fluid Dynamics–The Basics with Applications”, Mc Graw Hill, New Delhi, 1995.
8. Robert W Fox, "Introduction to Fluid Mechanics", Fourth Edition, John Wiley and sons, Singapore, 1994.

OUTCOMES:

Students should be able to

- Apply the laws of fluid mechanics and measure parameters of fluid flow
- Analyse the performance of Hydraulic turbines and pumps
- Evaluate performance of Impinging jet on vanes

SEMESTER V

MSC 3181 LEADERSHIP AND CEO TRAINING

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims at

- Bringing about positive transformation in students' attitude.
- Building unique leadership competencies that would ensure successful transition of students across all career stages.
- Sensitizing students to identify their strengths & weakness and training them to deal with it
- Assisting students in enhancing their expressive ability and inducing a high level of self-confidence to manage both business and emotions
- Training students to become more adaptable and flexible to changing business environment

MODULE I INTRODUCTION TO LEADERSHIP 12

Leadership concept - meaning, definitions, importance of leadership, leadership traits. Leadership functions- general functions, listening, observing, managing and decision making. Components of leadership - leaders, followers and situation. Leadership theories – Trait theory, Skills theory, Style theory, Situational theory, Transformational theory, Transactional theory, Path Goal Theory and LMX. Assessing emotional intelligence and exploring the capabilities and inherent traits. through psychometric tests - Multi factor leadership questionnaire and personal reflections

MODULE II LEADERSHIP STYLE AND COMMUNICATION 8

Leadership styles-visionary, Coaching, Affiliative, Democratic, Pacesetting Commanding, Transformational, Transactional. Autocratic, Participative, Laissez-Faire Leader versus Managers. Leadership communication - Rationale, tactic, assertive, formal, informal, communication in crisis- leadership and negotiations, Leadership Presentations-convincing and impressive style

MODULE III LEADERSHIP ROLES 8

Facets of leadership- Leader as an individual – personality and leadership, values, attitudes and ethics of a leader. Leader as a relationship builder- empowering people to meet higher order needs, initiating organization wide motivational programs, involvement with all stakeholders- focusing on organization growth. Leader as an inspirer- motivation and leadership, recognizing and appreciating contributions, empowering others to lead Leader as an innovator –leader's role in shaping culture and values in an organization. Leader as a Liaison- Leader as team player

MODULE IV LEADERSHIP CHALLENGES AND STRATEGIES 9

Challenges in leadership: Perception of organization culture and values, interpreting the power dynamics in the organization, establishing work life balance. Bad leadership – Reasons and impact.-Case Study of Marissa Mayer-Yahoo. Inc Organizational transformation through efficient leaders-Case study of Apple Inc. Blue Ocean Leadership-Steps to Blue ocean Leadership-Four Pillars of Blue Ocean leadership-Blue Ocean leadership grid

MODULE V LEADERSHIP AND CEO TRAINING 8

Leader as a CEO: Traits of a successful CEO, Key responsibilities of a CEO, the path to be a CEO ,Training on Board Room Discussions, Meeting the CEO –Live sessions with industry CEO's. Requirements of Leadership: - Cognitive skills, Interpersonal skills, Business skills, Strategic skills. Role of Emotional Intelligence in taking up key-positions in the organization.

Teaching Pedagogy:

Nurturing – Based on the identified strengths and weaknesses, training will be given to enhance the strengths and overcome the weakness.

Assessment - Continuous evaluation will be effected through group discussions, oratory assignments and situational enactments. Pre-and post-training assessment through peer reviews and faculty feedback.

Sustained development – Training will be imparted for self-development and monitoring of leadership skills to ensure sustained applicability of the skills learnt.

Total Hours: 45

REFERENCES:

1. Andrew J DuBrin. "Leadership: Research Findings, Practice, and Skills", 8th Edition, South-Western College Pub, 2015.

2. Yukl G, “Leadership in Organisations”, 8th Edition, Pearson Education, 2013.
3. Richard L Daft, “Leadership”, 5th Edition, South Western Cengage Learning 2012.
4. Stephen P. Robbins and Timothy A. Judge. “Organizational Behaviour”, 15th Edition, New Delhi: Pearson, 2013.
5. Fred Luthans, “Organizational Behavior, an Evidence Based Approach”, 12th Edition, New Delhi: McGraw Hill Education, 2013.
6. Emotional Intelligence, Why it can matter no more than IQ by Daniel Goleman (include a book) Publisher: Bloomsbury Publishing India Private Limited; Latest edition (2017)
7. Primal Leadership: Unleashing the Power of Emotional Intelligence by Prof Daniel Goleman , Richard Boyatzis and McKee, Harvard Business Review Press

RECOMMENDED READINGS:

1. Jim Collins, (2001). “Good To Great: Why Some Companies Make the Leap...And Others Don't”, Random House Publishers India Pvt. Ltd, New Delhi
2. George, B. with Sims, P. True North: Discover Your Authentic Leadership, The Times Group Books; First edition (1 October 2015)
3. Kim, W. C., & Mauborgne, R. A. (2014). Blue ocean strategy, expanded edition: How to create uncontested market space and make the competition irrelevant. Harvard business review Press
4. Leadership Wisdom by Robin Sharma Jaico Publishing House;

OUTCOMES:

The students will be able to

- Explore through self-introspection one’s own leadership style, their strength and weakness
- Gain self-confidence to lead a team in the organization
- Realize the role of leadership in making or breaking of an organization
- Acquire the practice of self-introspection and development of leadership competencies thorough continuous efforts
- Manage their own emotions as well as other resulting in successful relationship building with all stakeholders

MSC 3182	SOCIAL ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To be able to understand the field of social entrepreneurship and Social problems
- To be able to describe and understand the traits of social entrepreneurs
- To recognize the social business opportunities
- To synthesize the resource mobilization ways for social entrepreneurship
- To understand the social entrepreneurship models
- To recognize the impact of social entrepreneurship on societies

MODULE I INTRODUCTION TO SOCIAL ENTREPRENEURSHIP 7

Introduction - Emergence and Development of Social Entrepreneurship. Social Problems in India: An Overview. Social Development: The Indian Scenario. Emergence of Social Entrepreneurs and Sustainable Solutions to Social Problem. Characteristics and Context of Social Entrepreneurship .The Role of Social Entrepreneurship in Societies & Economies.

MODULE II SOCIAL ENTREPRENEURSHIP: DRIVERS AND CHALLENGES 7

The Drivers of Social Entrepreneurship. Elements of the Social Entrepreneurial Personality. Challenges of financial constraints. Challenge to attract and cultivate talented workers. Challenge of evaluation of social entrepreneur impact. Challenge of scaling and its impact. Cases

MODULE III SOCIAL ENTREPRENEURSHIP: OPPORTUNITY RECOGNITION 7

Opportunity Recognition and Planning Process. Opportunities for Social Entrepreneurs. The Nature of Social Entrepreneurial Opportunities. Social Problems into Opportunities. Idea development and conceptualization of social problem. Cases

MODULE IV RESOURCE MOBILIZATION FOR SOCIAL VENTURE 8

Resources at Initial Stage. Social Network as a role of Social Capital. Team and Collective Efforts. Need and Determination of Important Resources. Resource of Knowledge, Skills and Abilities. Overview of venture capital and angel investment. Cases

MODULE V BUSINESS MODELS AND BUSINESS PLAN FOR SOCIAL ENTERPRISES 8

Design Principles of Social Entrepreneurship Business Models, Evaluation of the Root Cause of a Societal Problem. Developing business plan for social ventures. Developing an investor presentation. Feasibility study and report. How to start a business - Procedures for registration of small scale industry

MODULE VI THE IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETIES AND CASES 8

Static Impact of Social Entrepreneurship. Impact of Charitable NGOs vs. Social Entrepreneurship, Impact of For-Profit Companies vs. Social Entrepreneurship. Social entrepreneurship report preparation by students. Case Study of Social Entrepreneurs

Total Hours: 45

REFERENCES:

1. "Social Entrepreneurship: New models of sustainable social change" Alex Nicholls, Oxford University Press 2006
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India , Archana Singh Springer 2016
3. "Social Entrepreneurship and social business" Christine K Volkmann, Springer Gabler 2012
4. "Social Entrepreneurship" Manuel London , Routlege, 2010

OUTCOMES:

The students can able to

- Conceptualize social entrepreneurship in terms of a theoretical framework between changing social values and institutions
- Think and communicate about social values
- Learn about practical models of social change to launch, lead, manage, and evaluate a social venture
- Analyze funding needs and sources for the social venture
- Experience the ideas can be critically and collaboratively examined prior to commitment.

ENC 3181	**COMMUNICATION AND SOFT SKILLS-I CAREER CHOICE**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES:

- To create awareness of industrial trends and market demands.
- To encourage students to explore career opportunities in an industry and evaluate themselves in relation to industry preparedness.
- To train them in making presentations and writing statement of purpose effectively.

MODULE I **6**

Knowledge about specific industry-Discussion with industry experts --Self evaluating career prospects through survey questionnaire (based on his/her eligibility for taking up a job (industry preparedness)

MODULE II **6**

Knowing case studies of industries (pertaining to students' choice of career)-Reading and discussing about job markets-goal setting, working on creativity.

MODULE III **4**

SWOC analysis and discussing outcomes--exploring mini projects or case studies of latest industries.

MODULE IV **6**

Writing statement of purpose pertaining to career choice---- Outcomes

MODULE V **8**

Project or case study presentations (Presentation in pairs) -mini project report or case study report.

Total Hours: 30

REFERENCES:

1. Brown, D.(2002). Career Choice and Development. Wiley,J. & Sons. USA
2. Lore,N. (1998). The Pathfinder: How to Choose or Change Your Career for a Lifetime of Satisfaction and Success. Simon & Schuster. USA.
3. Shell, G.R.(2013). Springboard Launching your Personal Search for Success. Portfolio. USA.

OUTCOMES:

After the completion of the course, students would be able to

- Speak about their career choice.
- Self evaluate their strengths and weaknesses and speak about it.
- Make effective presentations on case studies or relating to projects.
- Write the statement of purpose relating to their career choice

MEC3101	DYNAMICS OF MACHINERY	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To study the basics of static and dynamic forces in mechanisms
- To learn about the engine dynamics
- To educate the significance of imbalance in machineries
- To study the basics of undamped free vibrations
- To acquire knowledge on damped free and forced vibrations
- To comprehend the dynamics of control mechanisms

MODULE I FUNDAMENTALS OF DYNAMICS 9

Introduction on static force analysis, Static Equilibrium, Equilibrium of Two force and three-force members, Member with Two force and a torque, Force convention, free body diagrams, Principle of Superposition. D-Alembert's Principle- Inertia Force Analysis of Mechanisms.

MODULE II ENGINE DYNAMICS 9

Velocity and acceleration of piston-Torque exerted on the crank shaft when friction and inertia of moving parts are neglected- Forces on the reciprocating parts of an engine considering friction and inertia of moving parts, Dynamically equivalent system, Turning moment diagrams-Fly wheels Engine shaking Forces.

MODULE III BALANCING OF MASSES 10

Introduction to balancing, Static balancing, dynamic balancing, balancing of several masses in same planes, balancing of several masses in different planes, Balancing of Reciprocating masses, balancing of locomotives, balancing of inline engines, balancing of V-engines.

MODULE IV UN-DAMPED FREE VIBRATIONS 10

Natural frequencies of free longitudinal vibrations of systems having single degree of freedom- Equilibrium method-Energy method and Rayleigh's method- Natural of free transverse vibrations due to point load and UDL acting over a simply supported shaft, dunkerley's method, critical speed of a shaft- Natural frequency of free torsional vibrations of a single rotor system, two rotor and three rotor system.

MODULE V DAMPED FREE AND FORCED VIBRATIONS 10

Damping factor and Logarithmic Decrement in free vibration- Forced Vibration- Steady state amplitude –Vibration due to Imbalance- Vibration isolation and transmissibility ratio for the systems subjected to forced vibrations.

MODULE VI CONTROL MECHANISMS 12

Introduction to Governors, types of Governor, Watt Governor, Porter governor, Proell Governor, Hartnell Governor, Sensitivity, Stability, Isochronism, Hunting, Governor Effort and Power, controlling force. Introduction, Precessional angular motion, gyroscopic couple, effect of gyroscopic couple on an aero plane, effect of gyroscopic couple on a naval ship -stability of a four wheel drive moving in a curved path- stability of a two wheel vehicle taking a turn.

L – 45; T – 15; Total Hours: 60

REFERENCES:

1. S.S.Rattan, 'Theory of Machines', Tata McGraw Hill Publishing Company Ltd., New Delhi, 1994.
2. Design of Machinery by R.L.Norton, Mc Graw Hill Publications.
3. J.E.Shigley and J.J.Uicker, Theory of machines and Mechanisms, McGraw Hill, Inc., 1995.
4. Theory of Machines by Thomas Bevan, Pearson education publications.
5. A.Ghosh and A.K.Mallick, 'Theory of Mechanisms and Machines', Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
6. Theory of Machines by P.L.Ballaney, Khanna Publications.
7. Theory of Machines by R.S. Khurmi & J.K.Gupta, S. Chand Publications.

OUTCOMES:

Student should be able to

- Identify the static and dynamic forces in mechanisms
- Analyse the dynamics of engine
- Determine the level of imbalance in machineries
- Solve problems on undamped free vibrations in mechanisms
- Analyse damped free and forced vibrations in machines
- Illustrate the dynamics of control mechanisms

ECC3181	**ELECTRONICS FOR MECHANICAL SYSTEMS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

OBJECTIVES:

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

MODULE I SEMICONDUCTORS AND RECTIFIERS 8

Classification of solids based on energy band theory-Intrinsic semiconductors-Extrinsic semiconductors-P type and N type-PN junction and its application – Zener diode. Bipolar junction transistor- CB, CE, CC configuration and characteristics- Field effect transistor: Configuration and characteristic-SCR, DIAC, TRIAC, UJT Characteristics and simple applications.

MODULE II DIGITAL ELECTRONICS 7

Number systems- Binary Arithmetic Operations-Boolean Algebra-Logic gates-Karnaugh map: SOP, POS.

MODULE III COMBINATIONAL AND SEQUENTIAL CIRCUITS 8

Combinational Circuits: Half and full adders- Magnitude Comparator- Multiplexer/ Demultiplexer- encoder / decoder Sequential circuits: Flip Flops: SR, JK, D and T FF- Truth tables and circuits-Shift Registers-Ripple Counters.

MODULE IV 8085 MICROPROCESSOR AND APPLICATIONS OF MICROPROCESSOR 7

Architecture of 8085-Pin configuration - Instruction set-Addressing modes-Simple programs using arithmetic and logical operations. Applications - printed boards-Arduino / Raspberry Pi

Total Hours: 30

TEXT BOOKS:

1. Milman and Halkias, "Integrated Electronics", Tata McGraw-Hill publishers, 1995.
2. Ramesh Goankar, "Microprocessor Architecture", Programming and

Applications with 8085, Wiley Eastern, 1998.

REFERENCES:

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

OUTCOMES:

The student should be able to understand

- Working principles and characteristics of various semiconductor devices.
- Different digital logic circuits: Combinational and sequential circuits.
- Architecture of 8085, its features and programming for specific application.

MEC3102	**THERMAL ENGINEERING (INTEGRATED LAB)**	**L**	**T**	**P**	**C**
		3	**0**	**3**	**4**

(Use of Steam Tables, Mollier Diagram, Psychrometric chart and Refrigeration property Tables are permitted in the University examination)

OBJECTIVES:

- To impart knowledge on working and performance of IC engines, steam nozzles, turbines and air compressors.
- To comprehend the cycles and systems of refrigeration and air conditioning
- To learn the working principle of IC engines
- To study the performance of various engines under different loadings
- To learn the various heat transactions within and outside the engines
- To acquire knowledge on the properties of fuels and exhaust gases

MODULE I I.C. ENGINES 10

Classification of IC engine - components and functions. Two stroke and Four stroke engines - working principle, actual and theoretical valve timing diagrams, port timing diagrams and PV diagrams. Comparison - two stroke and four stroke engines- petrol and diesel engines. Fuel supply systems and ignition systems, Lubrication system and cooling system

MODULE II AIR STANDARD CYCLES AND IC ENGINE PERFROMANCE 10

Otto, Diesel, Dual, Brayton cycles - Calculation of mean effective pressure and air standard efficiency, Actual and theoretical PV diagram of two stroke and four stroke engines. Performance test on IC engine and Heat balance calculation. Knocking and Detonation. Exhaust gas analysis, pollution control norms.

MODULE III STEAM NOZZLES AND TURBINES 10

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, super saturated flow. Impulse and reaction principles, compounding, velocity diagrams for simple and multistage turbines, speed regulations - governors and nozzle governors.

MODULE IV AIR COMPRESSORS 10

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

MODULE V REFRIGERATION SYSTEMS 10

vapour compression refrigeration cycle - super heating, sub cooling-performance calculations. Working principle of vapour absorption system. Ammonia - water, Lithium bromide - water systems, comparison between vapour compression and absorption systems.

MODULE VI AIR-CONDITIONING SYSTEMS 10

Psychrometry, Psychometric chart, cooling load calculation, Concept of RSHF, GSHF, ESHF. Air conditioning Systems - summer and winter air conditioning systems Requirements for comfort and industrial air-conditioning.

List of Experiments:

1. (a)Experimental study on valve timing diagram in 4-stroke engine cut model.

   (b)Experimental study on port timing diagram in 2-stroke engine cut model.
2. Experiment on Fuel properties
   a) Viscosity
   b) Fire and Flash point
   c) Calorific Value
3. Performance test on constant speed 4-stroke diesel engine.
4. Heat balance test on 4-stroke twin cylinder diesel engine.
5. IC engine performance and heat balance evaluation using PC interface.
6. Motoring test on 4-stroke diesel engine with electrical loading.
7. Retardation test on 4-stroke diesel engine with mechanical loading.
8. Study on the composition of Exhaust gas of an IC engine using Orsat Apparatus under various loads.
9. Performance test on high pressure two stage reciprocating air compressor.
10. Experiment on air conditioning unit.
11. Experiment on vapour compression refrigeration unit.

12. Experiment on Vapour absorption refrigeration unit.

L – 45; P-15; Total Hours: 60

TEXT BOOKS:

1. Rajput, R.K, " Thermal Engineering", 8th Edition, Laxmi Publications Pvt Ltd., 2010

REFERENCES:

1. Rudramoorthy R, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2006.
2. Sarkar .B.K, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2005.
3. Ganesan V, "Internal Combustion Engine", 3rd edition, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2008.
4. Rajput, R.K, "Thermal Engineering", 8th edition, Laxmi publications Pvt Ltd., 2010
5. Arora. C.P. "Refrigeration and Air conditioning" 3rd edition, Tata McGraw Hill Publishers Co. Ltd., 2008.
6. Frank Kreith, "Hand Book of thermal Engineering", CRC press, 2000.
7. Manohar Prasad, "Refrigeration and Air-conditioning" 2nd edition, new age international, 2003.

OUTCOMES:

The students should be able to

- Explain the working and performance of IC engines, steam nozzles, turbines and air compressors.
- Illustrate the cycles and systems of refrigeration and air conditioning
- Analyze the performance and emission of IC engines
- Evaluate the performance of various engines
- Measure various heat transactions within and outside the engines
- Determine the properties of fuels and exhaust gases

MEC3103 MECHANICS LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To study the various principles of mechanics using simple mechanisms.
- To study the various controlling mechanisms such as governors and gyroscope.
- To determine the vibration parameters under various modes of vibration.

LIST OF EXPERIMENTS:

1. Governors - Determination of sensitivity, effort, etc. for watt, porter, proell, Hartnell governors.
2. Cam - Study of jump phenomenon and drawing profile of the cam.
3. Motorised Gyroscope-Verification of law's -Determination of gyroscopic couple.
4. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Determination of Moment of inertia by oscillation method for connecting rod and flywheel.
8. Vibrating system Spring mass-system-Determination of damping co-efficient of single degree of freedom system.
9. Determination of influence co-efficients for multi degree freedom suspension system.
10. Determination of transmissibility ratio - vibrating table.
11. Determination of torsional frequencies for compound pendulum and flywheel –system with lumped Moment of inertia
12. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.

Total Hours: 45

OUTCOMES:

The students should be able to

- Apply the principles of mechanics in real time mechanisms.
- Be familiar with various controlling mechanisms.
- Analyze the vibration parameters under various modes of vibration.

ECC3182	**ELECTRONICS LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1**

OBJECTIVES:

- To study the characteristics of various electronic devices.
- To learn the usage of microprocessor and controllers for various operations.

LIST OF EXPERIMENTS:

1. VI characteristics of PN Junction Diode
2. VI characteristics of Zener Diode
3. Characteristic of CE Transistor
4. Characteristics of JFET
5. Characteristics of Uni Junction Transistor
6. Study of Logic Gates (Basic Gates)
7. Half Adder and Full Adder
8. Shift Register
9. Ripple counter
10. bit addition, subtraction
11. Multiplication and division
12. Maximum and Minimum of block of data
13. Sorting and block transfer
14. Stepper Motor Interfacing
15. Traffic light controller

Total Hours: 45

OUTCOMES:

Students will be able to

- Analyze the characteristics of various electronic devices.
- Apply microprocessors and controllers for various operations.

SEMESTER VI

MSC 3181 LEADERSHIP AND CEO TRAINING

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims at

- Bringing about positive transformation in students' attitude.
- Building unique leadership competencies that would ensure successful transition of students across all career stages.
- Sensitizing students to identify their strengths & weakness and training them to deal with it
- Assisting students in enhancing their expressive ability and inducing a high level of self-confidence to manage both business and emotions
- Training students to become more adaptable and flexible to changing business environment

MODULE I INTRODUCTION TO LEADERSHIP 12

Leadership concept - meaning, definitions, importance of leadership, leadership traits. Leadership functions- general functions, listening, observing, managing and decision making. Components of leadership - leaders, followers and situation. Leadership theories – Trait theory, Skills theory, Style theory, Situational theory, Transformational theory, Transactional theory, Path Goal Theory and LMX. Assessing emotional intelligence and exploring the capabilities and inherent traits. through psychometric tests - Multi factor leadership questionnaire and personal reflections

MODULE II LEADERSHIP STYLE AND COMMUNICATION 8

Leadership styles-visionary, Coaching, Affiliative, Democratic, Pacesetting Commanding, Transformational, Transactional. Autocratic, Participative, Laissez-Faire Leader versus Managers. Leadership communication - Rationale, tactic, assertive, formal, informal, communication in crisis- leadership and negotiations, Leadership Presentations-convincing and impressive style

MODULE III LEADERSHIP ROLES 8

Facets of leadership- Leader as an individual – personality and leadership, values, attitudes and ethics of a leader. Leader as a relationship builder- empowering people to meet higher order needs, initiating organization wide motivational programs, involvement with all stakeholders- focusing on organization growth. Leader as an inspirer- motivation and leadership, recognizing and appreciating contributions, empowering others to lead Leader as an innovator –leader's role in shaping culture and values in an organization. Leader as a Liaison- Leader as team player

MODULE IV LEADERSHIP CHALLENGES AND STRATEGIES 9

Challenges in leadership: Perception of organization culture and values, interpreting the power dynamics in the organization, establishing work life balance. Bad leadership – Reasons and impact.-Case Study of Marissa Mayer- Yahoo. Inc Organizational transformation through efficient leaders-Case study of Apple Inc. Blue Ocean Leadership-Steps to Blue ocean Leadership-Four Pillars of Blue Ocean leadership-Blue Ocean leadership grid

MODULE V LEADERSHIP AND CEO TRAINING 8

Leader as a CEO: Traits of a successful CEO, Key responsibilities of a CEO, the path to be a CEO ,Training on Board Room Discussions, Meeting the CEO – Live sessions with industry CEO's. Requirements of Leadership: - Cognitive skills, Interpersonal skills, Business skills, Strategic skills. Role of Emotional Intelligence in taking up key-positions in the organization.

Teaching Pedagogy:

Nurturing – Based on the identified strengths and weaknesses, training will be given to enhance the strengths and overcome the weakness.

Assessment - Continuous evaluation will be effected through group discussions, oratory assignments and situational enactments. Pre-and post-training assessment through peer reviews and faculty feedback.

Sustained development – Training will be imparted for self-development and monitoring of leadership skills to ensure sustained applicability of the skills learnt.

Total Hours: 45

REFERENCES:

1. Andrew J DuBrin. "Leadership: Research Findings, Practice, and Skills", 8th Edition, South-Western College Pub, 2015.

2. Yukl G, “Leadership in Organisations”, 8th Edition, Pearson Education, 2013.
3. Richard L Daft, “Leadership”, 5th Edition, South Western Cengage Learning 2012.
4. Stephen P. Robbins and Timothy A. Judge. “Organizational Behaviour”, 15th Edition, New Delhi: Pearson, 2013.
5. Fred Luthans, “Organizational Behavior, An Evidence Based Approach”, 12th Edition, New Delhi: McGraw Hill Education, 2013.
6. Emotional Intelligence, Why it can matter no more than IQ by Daniel Goleman (include a book) Publisher: Bloomsbury Publishing India Private Limited; Latest edition (2017)
7. Primal Leadership: Unleashing the Power of Emotional Intelligence by Prof Daniel Goleman , Richard Boyatzis and McKee ,Harvard Business Review Press

RECOMMENDED READINGS:

1. Jim Collins, (2001). “Good To Great: Why Some Companies Make the Leap...And Others Don't”, Random House Publishers India Pvt. Ltd, New Delhi
2. George, B. with Sims, P. True North: Discover Your Authentic Leadership, The Times Group Books; First edition (1 October 2015)
3. Kim, W. C., & Mauborgne, R. A. (2014). Blue ocean strategy, expanded edition: How to create uncontested market space and make the competition irrelevant. Harvard business review Press
4. Leadership Wisdom by Robin Sharma Jaico Publishing House;

OUTCOMES:

The students will be able to

- Explore through self-introspection one’s own leadership style, their strength and weakness
- Gain self-confidence to lead a team in the organization
- Realize the role of leadership in making or breaking of an organization
- Acquire the practice of self-introspection and development of leadership competencies thorough continuous efforts
- Manage their own emotions as well as other resulting in successful relationship building with all stakeholders

MSC 3182	**SOCIAL ENTREPRENEURSHIP**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To be able to understand the field of social entrepreneurship and Social problems
- To be able to describe and understand the traits of social entrepreneurs
- To recognize the social business opportunities
- To synthesize the resource mobilization ways for social entrepreneurship
- To understand the social entrepreneurship models
- To recognize the impact of social entrepreneurship on societies

MODULE I INTRODUCTION TO SOCIAL ENTREPRENEURSHIP 7

Introduction - Emergence and Development of Social Entrepreneurship. Social Problems in India: An Overview. Social Development: The Indian Scenario. Emergence of Social Entrepreneurs and Sustainable Solutions to Social Problem. Characteristics and Context of Social Entrepreneurship .The Role of Social Entrepreneurship in Societies & Economies.

MODULE II SOCIAL ENTREPRENEURSHIP: DRIVERS AND CHALLENGES 7

The Drivers of Social Entrepreneurship. Elements of the Social Entrepreneurial Personality. Challenges of financial constraints. Challenge to attract and cultivate talented workers. Challenge of evaluation of social entrepreneur impact. Challenge of scaling and its impact. Cases

MODULE III SOCIAL ENTREPRENEURSHIP: OPPORTUNITY RECOGNITION 7

Opportunity Recognition and Planning Process. Opportunities for Social Entrepreneurs. The Nature of Social Entrepreneurial Opportunities. Social Problems into Opportunities. Idea development and conceptualization of social problem. Cases

MODULE IV RESOURCE MOBILIZATION FOR SOCIAL VENTURE 8

Resources at Initial Stage. Social Network as a role of Social Capital. Team and Collective Efforts. Need and Determination of Important Resources. Resource of Knowledge, Skills and Abilities. Overview of venture capital and angel investment. Cases

MODULE V BUSINESS MODELS AND BUSINESS PLAN FOR SOCIAL ENTERPRISES 8

Design Principles of Social Entrepreneurship Business Models, Evaluation of the Root Cause of a Societal Problem. Developing business plan for social ventures.

Developing an investor presentation. Feasibility study and report. How to start a business - Procedures for registration of small scale industry

MODULE VI THE IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETIES AND CASES 8

Static Impact of Social Entrepreneurship. Impact of Charitable NGOs vs. Social Entrepreneurship, Impact of For-Profit Companies vs. Social Entrepreneurship. Social entrepreneurship report preparation by students. Case Study of Social Entrepreneurs

Total Hours: 45

REFERENCES:

1. “Social Entrepreneurship: New models of sustainable social change” Alex Nicholls, Oxford University Press 2006
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India , Archana Singh Springer 2016
3. “Social Entrepreneurship and social business” Christine K Volkmann, Springer Gabler 2012
4. “Social Entrepreneurship” Manuel London , Routlege, 2010

OUTCOMES:

The students can able to

- Conceptualize social entrepreneurship in terms of a theoretical framework between changing social values and institutions
- Think and communicate about social values
- Learn about practical models of social change to launch, lead, manage, and evaluate a social venture
- Analyze funding needs and sources for the social venture
- Experience the ideas can be critically and collaboratively examined prior to commitment.

ENC 3281 COMMUNICATION AND SOFT SKILLS-II CONFIDENCE BUILDING

L	T	P	C
0	0	2	1

OBJECTIVES:

- To develop professional skills like work ethics, analytical skills, presentation skills, etc., among students.
- To expose students to problem solving skills and leadership skills pertaining to industries.
- To train them in team building skills.
- To help them in realizing their career goals

MODULE I **6**

Brief about Multinational companies- Analyzing work ethics of multinational companies and small industries- discussing as pairs-Knowledge about etiquette (different types)

MODULE II **6**

Visit to an Industry and prepare reports --Critically reading of industry based journal articles and write ups-- preparing reports.

MODULE III **4**

Analysing problem solving situations in industries (relating to application of core subject to specific jobs) and discussing about them - working on a sample case.

MODULE IV **6**

Developing Leadership in team projects-- debating about various aspects of leadership: for example, responsibility and reliability-time management

MODULE V **8**

Team building skills-- group discussions pertaining to industries (peer evaluation)-- presenting career goals -- preparing for interviews- interpersonal skills

Total Hours: 30

REFERENCES:

1. Covey,S.R. (2004). The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change. Free Press.UK
2. Fine, P.M. & Alice Olins. (2016).Step up: Confidence, Success and Your Stellar Career in 10 Minutes a Day. Vermilion.UK
3. Pai, A. (1993).How to Develop Self-Confidence. Soma Books Ltd
4. Wentz, F.H. (2012). Soft skills training: A Workbook to Develop Skills for Employment. Create space Independent Pub; Large Print edition (14 May

2012)

OUTCOMES:

After completing the course students would be able to

- Exhibit critical reading skills through review of industry specific articles.
- Provide solutions to problem based situations.
- Exhibit leadership qualities by debating over industry specific issues.
- Participate in group discussions confidently.
- Present their career goals.

MEC3211 MACHINE DESIGN

L	T	P	C
3	1	0	4

OBJECTIVES:

- To learn steady stresses and variable stresses in a machine component
- To impart knowledge on design of shafts and couplings
- To educate the design process of temporary and permanent joints
- To acquire knowledge on design of energy storing elements
- To learn the design of bearings
- To educate the design of miscellaneous components

MODULE I STEADY STRESSES AND VARIABLE STRESSES 12

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

MODULE II DESIGN OF SHAFTS AND COUPLINGS 10

Design of solid and hollow shafts based on strength, rigidity and critical speed - Design of Keys, key ways and splines - Design of rigid, flange and muff couplings.

MODULE III DESIGN OF TEMPORARY AND PERMANENT JOINTS 10

Threaded fasteners - Design of bolted joints including eccentric loading, Knuckle joints – Design of welded joints, riveted joints for structures - theory of bonded joints-Limitations of bonded joints - Applications

MODULE IV DESIGN OF ENERGY STORING ELEMENTS 8

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

MODULE V DESIGN OF BEARINGS 12

Sliding contact and rolling contact bearings -Design of hydrodynamic journal bearings, McKee's Eqn., Sommerfield Number, Raimondi & Boyd graphs – Derivation of McKee's Eqn - Selection of Rolling Contact bearings.

MODULE VI DESIGN OF MISCELLANEOUS ELEMENTS 8

Design of Seals and Gaskets -Design of crankshafts- Design of Connecting Rod.

L – 45; T – 15; Total Hours:60

TEXT BOOKS:

1. Shigley J.E, Mischke C. R., “Mechanical Engineering Design”, 6th Edition, Tata McGraw-Hill, 2003.
2. Bhandari V.B, “Design of Machine Elements”, 6th Edition, Tata McGraw-Hill Book Co, 2007.

REFERENCES:

1. Sundararajamoorthy T.V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
3. Ugural A.C, “Mechanical Design – An Integral Approach”, McGraw-Hill Book Co, 5. 2004.
4. Spotts M.F., Shoup T.E, “Design and Machine Elements” Pearson Education, 2004.

OUTCOMES:

Students should be able to

- Identify the steady and variable stresses in a machine component
- Solve the problems on design of shafts and couplings
- Apply the knowledge on design of temporary and permanent joints
- Design the key parameters of energy storing elements
- Design different types of bearings for various loading
- Design of miscellaneous components for given conditions

MEC3212	METROLOGY AND MECHANICAL MEASUREMENTS (INTEGRATED LAB)	L	T	P	C
		3	0	3	4

OBJECTIVES:

- To study the basic concepts of measurement
- To learn the linear and angular measuring techniques
- To impart knowledge on form and finish measurements
- To acquire knowledge on laser and advanced metrology
- To educate about measurement of power flow and temperature related properties
- To learn about sensors and sensing systems for process, system and condition monitoring techniques

MODULE I CONCEPT OF MEASUREMENT 10

Definition of metrology, General Concepts of measurement system-Units and standards-measuring instruments- sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-Measurement system behavior: General model for dynamic measurement system and special cases: zero order, first order and second order system, determination of time constant and settling time, phase linearity- systematic and random errors-correction, calibration, interchangeability, traceability. Statistical concepts: Mean, Range, Variance and Standard deviation in error analysis.

Hands on Practice : Calibration and Error analysis of measuring Instruments

MODULE II LINEAR AND ANGULAR MEASUREMENTS 11

Linear measuring instruments: Slip gauges, Tool Maker's microscope, limit gauges. Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements: -Sine bar, bevel protractor-Taper angle measurements.

Hands on Practice : Complete all measurements including intricate internal details of the given component using standard equipment and by other measuring procedures, Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical), Measurement of angle using Sine bar / Sine Center / Toolmakers microscope/ Slip gauge. Measurement of taper using standard balls / rollers. Measurement of straightness and flatness.

MODULE III FORM AND FINISH MEASUREMENT 10

Form measurement- Measurement of screw threads- floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method- straightness, flatness and roundness measurements- surface finish-surface roughness tester.

Hands on Practice: Measurement of thread parameters and Measurement of gear parameters.

MODULE IV LASER AND ADVANCES IN METROLOGY 9

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

Hands on Practice: Scanning the surface using Coordinate Measuring Machine (CMM). Measurement using vision system.

MODULE V MEASUREMENT OF POWER FLOW AND TEMPERATURE RELATED PROPERTIES 10

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

Hands on Practice: Measurement of Temperature. Measurement of Displacement, Force and Torque.

MODULE VI SENSORS AND SENSING SYSTEMS FOR PROCESS, SYSTEM AND CONDITION MONITORING 10

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

Hands on Practice: Measurement of vibration

L – 45; P-15; Total Hours : 60

TEXT BOOKS:

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2009
2. Alan S. Morris, “The Essence of Measurement”, Prentice Hall of India, 1997

REFERENCES:

1. Gupta S.C, “Engineering Metrology”, Dhanpat rai Publications, 2005.
2. Beckwith T.G, and R.D. Marangoni, “Mechanical Measurements”, Addison Wesley, 2007
3. Donald D Eckman, “Industrial Instrumentation”, Wiley Eastern, 1985.
4. ASTME, “hand book of industrial metrology” Prentice Hall of India, 1988

5. ASNT, “Nondestructive testing handbook Emission” Volme.5- Acoustic emission testing,1994

OUTCOMES:

Students should be able to

- Explain the basic concepts of measurement
- Perform the linear and angular measurements
- Execute form and finish measurements
- Demonstrate the laser measurement and advanced metrology
- Measure the power flow and temperature
- Use sensors and sensing systems for process, system and condition monitoring techniques

MEC3213	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the different modes of heat transfer and their application in engineering
- To learn heat conduction equation in steady and transient states
- To impart knowledge on boundary layer development in convection process
- To educate thermal radiation with the influence of orientation of surfaces
- To learn various types of heat exchangers and boiling heat transfers
- To comprehend the basic concepts of mass transfer.

MODULE I BASIC OF HEAT TRANSFER & GOVERNING EQUATIONS 10

Basic Concepts- Modes of heat transfer- conduction, convection, and radiation, Fourier law of heat conduction, three-dimensional heat conduction equations in various co-ordinate systems, steady state heat conduction equation for plane, cylindrical and spherical shapes- overall heat transfer co-efficient, Composite systems, Critical radius of insulation.

MODULE II CONDUCTIVE HEAT TRANSFER 7

Variable thermal conductivity, heat transfer with heat generation in different shapes. Extended surfaces (fins)-numerical methods for varying sections of fins with different end conditions. Transient heat conduction Lumped parameter systems, infinite solids, semi-infinite solids, numerical and graphical methods.

MODULE III CONVECTIVE HEAT TRANSFER 7

Concepts of Boundary Layer: Differential and integral equations for hydrodynamics and thermal boundary layer. Convection Heat Transfer: Forced Heat transfer from flat plate, laminar and turbulent flow, cylinders and spheres, flow through tubes. Free convection, heat transfer from vertical and horizontal surfaces.

MODULE IV RADIATION HEAT TRANSFER 6

Radiation Heat Transfer: Emissive power, grey body. Radiation heat transfer between surfaces, shape factor.-Electrical analogy, Gas radiation.

MODULE V HEAT EXCHANGERS 9

Types-tube arrangements, single and multi-tube types, parallel, counter and cross flow, Overall heat transfer coefficient, Analysis – LMTD method, - NTU method. Fouling factor. Boiling and Condensation: Boiling heat transfer - bubble growth, freezing and melting. Condensation, film condensation and drop wise condensation.

MODULE VI MASS TRANSFER 6

Mass Transfer: Basic Concepts- Diffusion mass transfer- Fick's law of diffusion steady state molecular diffusion- convective mass transfer- momentum, Heat and mass transfer analogies- convective mass transfer correlations.

Total Hours: 45

REFERENCES:

1. Holman J P, "Heat Transfer", 9th edition, Tata McGraw Hill Inc., New York, 2008.
2. S. P. Sukhatme, "Text book of Heat transfer" 4th edition, University Press (India) Pvt. Ltd. 2006.
3. Yunus A Cengel, "Heat Transfer: A Practical Approach", 2nd Edition, Tata McGraw Hill Inc., New York, 2005.
4. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer", 4th edition, New Age International Publishers, New Delhi, 2010.
5. Nag P K., "Heat and Mass Transfer", Tata McGraw Hill Publishing Company, New Delhi, 2004.
6. Suhas V Patankar, "Numerical Heat transfer and fluid flow", ane books, 1st edition series in computational methods in mechanics and thermal sciences.
7. Frank P Incropera and David P Dewitt, "Heat and Mass Transfer", 5th edition 2001, Wiley.
8. Donald Q Kern, "Process Heat Transfer", TMH.

OUTCOMES:

The student should be able to

- Apply different modes of heat transfer and their application in engineering
- Solve heat conduction problems in steady and transient states
- Apply principle of convection and their relation to fluid dynamics
- Evaluate thermal radiation with the influence of orientation of surfaces
- Analyse various types of heat exchangers and boiling heat transfers
- Explain the basic concepts of mass transfer

MEC3214 HEAT AND MASS TRANSFER LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To experimentally study the different modes of heat transfer.
- To determine the parameters such as thermal conductivity, heat transfer coefficient and Stefan Boltzmann constant.

LIST OF EXPERIMENTS:

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Thermal conductivity of metal rod.
3. Thermal Conductivity of liquids.
4. Heat transfer through composite wall.
5. Thermal conductivity measurement using guarded plate apparatus.
6. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
7. Determination of heat transfer coefficient under forced convection from a tube.
8. Heat transfer from pin-fin (natural & forced convection modes)
9. Determination of Stefan – Boltzmann constant.
10. Determination of emissivity of a grey surface.
11. Heat transfer studies on pool boiling.
12. Effectiveness of Parallel / counter flow heat exchanger.
13. Drop and Film-wise condensation study
14. Transient heat conduction study

Total Hours: 45

OUTCOMES:

- Students should be able to apply heat laws and equations to measure heat transfer

MEC3215 CNC LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To learn part programming for CNC machines.
- To practice tool path simulation in CAD/CAM software.
- To generate NC code for CNC controllers from 3D models.
- To familiarize interfacing between software and machines.

LIST OF EXPERIMENTS:

CNC Lathe:

- Part programming for Linear and Circular interpolation.
- Part programming using standard canned cycles for Turning.

CNC Mill:

- Part programming for Linear, Circular interpolation and Contour motions.
- Part programming involving canned cycles for Drilling, Peck drilling and Boring.
- Modelling and Simulation in CAD/CAM software:
- Tool path generation and Mould design from 3D models using CAD/ CAM software.
- Post processing for standard CNC Controllers like FANUC, Sinumerik etc.
- Designing and realizing a product:
- Design a simple product and its required tooling and simulate its 3D model.
- Generate NC codes and interface with CNC machine to realize the product.

Total Hours: 45

TEXT BOOKS:

1. Lab Manual.

REFERENCES:

1. P.N. Rao, “CAD / CAM Principles and Applications”, 2nd Edition, Tata Mc Graw Hill, 2004.

2. Ibrahim Zeid, “CAD/CAM - Theory and Practice”, McGraw Hill, International Edition, 1998.

OUTCOMES:

Students should be able to

- Write part programs and operate CNC lathe.
- Write part programs and operate CNC milling machine.
- Choose proper manufacturing processes and tooling for machining.
- Create 3D models and simulate tool path using CAM software.
- Perform post processing for various CNC controllers and interface with machines.
- Develop their ideas into CAD models and realize it in a CNC machine.

SEMESTER VII

MEC4101	FINITE ELEMENT ANALYSIS (INTEGRATED LAB)	L	T	P	C
		3	0	3	4

OBJECTIVES:

- To study the basic concepts of mathematical modeling of engineering problems
- To learn the principles of discretization and finite element formulation
- To acquire knowledge on application of FEA in beams
- To impart knowledge on the use of FEM to a complex structures
- To learn isoparametric formulation and numerical integration
- To study the application of FEM in steady state thermal problems

MODULE I INTRODUCTION 8

Basic Concept, comparison with FDM and FVM, advantages and disadvantages, history of development, application. – Application to the continuum – Discretization – Governing equations for continuum – Variational methods - Weighted residual method.

Hands on Practice: Fundamentals of FEA software

MODULE II BASICS OF FINIETE ELEMENT FORMULATION 12

Finite Element Analysis of 1D Problems - Element type - Spring element, two noded line element - lower order and higher order element types - discretization, displacement function, shape function, formulation, element equations, assembly, boundary conditions, solution of equations- post processing, convergence criteria, examples from solid mechanics.

Hands on Practice: Analysis of uniform and stepped bar for different loading

MODULE III BEAM ELEMENT AND ITS APPLICATIONS 12

Element Shape Functions - C0, C1 continuity- completeness and compatibility condition, formulation, element equations, assembly, boundary conditions, solution of equations and examples - types of beam and different loading conditions.

Hands on Practice:

Point Loading of a beam [1D BEAM, 2D SHELL, 3D SOLID]

Bending Moment Loading of a beam [1D BEAM, 2D SHELL, 3D SOLID]

Distributed loading of a beam [1D BEAM, 2D SHELL, 3D SOLID]

MODULE IV TWO DIMENSIONAL STRUCTURAL ANALYSIS 10

Theory of Elasticity – Plane Stress – Plain Strain and Axisymmeteric Concept – CST - LST - shape function - strain - displacement matrix - constitutive matrix - stiffness matrix - assembly - solutions - examples - finite element formulation of plate, dam, pipe, pressure vessels problems.

Hands on Practice:

Analysis of truss structure [2D,3D]

Analysis of a Plate with a circular hole [plane stress]

Analysis of cylindrical pressure vessel under internal pressure [Plane Strain]

Analysis of an thick cylinder [Axisymmetric approach]

MODULE V ISOPARAMETRIC FORMULATION AND NUMERICAL INTEGRATION 8

Natural co-ordinate systems –Lagrangian Interpolation Polynomials-Serendipity Formulation- Isoparamatric Elements Formulation - Rectangular elements - Numerical integration – simple Problems using Gauss quadrature Technique.

Hands on Practice: Analysis of 2D and 3D complex problems using quadrilateral and brick elements

MODULE VI FEA IN THERMAL ANALYSIS 10

Governing equation - 1D heat flow and finite element formulation – 2D thermal element and its formulation - Conduction and Convection - Simple problems - heat transfer in composite wall, fins

Hands on Practice:

Analysis of cooling fin [conduction and convection]

Thermal stress in a composite pipe.

L – 45; T – 15; Total Hours: 60

REFERENCES:

1. Reddy J.N. – "A Introduction to Finite Element Method", McGraw Hill, International Edition, 1993.
2. Seshu. P – "Textbook of Finite Element Analysis", Prentice-Hall India Pvt. Ltd, 2006.
3. Cook, Robert Devis etal, - "Concepts and Application of finite Element Analysis", Wiley John & Sons, 1999.
4. David V Hutton "Fundamentals of Finite Element Analysis" 2004.

McGraw-Hill Int. Ed.

5. O.C.Zienkiewicz and R.L.Taylor, “The Finite Element Methods”, Vol.1, “The basic formulation and linear problems”, Vol.1, Butterworth Heineman, 5th Edition, 2000.
6. Rao.S.S, - Finite Element Method in Engineering, Pergamon Press, 1989
7. Chandrupatla T.R., and Belegundu A.D., “Introduction to Finite Elements in Engineering”, Pearson Education 2002, 3rd Edition.
8. Krishnamoorthy C.S – “Finite Element Analysis: Theory and Programming”, Tata McGraw Hill Publishing Company .Ltd 1998.

OUTCOMES:

Students should be able to

- Formulate a mathematical modeling of engineering problems
- Discretize the given problem
- Solve various beam problems using FEA
- Apply FEM to a complex structures
- Explain isoparametric formulation and numerical integration
- Use steady state thermal problems

MEC4102	MECHATRONICS (INTEGRATED LAB)	L	T	P	C
		3	0	3	4

OBJECTIVES:

- To study the basic concepts and various sensors
- To impart knowledge on actuator and its applications
- To acquire knowledge on programmable logic controllers
- To learn about different system models
- To educate about different system controllers
- To learn about design of a mechatronic systems for different applications

MODULE I INTRODUCTION 12

Introduction to Mechatronics- Systems- Concepts of Mechatronics approach – Need for Mechatronics- Emerging area of Mechatronics- Sequential controllers. Introduction to Sensors & Transducers – Performance Terminology- Sensors for motion and position measurement, force, torque, tactile, temperature sensors, ultrasonic sensors, hall-effect sensors. Selection of sensors for different applications, Signal Conditioning.

Hands on Practices - Potentiometer, Strain gauge, Torque, LVDT, Hall effect, speed, Vibration, Pressure - Practices on Transducer – Temperature, optical - operational amplifier circuits.

MODULE II ACTUATORS 12

Review of Pneumatic and Hydraulic Systems - Control Valves, Actuators. Review of Mechanical Actuation Systems – Electrical Actuation Systems – Mechanical Switches, Solid State Switches, Solenoids, Construction and working principle of DC and AC Motors –speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor-servo motor

Hands on Practices - Electro Pneumatic trainer kit and simulation software.

MODULE III PROGRAMMABLE LOGIC CONTROLLER 8

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

Hands on Practices in Simulation of real life automation viz., bottling plant and punching operation using PLC Ladder Diagram

MODULE IV SYSTEM MODELS 9

System Models - Building blocks of Mechanical, Electrical, Fluid and Thermal

Systems, Modeling spring, mass & damper systems, Rotational –Translational Systems, Electromechanical Systems, and Hydraulic –Mechanical Systems.

Hands on Practices in the development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors, Measurement of damping ratio of a machine tool base from free vibration studies using an impact hammer and an accelerometer pick up with data acquisition system.

MODULE V SYSTEM CONTROLLERS 9

Closed-Loop Controllers - Continuous and discrete process Controllers, Control Modes –Two –Step mode, Proportional Mode, Derivative Mode, Integral Mode, PID Controllers –Digital Controllers –Velocity Control –Adaptive Control –Digital Logic Control.

Hands on Practices in control of speed, direction and number of revolutions of a stepper motor using PC interface, control valve characteristics, Level Process Stations.

MODULE VI DESIGN OF A MECHATRONICS SYSTEM 10

Mechatronics Design process-stages -Traditional and Mechatronics design concepts- Case studies of Mechatronics systems- Pick and place Robot, Autonomous mobile robot - Engine Management system- Automatic car park barrier- Robot walking machine. Introduction to data acquisition and control systems, virtual instrumentation, interfacing of various sensors and actuators with PC-Design of three axis robot using ARDUINO

Hands on Practices in interfacing of a thermal sensor to monitor and control the temperature in a thermal chamber within a specified tolerance limits - Virtual process controls systems and Heating and Ventilation control using Data Acquisition techniques

L – 45; T – 15; Total Hours: 60

REFERENCES:

1. Bolton,W, “Mechatronics”, Pearson education, second edition, fifth Indian Reprint, 2003.
2. Smaili.A and Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.
3. Michael B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 2000.
4. Sanjay Gupta and Joseph John, "Virtual Instrumentation and LabVIEW", Tata McGraw Hill Publications, Co., 2005.
5. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
6. Dan Necsulesu, “Mechatronics”, Pearson Education Asia, 2002 (Indian Reprint).

7. Lawrence J. Kamm, “Understanding Electro –Mechanical Engineering”, An Introduction to Mechatronics, Prentice –Hall of India Pvt., Ltd., 2000.

OUTCOMES:

Students will be able to

- Explain the basic concepts and various types of sensors
- Simulate different types of actuator for different applications
- To use programmable logic controllers for various applications
- Demonstrate different system models
- Devise a system controller for a given application
- Design of a mechatronic systems for different applications

MEC4103 DESIGN OF TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the design principles of belt, chain and rope drives
- To impart knowledge on the design aspects of spur and helical gears
- To acquire knowledge on design of bevel and worm gears
- To study the design procedure of gear box
- To learn the design aspects of various types of cam
- To educate the design procedure for clutches and brakes

MODULE I DESIGN OF BELT AND CHAIN DRIVES 10

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

MODULE II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

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

MODULE III BEVEL, WORM GEARS AND CROSSED HELICAL GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits –Terminology. Thermal Capacity, Materials forces and stresses, efficiency, estimating the size of the worm gear pair. Crossed - helical Terminology-helix angles – Estimating the size of the pair of Crossed-helical gears.

MODULE IV DESIGN OF GEAR BOXES 7

Progression – Standard step ratio – Ray diagram, kinematic layout – Design of Sliding mesh gear box- Constant mesh gearbox – Design of multi speed gear box.

MODULE V DESIGN OF CAMS 5

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

MODULE VI DESIGN OF CLUTCHES AND BRAKES 5

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

Total Hours: 45

TEXT BOOKS:

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition,Tata McGraw-Hill , 2003.
2. Sundararajamoorthy T. V and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

REFERENCES:

1. Maitra G.M. and Prasad L.V., “Hand book of Mechanical Design”, II Edition, Tata McGraw-Hill, 1985.
2. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd., 1994.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000,
4. Hamrock B.J., Jacobson B. and Schmid S.R., “Fundamentals of Machine Elements”, Tata McGraw-Hill Book Co., 1999.
5. Ugural A,C, "Mechanical Design, An Integrated Approach", Tata McGraw-Hill,2003.

STANDARDS:

1. IS 4460: Parts 1 to 3 : 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity.
2. IS 7443 : 2002, Methods of Load Rating of Worm Gears
3. IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, Pl and PM Profiles : Dimensions
4. IS 2122: Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission : Part 1 Flat Belt Drives.
5. 5. IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 2: V-Belt Drives.

OUTCOMES:

The students should be able to

- Design the belt, chain and rope drives
- Design spur and helical gears for the given conditions
- Design bevel and worm gears for the given conditions
- Design the gear box
- Design various types of cam
- Design the clutches and brakes

MEC4104 SIMULATION LAB **L T P C**

0 0 3 1

OBJECTIVES:

- To realize the importance of Computational efficiency in simulation of Real time Mechanical systems.
- To Implement Dynamics and control problems in Vibratory systems.
- To learn vibration pattern in vibratory systems with damping and without damping.
- To implement automation systems by virtual simulation and analysis of Real Time systems.

LIST OF EXPERIMENTS

1. Simulation of simple pendulum.
2. Simulation of Double pendulum.
3. Single degree of freedom spring-mass system with free and forced vibration.
4. Single degree of freedom spring-mass-damper system with free and forced vibration.
5. Two degree of freedom spring-mass system with free and forced vibration.
6. Two degree of freedom spring-mass-damper system with free and forced vibration.
7. Implementation of PID controller in Tuning and control of above dynamic systems.
8. Simulation of Four bar mechanism.
9. Simulation of Simple pendulum.
10. Simulations of Slider crank mechanism.
11. Simulation of Single link Robot Arm.
12. Simulation of Hydraulic system with Single-Acting Cylinder.
13. Simulation of Elevator system.
14. Simulation of Hydraulic system with Double-Acting Cylinder.

Total Hours : 45

OUTCOMES:

The students should be able to

- simulate and study different systems and mechanisms.
- acquire knowledge on automation through virtual simulation of real time systems

MEC4105	**AUTOMOBILE LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1**

OBJECTIVES:

- To study the various components of vehicle by dismantling and assembling
- To study the functions and performance of various automobile systems

LIST OF EXPERIMENTS

1. Dismantling & Assembling of petrol engine.
2. Dismantling & Assembling of diesel engine.
3. Study of oil filter, fuel filter, fuel injection system, carburetor, MPFI
4. Study of ignition system components – coil, magneto and electronic ignition systems.
5. Study of engine cooling system components
6. Study of engine lubrication system components
7. Dismantling & Assembling of Differential
8. Dismantling & Assembling of gear box
9. Dismantling & Assembling of Clutch assembly

Total Hours: 45

OUTCOMES:

Student should be able to

- Understand the function of various automobile components.
- Dismantle and assemble various components of a vehicle.

		L	T	P	C
MEC4106	**INTERNSHIP**	**0**	**0**	**0**	**1**

OBJECTIVES:

Students must undergo two weeks industrial training preferably in the industries relevant to Mechanical Engineering.

SEMESTER VIII

MEC4211	**PROJECT WORK**	**L**	**T**	**P**	**C**
		0	**0**	**24**	**12**

OBJECTIVES:

- To practice the knowledge gained from all the courses
- To develop individual responsibility and team work

Students should do a project which involves themselves with innovative ideas of design, fabrication, analysis, Industrial problem solving, new development.

Frequently, progress in the project work is evaluated by conducting reviews.

At end semester students should appear for their project viva-voce and submit the reports.

OUTCOMES:

Student can able to

- Examine a part or product feasibility
- Develop a real time working model
- Planning of activities and time management skills.
- Fault diagnosis of industrial parts.

ELECTIVE FOR DESIGN

MECX01	ADVANCED STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

Prerequisite : Knowledge on fundamentals of Strength of Materials

OBJECTIVES:

- To study the stress strain relations and location of shear centers
- To educate stress and deflections in curved beams
- To impart knowledge on unsymmetrical bending
- To learn the stresses in flat plates
- To acquire knowledge on torsional stresses in thin walled tubes and non-circular sections.
- To study the stresses in rotary sections and contacts

MODULE I STRESS AND STRAIN RELATIONS & TORSION OF NON-CIRCULAR SECTIONS 8

Elastic and Inelastic response of a solid, Transformation of stress, strain, principal stresses and strains, general equations of elasticity in Cartesian, differential equations of equilibrium-compatibility- boundary conditions. Representation of three dimensional stress of a tension, generalized hook's law – St. Venant's principle-plane stress-Airy's stress function.

Torsion of rectangular cross section – S.Venants theory – elastic membrane analogy, Prandtl's stress function. Torsional stress in hollow thin walled tubes.

MODULE II SHEAR CENTRE 7

Shear Centre – Location of shear centre for various sections: thin wall beam cross section, channel section, box beams, beams formed from stringers and thin webs-shear flows-Plastic bending

MODULE III UNSYMMETRICAL BENDING 8

Flexible Members – Circumference and radial stresses-deflections-curved beam with restrained ends-closed ring subjected to concentrated load and uniform load-chain links and crane hooks.

MODULE IV FLAT PLATES 7

Stresses in circular and rectangular plates due to various types of loading and end conditions, buckling of plates.

MODULE V THEORY OF PLASTICITY 8

Theory of plastic deformation – Yield criteria – Tresca and Von-mises-Distortion energy – Stress-stress relation – Mohr's circle representation of a state of stress – Cylindrical and spherical co-ordinate system – Upper and lower bound solution methods – Overview of FEM applications in metal forming analysis.

MODULE VI STRESSES DUE TO ROTARY SECTIONS & CONTACTS 7

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Contact Stresses – Methods of computing contact stress - deflection of bodies in point and line contact applications.

Total Hours: 45

REFERENCES:

1. Boresi A.P., Schmidt R.J., "Advanced Mechanics of Materials", John Wiley and Sons, Sixth edition, 2003.
2. Seely and Smith, "Advanced Mechanics of Materials", John Wiley International Edn, 1952.
3. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill.
4. Wang, "Applied Elasticity", McGraw Hill.
5. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mcmillan pub. Co., 1985.

OUTCOMES:

Students will be able to

- Explain the stress strain relations and location of shear centers
- Solve problems on stress and deflections in curved beams
- Express the bending phenomenon in unsymmetrical sections
- Evaluate stresses in flat plates
- Find torsional stresses in thin walled tubes and non-circular sections
- Comprehend the stresses in rotary sections and contacts

MECX02	COMPOSITE MATERIALS FOR MANUFACTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study various fibers and matrix materials in the composites
- To learn various polymer matrix composites processes
- To acquire knowledge on metal matrix composites
- To impart knowledge on ceramic matrix composites
- To educate about micromechanics
- To study fatigue and creep behaviour in composite materials

MODULE I INTRODUCTION 9

Fundamentals of composites - Need for composites - Matrix materials - Properties- Reinforcement - Fibres - Glass fibre, Aramid fibre, Carbon fibre, boron fibre - Fabrication - Properties - Applications - Comparison of fibres - Particulate and whisker reinforcements. Matrix Reinforcement Interface - Wettability - Effect of surface roughness - Interfacial bonding - Methods for measuring bond strength.

MODULE II POLYMER MATRIX COMPOSITES 8

Polymer matrix resins - Thermosetting resins -Thermoplastic resins – PMC Processes - Hand layup and spray processes - Compression moulding - Reinforced reaction injection moulding - Resin transfer moulding - Pultrusion- Filament winding - Injection moulding - Fibre Reinforced Plastics (FRP) – Glass fibre Reinforced Plastics(GRP).

MODULE III METAL MATRIX COMPOSITES 8

Characteristics - Types - Alloy vs. MMCs - Advantages - Limitations – Metallic materials - Reinforcement - Particles - Fibres - Effect of reinforcement – Volume fraction - Rule of mixtures - Processing of MMCs - Solid state, liquid state, deposition and insitu - Applications.

MODULE IV CERAMIC MATRIX COMPOSITES 8

Engineering ceramic materials - Properties - Advantages - Limitations – Need for CMCs - Processing - Hot pressing, liquid infiltration technique, Lanxide process, insitu chemical reaction techniques - CVD, CVI, Solgel process - Interface in CMCs - Applications.

MODULE V MICROMECHANICS 6

Micromechanics models for stiffness - Micromechanics models for strength - Thermal and moisture effects.

MODULE VI FATIGUE AND CREEP IN COMPOSITE MATERIALS 6

Fatigue - S-N curves - Fatigue behavior of CMCs - Fatigue of particle and whisker reinforced composites -Hybrid composites - Thermal fatigue - Creep.

Total Hours: 45

REFERENCES:

1. Mathews F.L. and Rawlings R.D., “Composite materials: Engineering and Science”, Chapman and Hall, London, England, 1st edition, 1994.
2. Chawla K.K., “Composite materials”, Springer - Verlag, 1987.
3. Clyne T.W. and Withers P.J. “Introduction to Metal Matrix Composites”, Cambridge University Press, 1993.
4. Strong A.B., “Fundamentals of composite Manufacturing”, SME, 1989.
5. Sharma S.C., “Composite Materials”, Narosa Publications, 2000.
6. Mathews F. L. and Rawlings R. D., “Composite Materials: Engineering and Science”, CRC Press and Woodhead Publishing Limited, 2002.
7. Derek Hull, “Introduction to Composite Materials”, Cambridge University Press, 1988.
8. Handbook of Composites - American Society of Metals, 1990.

OUTCOMES:

Students will be able to

- Discuss various fibers and matrix materials in the composites
- Explain various polymer matrix composites processes
- Elucidate metal matrix composites
- Describe ceramic matrix composites
- Expose micromechanics of the composites
- Deliberate fatigue and creep behaviour in composite materials

MECX03	DESIGN OF HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

Prerequisite : Basic knowledge on Hydraulics and Pneumatics

OBJECTIVES:

- To study the fundamentals and fluid power principles
- To learn about various hydraulic systems and components
- To acquire knowledge on design of hydraulic circuits
- To educate about various pneumatic systems
- To impart knowledge on design of various hydraulic and pneumatic circuits
- To instruct the students in the area of troubleshooting and maintenance of hydraulic and pneumatic systems

MODULE I FLUID POWER PRINCIPLES & REVIEW OF FUNDEMENTALS 7

Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids Basics of Hydraulics – Pascal's Law- Principles of flow – Work, Power and Torque. Properties of air– Perfect Gas Laws. General types of fluids – fluid power symbols.

MODULE II HYDRAULIC SYSTEM AND COMPONENTS 8

Sources of Hydraulic power: Pumping Theory – Pump Classification-Gear, vane and piston pumps - Construction, Working, Advantages, Disadvantages, Performance- Variable displacement pumps. Fluid power actuators: Linear hydraulic actuators – Types of hydraulic cylinders – single & double acting – special cylinders like tandem, rodless, Telescopic, cushioning Mechanism, construction of double acting cylinder, Rotary Actuator – Fluid motors, Gear, Vane and piston motors. Construction of control components – DCV – 3/2, 4/ 2 valves – shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, flow control valve- Fixed and adjustable, electrical control solenoid valves, relays, ladder diagrams.

MODULE III DESIGN OF HYDRAULIC CIRCUITS 7

Reciprocating, quick return, sequencing, synchronizing circuits, simple industrial circuits – Press circuits, earth movers, grinding machines. Safety and emergency emergency modules. Accumulators and intensifiers: Types, sizing and applications.

MODULE IV PNEUMATIC SYSTEM 8

Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems. Fluid power design, speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, and sequential circuit design for simple industrial applications using cascade methods.

MODULE V DESIGN OF HYDRALIC AND PNEUMATIC CIRCUITS 8

Servo systems – hydro mechanical servo systems, electro hydraulic servo systems and proportional valves. Introduction to electro hydraulic pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits.

MODULE VI TROUBLESHOOTING AND MAINTENANCE 7

Common faults in hydraulic system, Procedure for repair, contamination, Component fittings and failure due to contaminants, Filter and filter maintenance, Pump maintenance, hydraulic system maintenance, performance monotoring General safety measures for fluid power system.

Total Hours: 45

REFERENCES:

1. Anthony Esposito," Fluid Power with Applications", PHI / Pearson Education, 2005.
2. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
3. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw Hill, Fourth Reprint 2003.
4. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw Hill, 2007.
5. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

OUTCOMES:

Students will be able to

- Explain the fundamentals and fluid power principles
- Use various hydraulic systems and components for a given applications
- Design of hydraulic circuits
- Explain about various pneumatic systems
- Design of various hydraulic and pneumatic circuits
- Perform troubleshooting and maintenance of hydraulic and pneumatic systems

MECX04 NOISE, VIBRATION AND HARSHNESS

L	T	P	C
3	0	0	3

Prerequisite : Basic knowledge on kinematics and Dynamics

OBJECTIVES:

- To study the fundamental concepts of vibration
- To impart knowledge on basics of noise
- To acquire knowledge on modelling of vibrating systems
- To learn about different types of vibration measurement techniques
- To educate about noise controlling techniques
- To learn different types vibration controlling techniques

MODULE I INTRODUCTION 7

Introduction to Noise, Vibration and Harshness (NVH) and its role in automotive and industrial applications. Sources of vibration and noise. Physiological effects of noise and vibration. Vibration and noise standards and limit.

MODULE II BASICS OF NOISE 8

Basic concept about sound. Sound intensity measurements. Sound propagation characteristics. Acoustic parameters. Sound pressure level and sound intensity; frequency and time weightings. Assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

MODULE III MODELING OF VIBRATING SYSTEMS 7

Relevance and need for vibration analysis – Mathematical modeling of Vibrating Systems – Discrete and Continuous systems - Single degree of freedom Systems – Free and Forced Vibrations- Various Damping Models.

MODULE IV VIBRATION MEASUREMENTS 8

Vibration Monitoring. Data Acquisition. Vibration Parameter Selection. Vibration Sensors. Accelerometers. Performance Characteristics. Sensor Location Signal. Preamplifications. Types of Preamplifiers. Real Time Analysis. Digital Fourier Transforms. FFT Analysis. Vibration Meters. Vibration Signatures. Standards. Vibration Testing Equipment. Modal analysis.

MODULE V NOISE CONTROLLING METHODS 7

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

MODULE VI VIBRATION CONTROLLING TECHNIQUES 8

Methods of vibration control. Excitation reduction at source, Balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection of structural materials. Vibration absorbers. Tuned absorber. Tuned and damped absorber. Untuned viscous damper. Vibration isolation. Harshness. Sources and its Effects, Measurement and control.

Total Hours: 45

REFERENCES:

1. W.T. Thomson. (1997) “Mechanical Vibration”, 5th edition, Prentice- Hall.
2. S.S. Rao. (1995) “Mechanical Vibrations”, 3rd edition, Addison Wesley.
3. M.P. Norton. (1994) “Fundamentals of Noise and Vibrations Analysis for Engineers”, Cambridge University Press.
4. S.P. Parker. (1987) Acoustics Source Book, McGraw-Hill.
5. Gatti P. and Ferrari V. “Applied Structural and Mechanical Vibrations: Theory, Methods and Measuring Instrumentation”, E & FN Spon, London, 1999.
6. D.J. Ewins. (2000) Modal Testing: Theory, Practice and Applications, Research Studies.
7. Clarence W. de Silva. (2007) Vibration Monitoring, Testing, and Instrumentation, CRC Press.
8. M. Harrison. (2004) Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Elsevier Butterworth-Heinemann.

OUTCOMES:

Student should be able to

- Explain the fundamental concepts of vibration
- Describe about basics of noise
- Model simple vibrating systems
- Use different types of vibration measurement techniques
- Apply various noise controlling techniques for a given condition
- Use various vibration controlling techniques for a given condition

MECX05 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the basic functions of jigs and fixtures
- To learn about clamp and tolerances
- To educate about jigs, types of jigs and its applications
- To acquire knowledge on various types of fixtures
- To impart knowledge on dies and strip layouts
- To study the design and development of dies

MODULE I PURPOSE TYPES, FUNCTIONS OF JIGS AND FIXTURES 7

Tool design objectives - Production devices - Inspection devices – Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures.

MODULE II CLAMPS AND TOLERANCE 8

Types of clamps - Mechanical actuation-pneumatic and hydraulic actuation Analysis of clamping force-Tolerance and error analysis.

MODULE III JIGS 9

Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air operated Jigs components. Design and development of Jigs for given components.

MODULE IV FIXTURES 9

General principles of boring, lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures, Modular fixtures. Design and development of fixtures for given component.

MODULE V PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAYOUT 6

Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies:Die block-die shoe. Bolster plate-punch plate - punch holder-guide pins and bushes – strippers – knockouts-stops –pilots-Selection of standard die sets strip lay out-strip lay out calculations.

MODULE VI DESIGN AND DEVELOPMENT OF DIES 6

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

Total Hours: 45

TEXT BOOKS:

1. Edward G Hoffman, “Jigs & Fixture Design”, Thomson – Delmar Learning, Singapore 2004.
2. Donaldson. C, “Tool Design”, Tata McGraw-Hill, 1986.

REFERENCES:

1. Kempster, “Jigs & Fixtures Design”, The English Language Book Society”, 1978.
2. Joshi, P.H., “Jigs & Fixtures”, Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 2004.
3. Hiram E Grant, “Jigs and Fixture” Tata McGraw-Hill, New Delhi, 2003.
4. “Fundamentals of Tool Design”, CEEE Edition, ASTME, 1983.
5. Design Data Handbook PSG College of Technology, Coimbatore.

OUTCOMES:

- **Students will be able to**
- Explain the basic functions of jigs and fixtures
- Apply suitable clamp and tolerances for a given application
- Use suitable jigs based on the applications
- Practice suitable fixture for a particular application
- Demonstrate dies and strip layouts
- Elucidate design and development of dies

MECX06	**INDUSTRIAL PROBLEM SOLVING TECHNIQUES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To study the basic concepts of problem solving techniques
- To learn about statistical techniques
- To use optimization techniques
- To acquire knowledge on PERT & CPM
- To impart knowledge on artificial intelligence techniques
- To explore the knowledge on different domains

MODULE I PROBLEM SOLVING TECHNIQUES – AN INTRODUCTION 9

Introduction - 8 step problem solving methodology – Symptoms, Root cause , Difference between symptoms and root cause – Role of problem solving for continuous improvement – Various tools and techniques for problem solving – Action plan for execution of problem solving.

MODULE II STATISTICAL TECHNIQUES 9

Introduction to statistical quality control (SQC) – Need for SQC in industries – Different Techniques – Failure Mode and Effect Analysis – Quality function Deployment – Control charts for variable and attributes – Sampling techniques

MODULE III OPTIMISATION TECHNIQUES 9

Transportation –Mathematical model- algorithm – methods for finding initial solutions – North West corner method, Least cost method, Vogel's Approximation method – variations in transportation problem –Assignment – Mathematical formulation – Hungarian method for solving assignment problem – traveling salesman problem – variations in assignment problems

MODULE IV PERT & CPM 9

Introduction – Difference between PERT and CPM – different phases for project management – PERT/CPM network components – precedence relationships – Critical Path Method – Forward pass method – Backward pass method – Project Time – Cost Trade-off

MODULE V ARTIFICIAL INTELLIGENCE TECHNIQUES 9

Definition of Artificial Intelligence - Application and methods - Neural Computing – Artificial Neural Network – learning from big data – data processing-prediction- Genetic Algoirthms – introduction - Fuzzy Logic – Rule based learning – processing of big data.

MODULE VI CASE STUDIES 9

Case study - Automobile industries, Chemical industries, Cement and Pulp industries

Total Hours: 45

REFERENCES:

1. J K Sharma, Operations Research- Theory and Applications, Trinity Press, Edition 3.
2. Montgomery, Douglas C. (2009). Introduction to Statistical Quality Control, Sixth Edition. John Wiley and Sons, Inc. (ISBN: 978 -0-470-16992-6)
3. Stuart Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", 3rd Edition, Pearson Education / Prentice Hall of India, 2009.
4. Stephen Lucci, Danny Kopec," Artificial Intelligence in the 21st Century", Mercury Learning and Information, 2012.

OUTCOMES:

Students will be able to

- Explain the basic concepts of problem solving techniques
- Solve the problems using statistical techniques
- Perform optimization techniques
- Elucidate PERT & CPM
- Demonstrate on artificial intelligence techniques
- Solve problems in different domains

MECX07	**GEOMETRIC MODELLING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

OBJECTIVES:

- To study the basics of mathematical representation of geometry
- To learn the modeling techniques, tools and algorithms
- To educate the graphics standards and applications

MODULE I INTRODUCTION AND PRINCIPLES OF COMPUTER GRAPHICS 10

The design process and the role of CAD/CAM - Defining the modeling schemes: wire frame geometry, surface representation, Solid modeling – Elements of interactive computer graphics: Introduction, input and output devices, raster graphics, 2D (Translations, Rotation, Scaling and Shear) and 3D transformation (Translations, Rotation, Scaling, Shear, Orthographic and Perspective Projections), Windows to View port transformation, Clipping, Hidden line removal, Hidden Surface removal.

MODULE II LINES AND CURVES 10

Introduction to Equations - Implicit, explicit, parametric - Line Drawing Algorithm – Circles - Introduction to curves, parametric continuity condition, geometric continuity condition, Conics, Spline representation, Hermite Curves (Algebraic and Geometric Forms, Basis Functions, Matrix Form, Tangent Vectors, Truncating and Sub-dividing, 3-point and 4-point interpolation), Bézier Curves (Bézier basis functions, control points, truncating and subdividing, composite Bézier curve, characteristics of Bézier curve), B-Spline Curves (Uniform and Nonuniform B-Spline basis function, Quadratic and Cubic B-Spline basis function, Closed B-Spline Curve, Continuity, NURBS, Representation of conics with NURBS).

MODULE III SURFACES AND SOLIDS 10

Surfaces: Introduction, Implicit and explicit function of surfaces, types of surfaces, Surface Representation, Surface Analysis (Tangent, Normal, Twist, Distance Calculation, Curvature, Tangent Plane), Plane Surface, Ruled Surface, Surfaces of Revolution, Tabulated Surfaces, Hermite Bi-cubic surface, Bézier Surface, Coons Surface, Introduction, Solid Representation, Properties of Solid model, Regularized Boolean set operations, Primitive instancing, Sweep representations, Boundary representations (B-rep), Constructive Solid Geometry (CSG), Comparison of representations.

Total Hours: 30

REFERENCES:

1. Mastering CAD / CAM Ibrahim Zeid McGraw-Hill
2. Geometric Modelling M Mortenson Industrial Press.
3. CAD / CAM: Theory and Practice Ibrahim Zeid McGraw-Hill
4. Mathematical Elements of Computer Graphics David F Roger McGraw Hill
5. Computer Graphics: C Version Hearn and Baker Pretice Hall of India
6. Curves and Surfaces for CAGD: A Practical Guide 5/e, Gerald Farin Morgan Kaufmann
7. Computer Graphics and Geometric Modelling David Salomon Springer.
8. Computer Aided Engineering Design Anupam Saxena and Birendra Sahay Springer
9. Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development D E Whitney Oxford Press

OUTCOMES:

The students should be able to

- Explain the basics of mathematical representation of geometry
- Use the suitable modeling techniques, tools and algorithms
- Apply the graphics standards for the given applications

MECX08 REVERSE ENGINEERING

	L	T	P	C
	2	0	0	2

OBJECTIVES:

- To study the tools for reverse engineering and its scope
- To learn about the data management
- To educate about the integration in reverse engineering

MODULE I INTRODUCTION & TOOLS FOR REVERSE ENGINEERING 10

Scope and tasks of reverse engineering - Domain analysis- Process of duplicating - Functionality- Dimensional- Developing technical data - Digitizing techniques - Construction of surface model - Solid-part material- Characteristics evaluation - Software and application- Prototyping – Verification - History of reverse engineering – Preserving and preparation for the four stage process – Evaluation and verification- Technical data generation, Data verification, Project implementation.

MODULE II DATA MANAGEMENT 10

Data reverse engineering – Three data reverse engineering strategies – Definition – Organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design of experiments to evaluate a reverse engineering tool – Rule based detection for reverse engineering user interfaces – Reverse engineering of assembly programs: A model based approach and its logical basics.

MODULE III INTEGRATION 10

Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering - Coordinate measurement – Feature capturing – Surface and solid members.

Total Hours: 30

REFERENCES:

1. Bigger staff T J, Design Recovery for Maintenance and Reuse, IEEE Corpn. July 1991.
2. Rugaban S, White paper on RE, Technical Report, Georgia Instt. Of

Technology, 1994.
3. Katheryn A. Ingle, Reverse Engineering, McGraw-Hill, 1994
4. Aiken Peter, Data Reverse Engineering, McGraw-Hill, 1996
5. Linda Wills, Reverse Engineering, Kluiver Academic Publishers, 1996
6. Donald R. Honsa, Co-ordinate Measurement and reverse engineering, American Gear Manufacturers Association.

OUTCOMES:

Students should be able to

- Explain the tools for reverse engineering and its scope
- Discuss about the data management
- Demonstrate the integration in reverse engineering

MECX09 RELIABILITY ENGINEERING

	L	T	P	C
MECX09 RELIABILITY ENGINEERING	2	0	0	2

OBJECTIVES:

- To study about various reliability concepts
- To learn about reliability improvement and fault tree analysis
- To impart knowledge on maintainability/ availability and repairable systems

MODULE I RELIABILITY CONCEPTS 10

Probability concept-Definition of reliability-Failure data analysis: Mean time to failure and Mean time between failure- Bathtub curve and Hazard Model: Constant Hazard and linearly Increasing Hazard- System reliability: Series configuration, parallel configuration and mixed configurations. System Relaiblity Problems.

MODULE II RELIABILITY IMPROVEMENT AND FAULT TREE ANALYSIS 10

Improvements of components – Redundancy: Element redundancy, unit redundancy- Standby redundancy- Reliability cost Trade off- Redundancy problems- Fault Tree Construction- Calculation of Reliability from Fault tree.

MODULE III MAINTAINABILITY/ AVAILABILITY AND REPAIRABLE SYSTEMS 10

Maintainability approach, Availability aspect, System down time, Availability types: Inherent Availability, Achieved availability and operational availability- Reliability and Maintainability trade off- Instantaneous repair rate- Mean time to repair.

Total Hours: 30

REFERENCES:

1. L.S.Srinath,” Reliability Engineering” , Affiliated East West (PVT) Ltd, New Delhi
2. Patrick D To’ corner “Practical Reliability Engineering”, John Wiley and sons Inc, 2002.
3. Modarres, “Reliability and Risk analysis”, Maral Dekker Inc. 1993
4. Charles E Ebeling, “An Introduction to Reliability and Maintainability Engineering”, Tata McGraw Hill, New Delhi, 2009.
5. Dhillon , Engineering Maintainability – How to design for reliability and

easy maintenance, PHI, 2008

6. David J Smith, Reliability, maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.

OUTCOMES:

Students will be able to

- Explain various reliability concepts
- Discuss reliability improvement and fault tree analysis
- Demonstrate maintainability/ availability and repairable systems

MECX10 MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)

L	T	P	C
2	0	0	2

Prerequisite : Basic knowledge on Electronics

OBJECTIVES:

- To study about fundamentals of MEMS and micro sensors and micro actuators
- To learn about circuit and system design issues
- To impart knowledge on mems materials and fabrication technologies

MODULE I INTRODUCTION, MICRO SENSORS AND MICRO ACTUATORS 12

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro accelerometers, Micro actuators, Micro fluidics, Bio chemical micro system - Static bending of thin plates, Configurations of accelerometers, Thermo mechanics, Fracture mechanics, Thin film mechanics.

Pressure sensors, Thermal sensors, Electrostatics: basic theory, Gap and finger pull up, Electro static actuators, Comb generators, Inchworms, Electromagnetic actuators, Bistable actuators, Micro motors.

MODULE II CIRCUIT AND SYSTEM DESIGN ISSUES 8

System types, Basic modeling elements in system, Feedback systems, Noise, Modeling of MEMS systems, CAD for MEMS, Capacitive accelerometers.

MODULE III MEMS MATERIALS AND FABRICATION TECHNOLOGIES 10

MEMS materials, Substrates and wafers, Micro system fabrication: Photolithography, Etching techniques, CVD process, Oxidation, Diffusion, Micro machining process: Bulk micro machining, Surface micro machining, and LIGA process.

Total Hours: 30

TEXT BOOKS:

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

REFERENCES:

1. Nadim Maluf," An introduction to Micro electro mechanical system design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor," The MEMS Handbook", CRC press Baco

Raton, 2000.

3. Tai Ran Hsu," MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
4. Nitaigour Premchand Mahalik "MEMS" McGraw hill education (India) private limited, 2007.

OUTCOMES:

Students will be able to

- Explain about fundamentals of MEMS and micro sensors and micro actuators
- Demonstrate circuit and system design issues
- Discuss about mems materials and fabrication technologies

MECX11 GEOMETRIC DIMENSIONING AND TOLERANCING

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study the basic principles of geometric product definition
- To educate the students on types of tolerances.

MODULE I INTRODUCTION 5

Introduction to limits fits and tolerances – GDNT definitions and importance – Datum reference frame – Feature control frame - MMC & LMC – General Rules – Datum System.

MODULE II PRINCIPLES OF MEASUREMENT FOR GEOMETRIC CHARACTERISTICS 10

Geometric characteristic symbols and meanings – Form tolerances – Profile tolerances – Location tolerances – Runout tolerances – Orientation tolerances – True position theory – Dimensional and tolerance schemes.

Total Hours: 15

REFERENCES:

1. ASME Y – 14.5
2. Rao Ming, Harry Peck, “Designing for Manufacture”, Pitman Publications, London, 1983.
3. Krulikowski. A, “Fundamentals of Geomtric Dimensioning and Tolerancing”, Delmar Publishers – New York, 1997
4. Spotts.M.F, “Dimensioning and Tolerance for Quality Production”, Prentice Hall Inc., New Jersey, 1983.
5. Oliver R Wade, “Tolerance Control in Design and Manufacturing”, Industrial Press Inc., New York, 2008.

OUTCOMES:

Students should be able to

- Apply the basic principles for product definition
- Use different types of tolerances for a given application

MECX12 TOOL AND DIE DESIGN

L	T	P	C
1	0	0	1

OBJECTIVES:

- To learn the design aspects of cutting tools
- To study the design of dies

MODULE I DESIGN OF CUTTING TOOLS 8

Single Point Cutting Tools: Classification, Nomenclature, geometry, design of single point tools for lathes, shapers, planers etc. Chip breakers and their design. Multipoint Cutting Tools: Classification and specification, nomenclature, Design of drills, milling cutters, broaches, taps etc. Design of Form Tools: Flat and circular form tools, their design and applications.

MODULE II DESIGN OF DIES 7

Classification of dies, Design of Dies for Bulk metal Deformation-Wire Drawing, Extrusion, Forging and Rolling; Design of Dies for Sheet metal: Blanking and Piercing, Bending and Deep-drawing; Design of Dies used for Casting and Moulding, Powder Metallurgy die design.

Total Hours: 15

REFERENCES:

1. Donaldson, C., “Tool Design”, Tata Mc-Graw Hill, 2006
2. Pollack, H.W., “Tool Design” Reston Publishing Company, Inc. 1976.
3. Joshi, P.H., “Jigs and Fixtures, Tata Mc-Graw Hill, 2003
4. Grant, H,E., “Jigs and Fixtures, Tata Mc-Graw Hill, 2006
5. Kempster, M.H.A., “Principles of Jig and Tool Design”, English University Press Ltd., 1968.

OUTCOMES:

Students should be able to

- Design the cutting tools
- Design the dies

ELECTIVE COURSES FOR THERMAL

MECX21	REFRIGERATION AND AIRCONDITIONING	L	T	P	C
		3	0	0	3

Prerequisite : Basic knowledge on Thermodynamics and Thermal Engineering

OBJECTIVES:

- To study the principles of refrigeration
- To acquire knowledge on various components of air conditioning
- To learn the principles of psychrometry
- To educate cooling and heating loads
- To learn system components of refrigeration
- To study about various control equipment used in refrigeration and air conditioning

MODULE I REFRIGERATION SYSTEMS 7

Review of thermodynamic principles of refrigeration – Concept of air craft refrigeration system- Vapour compression refrigeration system – use of PH charts- Multi stage and multi evaporator systems- Cascade system- COP comparison- Vapour Absorption system- Ammonia water and lithium Bromide water systems - Steam jet refrigeration system.

MODULE II REFRIGERANTS AND COMPONENT SELECTION 8

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

MODULE III PSYCHROMETRY 7

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

MODULE IV COOLING LOAD CALCULATION 8

Types of load – design of space cooling load- heat transmission through building. Solar radiation–infiltration – internal heat sources (sensible and latent heat)-outside air and fresh air load-estimation of total load-domestic, industrial systems- central air conditioning systems.

MODULE V AIR CONDITIONING SYSTEMS 7

Air conditioning equipment – air cleaning and filters-humidifiers-dehumidifiersair washers-condensers-cooling tower and spray ponds.

MODULE VI AIR CONDITIONING SYSTEM DESIGN & CONTROLS 8

Design of summer and winter air conditioning systems-Elementary treatment of duct design- Air distribution system- Temperature, Pressure and Humidity sensors, Actuators- Thermal insulation of air conditioning system – Applications: Car, industry, Stores and public buildings.

Total Hours: 45

REFERENCES:

1. Manohar Prasad, "Refrigeration and Air conditioning", Wiley Eastern Ltd, 1983.
2. Arora C.P. "Refrigeration and Air conditioning", Tata Mcgraw-Hill NewDelhi, 1988.
3. Roy.J.Dosaat, "Principles of Refrigeration", Pearson Education 1997.
4. Jordan and Prister, "Refrigeration and Air conditioning", Prentice Hall of IndiaPvt Ltd. New Delhi, 1985.
5. Stoecker N.F. and Jones, "Refrigeration and Air conditioning", Tata McGrawHill, New Delhi, 1981.
6. Arora & Domkundwar, A course in Refrigeration & Air Conditioning –, Dhanpat Rai & Sons.
7. R.C. Jordan and G.B. Priester, "Refrigeration & Air conditioning" – Prentice Hall of India. Manohar Prasad, "Refrigeration and Air conditioning", Wiley Eastern Ltd, 1983.

OUTCOMES:

Student will be able to

- Discuss the principles of refrigeration
- Comprehend the knowledge of various components of air conditioning
- Explain the principles of psychrometry
- Evaluate the cooling and heating loads
- Design refrigeration systems
- Demonstrate control equipments used in refrigeration and air conditioning

MECX22 ADVANCED I.C. ENGINES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn various fuel supply systems used in I.C. engine
- To educate the combustion process in I.C. engine
- To study various components of I.C. engine.
- To learn about automobile emissions and ways to control it.
- To educate about alternate fuels and its usage in automobile.
- To impart knowledge on recent advancements in I.C. engine.

MODULE I FUEL SUPPLY SYSTEM FOR IC ENGINE 7

Carburetion- Theory of carburetion, Mixture requirements for components in S.I Engines, Simple carburetor, Requirements of ignition system; types of ignition system- Direct and indirect- Mono point, Multipoint injection – MPFI Types of Nozzles.

MODULE II COMBUSTION IN I.C. ENGINES 8

combustion phenomena S.I Engine– Normal and abnormal combustion – Factors affecting combustion in S.I. Engines, Combustion chamber for S.I engines, octane rating of fuels; knocking in S.I and C.I Engine- combustion phenomena C.I Engine– Normal and abnormal combustion - Factor affecting combustionin C.I. Engines, Combustion chamber for C.I engines, Cetane rating.

MODULE III ENGINE SYSTEM AND COMPONENTS 7

Ignition system, Lubrication system, Engine starting system, Engine cooling system, Governing system.

MODULE IV AIR POLLUTION FROM IC ENGINE AND ITS REMEDIES 8

Pollutants - sources - formation of carbon monoxide , unburnt hydrocarbon, NOx , Smoke and particulate matter – Method of controlling Emissions -Catalytic converters and particulate Traps - EGR – SER, Method of measurement – Emissions norms.

MODULE V ALTERNATIVE FUELS 8

Alcohol, Hydrogen, Compressed Natural Gas, LPG, Bio Diesel – properties, Suitability, Merits and Demerits – Engine Modifications.

MODULE VI RECENT TRENDS 7

HCCI - Variables Geometry turbochargers - CRDI- Free piston Engines, Plasma Jet Ignition, Stratified charge engine- six stroke engine, fuel cells.

Total Hours: 45

REFERENCES:

1. Heywood, J.B., Internal Combustion Engine Fundamentals, Tata Mc-Graw-Hill, 1988.
2. V.Ganesan, Internal Combustion Engines, 4th Edition, Tata Mc-graw Hill Publishing Co. Ltd. 2012.
3. K.K. Ramalingam, Internal Combustion Engines Fundamentals, Scitech Publications (India) Pvt Ltd, 2009.
4. Dr. V.M. Domkundar, A Course In Internal Combustion Engines, Dhanapat Rai & Co, Delhi.
5. R.Yadav, I.C.Engines, Central book Depot, Allahabad.
6. Willard w.Pulkrabek, Internal Combustion Engines, Pearson Education.

OUTCOMES:

Student will be able to

- Analyse and compare different fuel supply system of an I.C. Engine.
- Identify the different combustion process and the factors which are involved in it.
- Demonstrate the various systems of I.C engines
- Realize the ill effects of automobile emissions and the use of alternate fuels.
- Demonstrate the alternate fuels and its usage
- Recognize recent trends and developments in I.C. Engines

MECX23 NUCLEAR ENGINEERING

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To study the basics of nuclear physics.
- To learn nuclear reactions and reaction materials.
- To educate nuclear fuel cycles and reprocessing of fuel.
- To impart knowledge about various nuclear reactors.
- To elucidate separation of reactor products.
- To educate safe disposal of nuclear waste.

MODULE I NUCLEAR PHYSICS 7

Nuclear model of an atom-Equivalence of mass and energy-binding-radioactivity-half life-neutron interactions-cross sections.

MODULE II NUCLEAR REACTIONS AND REACTION MATERIALS 8

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

MODULE III REPROCESSING 7

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

MODULE IV NUCLEAR REACTOR 8

Nuclear reactors: types of fast breeding reactors-design and construction offast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

MODULE V SEPARATION OF REACTOR PRODUCTS 8

Processes to be considered - 'Fuel Element' dissolution - precipitation process– ion exchange - redox - purex - TTA - chelation -U235 - Hexone - TBP and thorax Processes - oxidative slaging and electro - refining - Isotopes – principles of Isotope separation.

MODULE VI SAFETY AND DISPOSAL 7

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

Total Hours: 45

REFERENCES:

1. Thomas J.Cannoly, “Fundamentals of nuclear Engineering” John Wiley 1978.
2. Collier J.G., and Hewitt G.F, “Introduction to Nuclear power”, Hemisphere publishing, New York. 1987.
3. Wakil M.M.El., “Power Plant Technology” – McGraw-Hill International, 1984.
4. S. Glasstone and A. Sesonske, “Nuclear Reactor Engineering: Reactor Design Basics”, Vol. 1, Ed. 4, Chapman and Hall, London, 1994.
5. S. Glasstone and A. Sesonske, “Nuclear Reactor Engineering: Reactor Systems Engineering”, Vol. 2, Ed. 4, Chapman and Hall, New York, 1994.

OUTCOMES:

Students will be able to

- Demonstrate basic concepts of nuclear physics.
- Explain nuclear reactions and materials.
- Analyze nuclear fuel cycles.
- Describe various nuclear reactors
- Discuss separation of nuclear products
- Recognise various methods of nuclear waste disposal.

MECX24	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

Prerequisite : Basic knowledge on Fluid Mechanics and Thermodynamics

OBJECTIVES:

- To educate the applications of compressible flows and their fundamentals
- To study the governing equations in compressible flow for variable area ducts
- To learn governing equations in compressible flow for constant area ducts
- To impart knowledge on the flow properties in normal and oblique shocks
- To learn the elements of jet engines
- To educate space vehicles and its applications

MODULE I COMPRESSIBLE FLOW – FUNDAMENTALS 7

Energy and momentum equations for compressible fluid flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle-Effect of Mach number on compressibility.

MODULE II FLOW THROUGH VARIABLE AREA DUCT 8

Isentropic flow through variable area ducts, comparison of isentropic and adiabatic process, T-s and H-s diagrams for nozzle and diffuser flows- Mach number Variation- Impulse function Area ratio as a function of Mach number mass flow rate through nozzles and diffusers.

MODULE III FLOW THROUGH CONSTANT AREA DUCT 8

Flow in constant area ducts with friction (Fanno flow)- Fanno curves, variation of flow properties, variation of Mach number with duct length, Isothermal flow with friction- Flow in constant area ducts with heat transfer(Rayleigh flow),Rayleigh line, variation of flow properties, maximum heat transfer.

MODULE IV NORMAL SHOCK 8

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl-Meyer equation, Impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock, normal shock in Fanno and Rayleigh flows, flow with oblique shock (elementary treatment only).

MODULE V JET PROPULSION 7

Aircraft propulsion- types of jet engines- energy flow through jet engines, study of turbo jet engine components- diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines- thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbojet engines, Ram jet and pulse jet engines.

MODULE VI SPACE VEHICLES 7

Rocket propulsion- Types of rocket engines- Constructional details and working principle – Thrust equation- effective jet velocity, specific impulse- Rocket engine performance, solid and liquid propellants, and comparison of different propulsion systems. Space vehicle applications.

Total Hours: 45

REFERENCES:

1. Yahya. S.M., "Fundamentals of compressible flow with Aircraft and Rocket Propulsion", New Age Internal Pvt Ltd., New Delhi, 2003.
2. Patrich.H. Oosthvizen, William E.Carscallen, "Compressible Fluid Flow", TataMcGraw –Hill, 1997.
3. Cohen.H., Rogers R.E.C and Saravanmutoo, " Gas Turbine theory", Addision Wesley Ltd., 1987.
4. Ganesan. V., "Gas Turbines", Tata McGraw –Hill, New Delhi, 1999.
5. RadhaKrishnan. E, "Gas Dynamics", Prentice Hall of India, New Delhi, 2001.

OUTCOMES:

Student should be able to

- Apply the concepts of gas dynamics for applications related to compressible flows
- Calculate the flow variables in variable area duct
- Possess the knowledge of jet engines and space propulsion theories
- Evaluate the flow properties associated with shock waves
- Explain elements of jet engines
- Demonstrate space vehicles and its applications

MECX25	ENERGY CONVERSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on power generation from thermal power plant.
- To study about energy extraction from diesel and hydroelectric plant.
- To learn about nuclear and gas turbine plant and methods to improve efficiency
- To acquire knowledge on renewable energy sources and its uses.
- To obtain knowledge on the methods of energy recovery and conservation
- To study about effective utilisation of energy and ill effects of pollution.

MODULE I COAL BASED THERMAL POWER PLANT 9

High Pressure and Super Critical Boilers – Fluidized Bed Boilers, coal and ash handling, burning-stoker firing, burners, FBC, dust collection-scrubbers, ESP, boiler calculations. Layout of thermal plant – components.

MODULE II DIESEL ENGINE AND HYDROELECTRIC PLANTS 7

Diesel engine power plant layout – components, various operating systems, merits, demerits, applications. hydel plant – layout and system components, hydraulic turbines, types of hydel plants, safety.

MODULE III NUCLEAR AND GAS TURBINE PLANTS 7

Development of nuclear plant in India, nuclear energy – fission chain reaction, reactor components, types of reactors and plants, waste disposal and safety. Gas turbines – working, types, methods to improve power output and efficiency, layout with inter-cooling, reheating and regeneration.

MODULE IV RENEWABLE ENERGY BASED PLANTS AND MHD PLANTS 9

Power from wind – wind turbine working and types, solar thermal power plants–low medium and high power generation, power from wave, tidal, geothermal sources, OTEC system, Energy from biomass. MHD power plants – working, types, merits and demerits.

MODULE V ENERGY CONSERVATION AND WASTE HEAT RECOVERY 6

Energy conservation – need and importance, energy efficient equipment, energy conservation opportunities (ECOs) in residential, transport, commercial and industrial sectors. Energy from wastes, Waste heat recovery – need and importance, cogeneration, combined cycle plants.

MODULE VI ENERGY ECONOMICS AND ENVIRONMENTAL POLLUTION 7

Cost of Energy generation – load curves– Economics of load sharing, comparison of economics of various power plants. Environmental degradation-emissions from fossil based power plants and their implications –remedial measures.

Total Hours: 45

REFERENCES:

1. El- Wakil M.M, "Power Plant Technology", McGraw-Hill 1984.
2. G.R. Nagpal, "Power Plant Engineering", Hanna Publishers, 1998.
3. G.D.Rai, "Introduction to Power Plant Technology", Khanna Publishers, 1995
4. Arora S.C and Domkundwar S, "A course in Power Plant Engineering", Dhanpatrai, 2001.
5. Nag P.K, "Power plant Engineering", Tata McGraw-Hill, 1998.
6. R.K.Rajput, "Power Plant Engineering", Laxmi Publications, 1995.

OUTCOMES:

Students should be able to

- Recognize the construction and working of thermal power plant.
- Demonstrate power generation from diesel and hydro electric power plant
- Comprehend the construction and working of nuclear and gas turbine power plants
- Explain renewable energy sources and its uses
- Implement the concepts of cogeneration and combined cycle plants appropriate applications
- Implement the concepts of energy conservation and waste heat recovery wherever applicable.

MECX26 TURBO MACHINERY

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To obtain knowledge on the basic principles of turbo machinery
- To study the types of fans and blowers and their performance
- To learn the constructional details and performance curves of centrifugal compressor
- To educate velocity diagram in designing the axial flow compressor
- To elucidate the characteristics of an axial and radial flow turbine
- To learn the performance of steam turbine and their affecting parameters.

MODULE I PRINCIPLES 9

Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

MODULE II CENTRIFUGAL FANS AND BLOWERS 7

Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

MODULE III CENTRIFUGAL COMPRESSOR 7

Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

MODULE IV AXIAL FLOW COMPRESSOR 9

Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage design problems and performance characteristics.

MODULE V AXIAL AND RADIAL FLOW TURBINES 6

Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

MODULE VI STEAM TURBINES 7

Flow through nozzles, compounding, effect of wetness in steam turbines, gas turbines, Hydraulic turbines – Pelton, Francis and Kaplan turbines

Total Hours: 45

REFERENCES:

1. Yahya, S.H., “Turbines, Compressor and Fans ", Tata McGraw Hill

Publishing Company, 1996.
2. Bruneck, Fans, Pergamom Press, 1973.
3. Earl Logan, Jr., “Hand book of Turbomachinery ", Marcel Dekker Inc., 1992.
4. Dixon, S.I., “Fluid Mechanics and Thermodynamics of Turbomachinery ", Pergamom Press, 1990.
5. Shepherd, D.G., “Principles of Turbomachinery ", Macmillan, 1969.
6. Stepanff, A.J., “Blowers and Pumps ", John Wiley and Sons Inc., 1965.
7. Ganesan .V., " Gas Turbines ", Tata McGraw Hill Pub. Co., New Delhi, 1999

OUTCOMES:

Student will be able to

- Express the principle of turbo machinery
- Recognise the different types fans and blowers available
- Evaluate the performance of centrifugal compressor
- Demonstrate the velocity diagram in designing the axial flow compressor
- Discuss the characteristics of axial and radial flow turbine
- Explain the concept of steam turbine and their application

MECX27	**ENERGY CONSERVATION AND MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To educate the need for energy conservation
- To learn the potential opportunities for thermal energy conservation
- To educate various heat exchanging equipment
- To study energy conservation opportunities in industrial sectors
- To acquire knowledge on energy conservation opportunities in residential and commercial sectors
- To educate the important aspects of energy audit and management

MODULE I CONCEPTS AND NEED FOR ENERGY CONSERVATION 7

Concept of energy conservation – Sankey diagram – thermodynamic limitations: first and second laws of thermodynamics of energy transfer – availability analysis of various thermodynamic processes/devices/cycles. Need for energy conservation in domestic, transportation, agricultural and industrial sectors – Lighting and HVAC systems – simple case studies.

MODULE II THERMAL ENERGY CONSERVATION 8

Thermal energy conservation: combustion systems and processes – combustion efficiency –boiler performance – methodology of improving the boiler performance – steam turbine and distribution systems: energy conservation in turbines – necessity for maintenance of correct pressure, temperature and quality of steam – condensate recovery – recovery of flash steam – air and gas removal – thermal insulation.

MODULE III HEAT EXCHANGER ANALYSIS 7

Heat exchange systems – recuperative and regenerative heat exchangers – compact heat exchangers – fluidized bed heat exchange systems – heat pumps – heat pipes – heat recovery from industrial processes - waste heat recovery and cogeneration schemes, combined cycle plants.

MODULE IV ENERGY CONSERVATION IN INDUSTRIES 8

Energy conservation in industries - energy conservation in pumps, fans, compressed air systems, refrigeration & air conditioning systems, emergency DG sets, illumination, electrical motors – energy efficient motors and variable speed motors. Case studies for energy conservation in various industries such as cement, iron and steel, glass, fertilizer, food processing, refinery etc.

MODULE V ENERGY CONSERVATION IN RESIDENTIAL, COMMERCIAL AND TRANSPORT SECTORS 7

Energy conservation opportunities in residential house, office, educational institutions and commercial shops – Energy efficient lighting - use of CFL, LED, movement sensors, tiny switches, ventilation – concept of green building. Energy conservation in transport sector - fuel economy, additives, preventive and periodic maintenance.

MODULE VI ENERGY MANAGEMENT 8

Concept of energy management – Energy demand and supply – Economic analysis of energy options – Duties of energy managers. Energy auditing: definition, necessity and types. Understanding energy costs – bench marking – energy performance – matching energy use to requirement – maximizing system efficiencies – optimizing the input energy requirements. Fuels and energy: supplementing and substitution – energy audit instruments – energy economics: discount rate, payback period, internal rate of return, life cycle costing – energy conservation systems analysis for safety, health and pollution.

Total Hours: 45

REFERENCES:

1. S.S. Rao and Parulekar, “Energy Technology”, Khanna Publishers Ltd, 1996
2. Archie, W Culp, “Principles of Energy Conservation”, McGraw Hill, 1991
3. Wayne C Turner, “Energy Management Handbook”, The Fairmount Press,1988
4. D Patrick and S W Fardo, “Energy Management and Conservation”, PHI,1990
5. P. O’Callaghan: “Energy Management”, McGraw - Hill Book Company, 1993.
6. Kenney, W. F., “Energy Conservation in Process Industries”, Academic Press,1983
7. Tyagi A. K, “Handbook of energy audits and management”, TERI.

OUTCOMES:

Students should be able to

- Demonstrate the need for energy conservation
- Implement potential opportunities for thermal energy conservation
- Analyze various heat exchanging equipments
- Identify energy conservation opportunities in industrial sectors
- Employ energy conservation opportunities in residential and commercial sectors
- Comprehend energy economics and management.

MECX28	**COMPUTATIONAL FLOW AND HEAT TRANSFER**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite : Basic knowledge on Fluid Mechanics and Heat & Mass Transfer

OBJECTIVES:

- To learn the Governing Equations of viscous fluid flows.
- To study the governing equation in algebraic form and to study various schemes
- To learn numerical modelling and its role in the field of fluid flow and heat transfer in finite volume method.
- To educate the numerical modelling for diffusion oriented problem.
- To elucidate the flow field for appropriate problem.
- To acquire knowledge on the turbulence modelling

MODULE I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8

Basics of computational fluid dynamics – Governing equations of fluid dynamics– Continuity, Momemtum and Energy equations – Chemical species transport– Physical boundary conditions – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

MODULE II FINITE DIFFERENCE METHOD 8

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

MODULE III FINITE VOLUME METHOD (FVM) FOR DIFFUSION 8

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

MODULE IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 7

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

MODULE V CALCULATION FLOW FIELD 7

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants.

MODULE VI TURBULENCE 7

Introduction-Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations Turbulence models, mixing length model, two equation (k-ϵ) models – High and low Reynolds number models.

Total Hours: 45

REFERENCES:

1. T.J. Chung, “Computational Fluid Dynamics”, Cambridge University, Press, 2002.
2. Versteeg, H.K., and Malalasekera, W., “An Introduction to Computational FluidDynamics:, the finite volume Method”, Longman, 1998.
3. Ghoshdastidar, P.S., “Computer Simulation of flow and heat transfer”, TataMcGraw Hill, Publishing Company Ltd., 1998.
4. Patankar, S.V. “Numerical Heat Transfer and Fluid Flow”, Hemisphere Publishing Corporation, 2004.
5. Muralidhar, K., and Sundararajan, T., “Computations Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.
6. Ghoshdastidar P.S., “Heat Transfer”, Oxford Unversity Press, 2005.
7. ProdipNiyogi, Chakrabarty .S.K., Laha .M.K. “Introduction to Computational Fluid Dynamics”, Pearson Education, 2005
8. Anil W. Date “Introduction to Computational Fluid Dynamics” Cambridge University Press, 2005.

OUTCOMES:

Students should be able to

- Derive the governing equations to solve real time problems.
- Relate the governing equation with finite difference scheme and solve problems
- Solve problems in the field of heat transfer.
- Evaluate convection dominated fluid flow and heat transfer problems.
- Analyse the flow field and know the appropriate algorithm to be chosen.
- Evaluate problems which involves turbulence.

		L	T	P	C
MECX29	**RENEWABLE SOURCES OF ENERGY**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on the global and national energy scenario of renewable energy resources.
- To study harnessing of energy from solar
- To learn harnessing of energy from wind and geothermal sources
- To educate harnessing of energy from ocean and tides
- To study harnessing of energy from bio system
- To learn harnessing of energy from renewable sources

MODULE I INTRODUCTION 7

Primary energy sources - World energy resources-Indian energy scenario, energy cycle of the earth-environmental aspects of energy utilisation-CO2emmisions and Global warming, Global dimming - renewable energy resources and their importance. Potential impacts of harnessing the different renewable energy sources.

MODULE II SOLAR ENERGY 8

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

MODULE III WIND AND GEOTHERMAL ENERGY 8

Wind potential in India, Energy from the wind – general theory of wind mills, types of windmills design aspects of horizontal axis wind mills – applications, Potential Sites, Estimations of Geothermal Power, Nature of Geothermal Sites, Hot-Dry Rocks, Resources, Magma Resources, Systems for Energy Generation, Applications of Geothermal, Energy, Environmental Issues.

MODULE IV OCEAN ENERGY, TIDAL ENERGY AND SMALL SCALE HYDRO ELECTRIC POWER PLANTS 7

Basic theory of OTEC, potential and application of technologies- Energy from tides and waves – working principles of tidal plants, Classification of Small Hydro

Power Stations, Mini and Micro Hydel Projects,Turbines and Generators for Small Scale Hydro Electric, Protection, Advantages and Limitations

MODULE V BIO ENERGY 8

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

MODULE VI OTHER RENEWABLE ENERGY SOURCES 7

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

Total Hours: 45

REFERENCES:

1. Sukhatme. S.P., Solar Energy, 2nd Edition, TMH, 2003.
2. Sulton, “Direct Energy Conversion”, Mc-Graw-Hill, 1966.
3. Duffie and Beckmann, “Solar Energy Thermal Processes”, John Wiley, 1974.
4. Garg. H.P and Prakash. J.,” Solar Energy – Fundamentals and Applications”, TMH, New Dwlhi, 1997.

OUTCOMES:

Students should be able to

- Recognize the significance of renewable energy and its harnessing.
- Understand and Harness energy from solar energy and apply it to real world problem.
- Identify the sources and techniques of wind and geothermal energy extraction.
- Apply the techniques of effective utilisation of ocean, tidal and hydro-electric power plants.
- Utilise ecosystem as energy source for various process.
- Identify other renewable sources of energy

MECX30	SOLAR ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn solar radiation measurement and data estimation
- To impart knowledge on performance characteristics of flat plat collectors
- To study performance characteristics of concentrating collectors
- To learn the principle and application of photovoltaic cells
- To acquire knowledge on the application of solar energy in various fields
- To elucidate the economic use of solar energy

MODULE I SOLAR RADIATION AND MEASUREMENT 9

The Solar energy option- an overview of thermal applications. Solar Radiation analysis – Solar constant, electromagnetic energy spectrum, determination of earth-sun angles, Solar time, solar angles, sunset, sunrise, and day length. Solar Radiation -Measurements and data estimation.

MODULE II FLAT PLATE COLLECTOR 9

Physical principle and general characteristics of a Liquid flat plate collectors- Performance and thermal analysis of liquid flat plate collector, Coatings and selection of materials, effect of dust and shade. High temperature non concentrating collectors.

Solar Air heaters collectors – materials, types, Performance analysis and applications.

MODULE III CONCENTRATING COLLECTORS 7

Line focusing and point focusing collectors- cylindrical parabolic collector, compound parabolic concentrators (CPC), Parabolic disc collector, Thermal performance of focusing collectors. Solar energy storage – types, Solar Ponds

MODULE IV SOLAR CELLS 7

Photovoltaic principle- materials for solar cells. Design and fabrication of Photovoltaic cells. Performance analysis of P-V cells- thermoelectric generator solar cells.

MODULE V APPLICATIONS OF SOLAR ENERGY 6

Solar heating, solar cooling, heat pump, solar pumping, Solar distillation, solarcooking. Solar Thermal Power generation.

MODULE VI ECONOMIC ANALYSIS 7

Cost analysis and pay back calculations for different types of solar panels and collectors, installation and operating costs; Environmental and safety issues, protection systems, performance monitor.

Total Hours: 45

REFERENCES:

1. G.D.Rai, “Solar energy utilisation, Khanna Publishers”, New Delhi.
2. S.P. Sukhatme, “Solar Energy”, Tata McGrew Hill Company Ltd., New Delhi.
3. H.P. Garg, “Advanced in Solar Energy Technology”, D. Reidel Publishing Co., Drdricht.
4. Mathur and Methaf – “Solar Energy”.
5. Duffle and Beckman, “Solar Thermal Engineering Process’, John Wiley &Sons, New York.
6. J.S. Hsieh, “Solar Energy”, Prentice Hall Inc. New Jerssey.
7. A.B. Meinel and M.B. Meinel, “Applied Solar Energy”, Addison – Wiley Pub. Co., Reading.
8. G.N. Tiwari and S. Suneja, “Solar Thermal Engineering Systems”, Narosa Publishing House.

OUTCOMES:

Students will be able to

- Demonstrate the solar radiation measurement and data estimation
- Evaluate the performance characteristics of flat plat collector
- Explain the performance characteristics of concentrating collector
- Express solar photovoltaic principle and its applications
- Demonstrate the application of solar energy in various fields
- Recognise the economic and effective use of solar energy

MECX31	**DESIGN OF THERMAL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To study the working and performance of basic heat transfer equipment.
- To learn design of thermal systems for effective and efficient heat transfer.
- To educate the design of compact Heat exchanger
- To impart knowledge on the purpose of condenser and its application
- To study the design of evaporator for Refrigeration Air-conditioning and chillers
- To acquire knowledge on the characteristics of cooling tower and its accessories.

MODULE I DOUBLE PIPE HEAT EXCHANGER AND HEAT PIPES 8

Thermal and hydraulic design-Inner pipe- Annulus, Hairpin heat exchangers-Base inner tube-finned inner multi tubes-parallel and series arrangements, pressure drop and constructional features. Heat pipes-structures-Applications-Basic relations-Performance characteristics-Effects of working fluid and operating temperature, Wick- selection of material-pore size

MODULE II SHELL AND TUBE HEAT EXCHANGERS 7

Basic components-shell-tube bundles-Baffles –Types and geometry, Design procedure-Preliminary estimation of size, pressure drop and heat transfer calculations- shell and tube sides-Kenn method –bell-Delaware method.

MODULE III COMPACT AND GASKETTED PLATE HEAT EXCHANEGRS 8

Compact heat exchangers- types-constructional features, heat transfer and pressure drop calculation- Finned plate and tube. Gasketted plate heat exchangers- Constructional features-Plate pack and frame-operational characteristics- flow arrangement, heat transfer and pressure drop calculation, performance analysis, comparison with other type of heat exchangers.

MODULE IV CONDENSERS 7

Shell and tube condenser- horizontal and vertical types- temperature distribution and heat flow in a condenser-pressure drop in a condenser -extended surfaces-design and operational consideration, plate heat condenser, air cooled and direct contact types, condensers for refrigeration, evaporative condenser.

MODULE V EVAPORATORS 7

Temperature distribution and heat flow in an evaporator-Evaporator for refrigeration and air conditioning- chillers- air coolers- thermal analysis- Shah, Kandhar and Ghngor and Wintertom correlations, standard types.

MODULE VI COOLING TOWERS 8

Cooling tower-types-Basic relation- heat balance and heat transfer-Characteristics, effects of: Packings- Geometry, spray Design- Selection of: Pumps, Fans, Testing, Maintenance, Environmental effects, Wind loads, Typical Installations.

Total Hours: 45

REFERENCES:

1. Sadic Kakac and Hongtan Lin, Heat Exchangers – CRC Press, London, 1998.
2. Arthur P.Fraas, Heat Exchnger design – John Wiley & Sons, 1997.
3. Kenn.D.Process Heat Transfer –Tata McGraw Hill, 1980.
4. Walker, Industrial Heat Exchangers-Tata Mcgraw Hill, 1997.
5. Holger Martin, Heat Exchangers- Hemisphere Publishing Corporation, London, 1992.
6. Arora, Domkundwar, A course in Heat and mass Transfer – Dhanpat Rai & co. (P) ltd -2003.

OUTCOMES:

Student will be able to

- Demonstrate the characteristics and performance of various thermal systems.
- Calculate the effectiveness of Heat exchanger.
- Recognise the selection the compact HX for specific application
- Evaluate the condenser performance and its affecting parameters
- Estimate the load on the evaporator for R&AC and chiller application
- Demonstrate the performance of cooling tower

MECX32 AUTOMOBILE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the automobile vehicle structures, internal combustion engines and to identify the functions and materials of internal combustion engines.
- To educate the working of internal combustion engines sub systems.
- To learn the manual and automatic transmission system.
- To obtain knowledge on the steering geometry and wheel alignment parameters.
- To study about the suspension systems.
- To impart knowledge on safety and recent technological developments.

MODULE I VEHICLE STRUCTURE AND ENGINES 7

Types of Automobiles- Vehicle construction- Chassis – Frame and Body – aerodynamics. Components of Engine – Their forms, Functions and Materials- Basic layout of Automotive vehicles.

MODULE II ENGINE SYSTEMS 8

Cooling and Lubrication systems in Engine - fuel injection systems- Electrical systems- Battery generator- Starting Motor and drives – Lighting and Ignition (Battery ,Magneto Coil and Electronic Types)- Regulators – Cut outs.

MODULE III TRANSMISSION SYSTEM 7

Types of Clutch- gear box (manual and automatic)-differential and types ofrear axle- Transfer Box Fluid flywheel – Torque convertors- Propeller shaft.

MODULE IV STEERING AND BRAKING SYSTEM 8

Wheels and Tyres- Wheel Alignments Parameters – Steering Geometry and Types of Steering gear box- Power Steering- Breaking Systems – Types and Constructions – Diagonal Braking Systems

MODULE V SUSPENSION SYSTEMS 7

Shock absorbers – Independent Suspension -Torsions bars – Air suspensions systems.

MODULE VI AUTOMOTIVE SAFETY AND RECENT TRENDS 8

Safety systems- Active safety- Passive safety – Electric Vehicle- Hybrid vehicles, Fuel cells – Antilock Braking Systems- Adaptive lighting- Active cruise Control- Traction control-Drive by wire.

Total Hours: 45

REFERENCES:

1. Automotive Mechanics, William H Crouse and Donald L. Anglin, Tata McGrawHill Publishing Company Ltd., 2004, Tenth Edition.
2. Automotive Handbook, Bosch, Robert Bosch GmbH, Germany 2004, Eighth edition.
3. Automotive Technology – A Systems Approach, Jack Erjavek, Thomson Learning, 3rd Edition, 1999.
4. The Motor Vehicle K. Newton, W. Steeds, T. K. Garrett, SAE International,13th edition
5. Advanced Vehicle Technology, Heinz Heisler, Elsevier Ltd, (Second Edition)

OUTCOMES:

Student should be able to

- Identify the automobile vehicle structures and list the number of component present in internal combustion engines
- Discuss the working of sub-systems of Internal combustion engines
- Relate the functions of manual and automatic transmission system.
- Inspect steering geometry and wheel alignment parameters.
- Compare different suspension systems of automobile vehicles.
- Validate the safety and recent technological developments.

MECX33 AUTOMOTIVE POLLUTION AND CONTROL

L	T	P	C
2	0	0	2

OBJECTIVES:

- To educate about emission and noise pollution in automobiles
- To learn pollution control techniques for SI and CI engines
- To study about automotive pollution measuring instruments

MODULE I EMISSION AND NOISE POLLUTION IN AUTOMOBILES 10

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aero dynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction —Silencer Design.

MODULE II SI ENGINE AND CI ENGINE EMISSIONS AND CONTROL 10

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide – Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, Positive Crank case ventilation system, Secondary air injection, thermal reactor.

Formation of White, Blue, and Black Smokes, NOx, soot, Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

MODULE III TEST PROCEDURES AND EMISSION MEASUREMENTS 10

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dynamometers - Seven mode and thirteen mode cycles for Emission Sampling.

Emission analysers —NDIR, FID, Chemiluminescent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

Total Hours: 30

REFERENCES:

1. V.Ganesan, ‘Internal combustion Engines’, Tata McGraw Hill Book Co, Eighth Reprint, 2005.

2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company, Newyork 1993.
3. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, NewYork. 1986.
4. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', AnnaArbor Science Publication, 1985.
5. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
6. C.Duerson, 'Noise Abatment', Butter worths ltd., London1990.
7. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise', Applied science publisher ltd., London, 1987.

OUTCOMES:

The student should be able to

- Demonstrate sources of emission and noise pollution in automobiles
- Explain pollution control techniques for various types of engines
- Apply appropriate instrument and procedure for measurement of emissions

MECX34	FUELS AND COMBUSTION	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To study the types and utility of solid and liquid fuels
- To study the types and utility of gaseous fuels
- To educate the concept of combustion phenomenon and stoichiometric analysis of different fuels.

MODULE I SOLID, LIQUID FUELS 12

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels- Solid fuel types - Coal Family - Properties - Calorific Value - ROM, DMMF, DAF and Bone Dry Basis - Ranking - Bulk & Apparent Density - Storage - Washability -Coking & Caking Coals - Renewable Solid Fuels - Biomass - Wood Waste -Agro Fuels – Manufactured Solid Fuels

Liquid fuel types - Sources - Petroleum Fractions - Classification - Refining – Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc, - Alcohols - Tar Sand Oil

MODULE II GASEOUS FUELS 8

Classification - Composition & Properties - Estimation of Calorific Value –Gas Calorimeter. Rich & Lean Gas - Wobbe Index - Natural Gas - Dry & Wet Natural Gas - Stripped NG - Foul & Sweet NG - LPG - LNG - CNG – Methane- Producer Gas - Gasifiers - Water Gas - Town Gas - Coal Gasification -Gasification Efficiency - Non - Thermal Route - Biogas - Digesters – Reactions- Viability - Economics.

MODULE III COMBUSTION STOICHIOMETRY & KINETICS 10

Stoichiometry - Mass Basis & Volume Basis - Excess Air Calculation - Fuel &Flue Gas. Compositions - Calculations - Rapid Methods – Combustion Processes – Stationary. Flame - Surface or Flameless Combustion -Submerged Combustion - Pulsating & Slow. Combustion Explosive Combustion. Mechanism of Combustion - Ignition & Ignition Energy -Spontaneous Combustion - Flame Propagation - Solid, Liquid & Gaseous Fuels Combustion - Flame Temperature - Theoretical, Adiabatic & Actual -Ignition Limits - Limits of Inflammability

Total Hours: 30

REFERENCES:

1. Bhatt, Vora Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1984.
2. Fuels and Combustion (3rd Edition), Samir Sarkar, Orient Black Swan.

3. Sharma SP, Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984
4. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966

OUTCOMES:

Student will be able to

- Recognize the nature, characteristics and suitability of solid and liquid fuels
- Identify the characteristics of gaseous fuels
- Calculate the air – fuel ratio for different fuels under different types of combustion.

MECX35 ALTERNATE FUELS

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study the various types of alternative fuels
- To educate production methods and application of alternate fuels

MODULE I INTRODUCTION TO ALTERNATE FUELS 8

Introduction to alternative fuels. – Need for alternative fuels – Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils – Performance in engines.

MODULE II ALTERNATE FUELS AND ELECTRIC VEHICLES 7

Production methods, properties studies, modification required to use in SI and CI engines – hydrogen, biogas, natural gas and LPG as fuels,- electric, hybrid and fuel cell vehicles

Total Hours: 15

REFERENCES:

1. Ayhan Demirbas, ‘Biodiesel A Realistic Fuel Alternative for Diesel Engines’, Springer- Verlag London Limited 2008,
2. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
3. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.
4. Transactions of SAE on Bio fuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).
5. Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.
6. Devaradjane. Dr. G., Kumaresan. Dr. M., “Automobile Engineering”, AMK Publishers, 2013.

OUTCOMES:

The students will be able to

- Discuss the various types of alternate fuels and modification required in I.C. engines
- Demonstrate production method of alternate fuels and working of electric vehicles

ELECTIVE FOR MANUFACTURING & MATERIAL SCIENCE

MECX41 MODERN MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To elucidate the concepts and applications of flexible manufacturing systems.
- To study the importance of computer control in FMS
- To learn simulation of FMS model.
- To practice creating part families through group technology.
- To learn the applications of FMS.
- To educate the future of FMS.

MODULE I INTRODUCTION TO FLEXIBLE MANUFACTURING SYSTEMS 7

Introduction to FMS– benefits - the challenge – major elements – types of flexibility – FMS application – single product, single batch, n – batch scheduling problem Production Flow Analysis - Rank Order Clustering – knowledge based scheduling system.

MODULE II COMPUTER CONTROL FOR FLEXIBLE MANUFACTURING SYSTEMS 8

Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.

MODULE III SIMULATION AND DATABASE 7

Application of simulation–model of FMS–simulation software – advantages and limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database.

MODULE IV MODULE IV GROUP TECHNOLOGY 8

Introduction – matrix formulation – graph formulation – knowledge based system for group technology – Part Family sequencing - Dispatching rules - economic justification of FMS- application of possibility distributions in FMS systems justification.

MODULE V APPLICATIONS OF FMS AND TOOLS 8

FMS application in machining, sheet metal fabrication, prismatic component production – aerospace application. Tools – Cellular Manufacturing, Automation, Material Handling - Just In Time Manufacturing – Kanban - CONWIP and

Kanbanetc,.

MODULE VI SYNCHRONOUS MANUFACTURING AND FUTURE FACTORIES FMS 7

The Goal - Principles of SM - TOC and LP - Scheduling FMS development towards factories of the future – artificial intelligence and expert systems in FMS.

Total Hours: 45

REFERENCES:

1. Montgomery, Douglas C., “Introduction to Statistical Quality Control”, 6th Edition, John Wiley and Sons, Inc., 2009.
2. Raouf, A. and Ben-Daya, M., “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
3. Groover M.P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpakjian, “Manufacturing engineering and technology”, Addison-Wesley Publishing Co., 1995.
5. TaiichiOhno, “Toyota production system: beyond large-scale production” Productivity Press (India) Pvt. Ltd. 1992.
6. Askin R G and Strandridge C R (1993), Modelling and Analysis of Manufacturing

OUTCOMES:

Students will be able to

- Identify the different types of flexible manufacturing systems
- Explain the aspects of computer control in FMS.
- Simulate and develop database for FMS
- Develop part families through group technology
- Implement FMS in the modernization of manufacturing systems
- Incorporate latest technologies like artificial intelligence in FMS

MECX42	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the need for process planning
- To learn the concept of work study and ergonomics
- To educate the importance of estimation and costing
- To elucidate about the elements of cost
- To learn basic calculation in manufacturing processes
- To study the cost estimation in different manufacturing units

MODULE I INTRODUCTION 9

Types of production- Standardization, Simplification- Production design and selection-Process planning, selection and analysis- steps involved in manual experience based planning and computer aided process planning- Retrieval, generative-Selection of processes analysis-Break-even analysis

MODULE II WORK STUDY AND ERGONOMICS 8

Method study, Definition- Objectives-Motion economy- Principles-Tools and Techniques – Applications- Work measurements- Purpose, Use, Procedure, tools and techniques, standard time- Ergonomics- Principles and applications.

MODULE III ESTIMATION AND COSTING 8

Importance and aims of cost estimation –Functions of estimation –costing – Importance and aims of costing- Difference between costing and estimation - importance of realistic estimates- Estimation procedure.

MODULE IV ELEMENTS OF COST 7

Introduction-Material cost- Determination of material cost, Labor cost - Determination of Direct Labor cost-Expenses- Cost of Product(Ladder of cost)- Illustrative examples, Analysis of overhead expenses-Factory expenses - Depreciation-Causes of depreciation- Methods of depreciation- Administrative expenses- selling and distributing expenses- allocation of overhead expenses.

MODULE V ESTIMATION OF MACHINE TIME AND COST 6

Estimation of machining time for machining operations involved in lathe, drilling, and milling and grinding – Estimation of machining cost

MODULE VI COST ESTIMATION IN FORMING, CASTING AND WELDING SHOP 7

Product cost Estimation: Estimation in forging shop-Losses in forging-Forging cost- Illustrative examples. Estimation in foundry shop-Estimation of pattern cost and casting cost- Illustrative examples. Estimation in welding shop-Gas cutting-Electric welding- illustrative examples

Total Hours: 45

REFERENCES:

1. Sinha.B.P., "Mechanical Estimation and costing", Tata McGraw hill publishing co., 1995
2. Nanusa Singh, "System approach to Computer Integrated Design and Manufacturing" John Wiley & Sons, Inc., 1996
3. Joseph G. Monks, "Operations Management, Theory & Problems", McGraw Hill Book Company, 1982
4. G.B.S. Narang and V. Kumar, "Production and costing ", Khanna Publishers, 1995

OUTCOMES:

Upon the completion of the course, students will be able to

- Explain about the need and various types of process planning
- Implement the process planning concepts
- Practice the concepts of work study and ergonomics in manufacturing units
- Distinguish various cost components
- Estimate the machining time for metal cutting operations
- Elucidate the cost for other different manufacturing units

MECX43 PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the various functions of production planning and control.
- To study the steps involved in the work study and principles of ergonomics.
- To provide knowledge on product and process planning.
- To learn the scheduling process to reduce the production time.
- To educate the line balancing problems
- To comprehend the production scheduling procedures, inventory control and recent trends in manufacturing requirement Planning (MRP) and Enterprise Resource Planning (ERP).

MODULE I INTRODUCTION 7

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis- Economics of a new design.

MODULE II WORK STUDY 8

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

MODULE III PRODUCT AND PROCESS PLANNING 7

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

MODULE IV PRODUCTION SCHEDULING 8

Introduction to Scheduling and Shop Floor Planning and Control; Production Control Systems-Loading and scheduling; Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading, Basic scheduling problems – Flow production scheduling-Batch production scheduling; Order Sequencing Rules and Their Performance Based on Different Evaluation Criteria; Changeover Costs and Job Sequence; Sequencing Jobs Through Two Work centers - Johnson's Rule.

MODULE V LINE BALANCING 8

Introduction to Line Balancing – Steps involved in line balancing - Techniques for Analyzing Line Balancing Problems; Application of Incremental Utilization and Longest-Task-Times Heuristics.

MODULE VI INVENTORY CONTROL AND RECENT TRENDS IN PPC 7

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

Total Hours: 45

TEXT BOOKS:

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

REFERENCES:

1. S.K.Mukhopadhyay, “ Production Planning and control : Text and cases”, Prentice-Hall of India Pvt. Ltd; 3rd Revised edition, 2015
2. Stephen N.Chapman, “The Fundamentals of Production Planning and Control”, Pearson, 2005.
3. Samuel Eilon, “Elements of Production Planning and Control”, 1st Edition, Universal Publishing Corp., 1999.
4. Baffa & Rakesh Sarin, “Modern Production / Operations Management”, 8th Edition, John Wiley & Sons, 2002.

OUTCOMES:

Students should be able to

- Explain the overall aspects of production planning and control activities.
- Conduct method study and time study to improve process and resource utilization
- Plan the product and processes effectively.
- Implement the concepts of scheduling in manufacturing.
- Analyze and provide solution for line balancing problems.
- Analyze and control inventory effectively.

MECX44 STATISTICS AND QUALITY CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the various statistical concepts and approaches
- To discuss the various statistical process control techniques
- To educate the quality management concepts and its requirements
- To elucidate the various tools and techniques for quality management
- To interpret the different control charts for the process control and improvement.
- To select the suitable sampling techniques for quality control

MODULE I STATISTICS 7

Introduction to Statistics - Meaning and significance of statistical process control (SPC) Process capability – meaning, significance and measurement – Six sigma concepts of process capability.

MODULE II STATISTICAL PROCESS CONTROL 8

Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP) – relevance to TQM, Terotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

MODULE III INTRODUCTION TO QUALITY MANAGEMENT 7

Definitions – TQM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

MODULE IV TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT 8

Overview of the contributions of Deming, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology. Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process.

MODULE V CONTROL CHARTS 8

Control Charts for X and R (statistical basis, development and use, estimating process capability; interpretation, the effect of non-normality on the chart, the OC function, average run length); Control Charts for X and S; Control Chart for

Individual Measurements. Control Chart for Fraction Nonconforming (OC curve of the control chart, variable sample size, nonmanufacturing application, the OC function and ARL calculation); Control Charts for Nonconformities or Defects; Choices Between Attribute and Variable Control Charts.

MODULE VI SAMPLING 7

Introduction to sampling distributions, sampling distribution of mean and proportion, application of central limit theorem, sampling techniques. Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size.

Total Hours: 45

REFERENCES:

1. Montgomery, Douglas C. (2009). Introduction to Statistical Quality Control, Sixth Edition. John Wiley and Sons, Inc. (ISBN: 978 -0-470-16992-6).
2. M. Jeya Chandra (2001) , Statistical Quality Control, CRC Press
3. Kaoru Ishikawa, Introduction to Quality Control, JUSE Press Ltd.

OUTCOMES:

Students should be able to

- Demonstrate the various statistical concepts and approaches
- Apply statistical tools and techniques for quality improvement.
- Appraise the quality management concepts and its requirements
- Operationalise the various tools and techniques for quality management
- Distinguish the different control charts for the process control and improvement
- Practice the suitable sampling techniques for quality control and improvement.

MECX45 MODERN PRODUCTION MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the manufacturing and production system
- To Design a layout for optimal usage of plant
- To learn the demand forecasting and project management
- To educate optimized way of controlling the processes in an industry
- To learn about maintaining the inventory level
- To elucidate the scope in maintenance part of firm

MODULE I INTRODUCTION 5

Manufacturing systems – types and concepts, manufacturing automation - Performance measures – types and uses of manufacturing models.

MODULE II FACILITY, CAPACITY & LAYOUT PLANNING 8

Facility planning – Factors affecting selection of plant location, Factor rating analysis: Break – event, Load distance model, closeness ratings.

Types of plant layout, criteria for good layout, Process layout, Assembly line balancing. Computer based solutions to layout problems such as CRAFT, ALDEP, CORELAP and PREP.

Capacity planning – Analysis of designed capacity, installed capacity, commissioned capacity, utilized capacity, factors affecting productivity and capacity expansion strategies.

MODULE III DEMAND FORECASTING & PROJECT MANAGEMENT 8

Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, numerical problems, Long term forecast methodologies.

Project management – its role in functional areas of management, network representation of a project, CPM and PERT techniques, Analyzing cost-time trade-offs – Case study.

MODULE IV PRODUCTION PLANNING & CONTROL 8

Steps in PPC process mapping, preparation of process mapping and feedback control for effective monitoring. Aggregate production planning, production planning strategies, Disaggregating the aggregate plan, Materials Requirement Planning (MRP), MRP-II, Supply chain management, Operation scheduling, prioritization.

MODULE V INVENTORY PLANNING & CONTROL 8

EOQ models- with and without shortages, price breaks, effect of quantity discount – selective inventory control techniques – ABC, FSN, VED etc. Types of inventory control – Perpetual, two-bin and periodic inventory system – JIT, SMED, kanban, Zero inventory – Case study.

MODULE VI MAINTENANCE SYSTEM 8

Maintenance strategies and planning, Maintenance economics: quantitative analysis, optimal number of machines, Replacement strategies and policies – economic service life, opportunity cost, replacement analysis using specific time period, spares management, Maintenance records.

Total Hours: 45

REFERENCES:

1. S. N. Chary, "Production and Operations Management", 4th Edition, SIE, TMH, 2009.
2. R. Pannererselvam, "Production and Operations Management", 3rd Edition, PHI, 2012.
3. James. B. Dilworth, "Operations Management – Design, Planning and Control for Manufacturing and Services", McGraw Hill Inc. Management Series, 1992.
4. Melnyk Denzler, "Operations Management – A Value Driven Approach", Irwin McGraw Hill 1996.
5. Lee. J. Krajewski, L. P. Ritzman, & M. K. Malhothra, "Operations Management – Process and Value Chains", 8th Edition, PHI/Pearson Education, 2007.
6. R. B. Chase, N. J. Aquilano, & F. R. Jacobs, "Operations Management – For Competitive Advantage", 11th Edition, SIE, TMH, 2007.
7. Kanishka Bedi, "Production and Operations Management", 2nd Edition, Oxford Higher Education, 2007.

OUTCOMES:

Students must able to:

- Identify the type of automation process in a manufacturing industry.
- Design an optimized plant layout.
- Apply forecasting techniques
- Prepare process plan for various production activities
- Control the inventory level
- Explain the various maintenance strategies

MECX46 ADVANCED OPTIMISATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the various advanced optimization tools.
- To gain basic knowledge on the different heuristics methods.
- To learn the use of genetic algorithm in optimization.
- To study the concepts of Ant colony optimization techniques.
- To impart knowledge to deal with ill identified and fuzzy problems.
- To relate optimisation techniques and its applications

MODULE I INTRODUCTION 7

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

MODULE II HEURISTICS METHODS 8

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming– Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing

MODULE III GENETIC ALGORITHM 7

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation –genetic algorithms in search, optimization and machine learning practical genetic algorithms

MODULE IV ANT COLONY OPTIMIZATION 8

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History – The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring – Advantages & Disadvantages

MODULE V FUZZY LOGIC AND ANN 8

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations – Design example – Biological foundations to intelligent systems: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

MODULE VI IMPLEMENTATIONS & APPLICATIONS 7

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

Total Hours: 45

REFERENCES:

1. Singiresu S. Rao, “Engineering optimization – Theory and practices”, John Wiley and Sons, 1996.
2. Ravindran – Phillips –Solberg, “Operations Research – Principles and Practice”, John Wiley and Sons, 1987.
3. Fredrick S.Hillier and G.J.Liberman, “Introduction to Operations Research”, McGraw Hill Inc. 1995.
4. Kalymanoy Deb, “Optimization for Engineering Design”,PHI,2003
5. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006

OUTCOMES:

Student will be able to

- Explain about optimization techniques.
- Formulate a real life situation as an optimization problem.
- Utilize Genetic algorithm to solve optimization problems.
- Implement the concepts of Ant colony optimization techniques.
- Utilize Fuzzy Logic and ANN to solve optimization problems.
- Identify the appropriate solution methodology and provide a solution

MECX47 MECHANICAL MAINTENANCE

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the importance of reliability in engineering and products.
- To impart knowledge on the maintenance concepts and models fors different types of industries.
- To learn about maintenance quality and total productive maintenance OEE

MODULE I CONCEPTS OF RELIABILITY, DESIGN FOR RELIABILIGY AND MAINTAINABILITY 8

Definition of reliability – reliability Vs quality – reliability function – derivation of the reliability function -MTTF – hazard rate function - Reliability improvement – techniques – Pareto analysis – Design for reliability– Redundancy – standby redundancy – failsafe systems classifications – failure characteristics – failure data analysis – mean time to failure maintainability and availability – system reliability in terms of probability of failure – MTBF –Acceptance sampling based on reliability test

MODULE II MAINTENANCE CONCEPT AND MODELS 12

Need for maintenance – Maintenance definition – Maintenance objectives – Challenges of Maintenance management – Tero technology – Scope of maintenance department – Maintenance costs.

Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus b/d maintenance – Optimal PM schedule and product characteristics – Optimal Inspection frequency: Maximizing profit – Minimizing downtime – Replacement models.

MODULE III MAINTENANCE QUALITY AND TOTAL PRODUCTIVE MAINTENANCE 10

Maintenance excellence –Five Zero concept –FMECA –Root cause analysis– System effectiveness – Design for maintainability – Maintainability allocation– CMMS – Reliability Centered Maintenance - TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars –TPM implementation– Autonomous maintenance.

Total Hours: 30

REFERENCES:

1. Patrick D T o'connor, "Practical Reliability Engineering", John-Wiley and Sonsinc, 2002.

2. David J Smith, “Reliability, Maintainability and Risk: Practical Methods forEngineers”, Butterworth, 2002
3. Way kuo, Rajendra Prasad V, Frank A and Tillman, ching- lai Hwang “Optimal Reliability Design and Applciations”, Cambridge University Press P ltd., 2001.
4. Srinath I.S, Engineering Design and Reliability, ISTE, 1999.
5. Oleg Vinogradov, “Introduction to Mechanical Reliability: A Designers Approach, Hemisphere Publications, 1991.
6. An introduction to Reliability and Maintainability Engineering –CharlesE. Ebeling, Tata McGraw-Hill, New Delhi, 2003.
7. Maintenance, Replacement and Reliability –Andrew K.S.Jardine and AlbertH.C. Tsang, Taylor & Francis, New York, 2006.
8. Autonomous maintenance in seven steps – Masaji Tajiri and Fumio Gotoh, Productivity Inc., Oregon, 1999.

OUTCOMES:

Students should be able to

- Effectively implement reliability concepts and maintenance strategies for different types of industries.
- Develop different maintenance models to reduce the downtime of machines
- Calculate overall equipment effectiveness of difference machines

MECX48 ROBOTICS AND AUTOMATION

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the basic concepts and working principles of different sensors
- To learn about various drives and controls of robot
- To impart knowledge about kinematics, dynamics and control of robots

MODULE 1 INTRODUCTION AND SENSORS 10

Robot – Definition – Robot Anatomy – Coordinate Systems, Work Envelope Types and classification – Specifications – pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their Functions – Need for Robots

Range sensing – Proximity sensing –Touch sensing – Force and Torque sensing. Introduction to Machine vision – Sensing and Digitizing – Image processing and analysis

MODULE II ROBOT DRIVES AND CONTROL 10

Controlling the Robot motion – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors.

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

MODULE III ROBOT MOTION ANALYSIS AND CONTROL 10

Manipulator kinematics, homogenous transformations and robot kinematics, manipulator path control, robot dynamics, configuration of robot controller.

Total Hours: 30

TEXT BOOKS:

1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987

REFERENCES:

1. YoramKoren,” Robotics for Engineers’ Mc Graw-Hill, 1987.
2. Kozyrey, Yu. “Industrial Robots”, MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics

Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R.” Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey,” Industrial Robotics Technology, Programming and Applications”, Mc Graw- Hill, Int. 1986.

OUTCOMES:

Students should be able to

- Explain the basic components of robots and sensors
- Apply suitable drives and controls for robot design
- Model forward and inverse kinematics of robot manipulators

MECX49	ADVANCED PRODUCTION PROCESS FOR AUTOMOTIVE COMPONENTS	L	T	P	C
		2	0	0	2

Prerequisite : Basic knowledge on Manufacturing Process

OBJECTIVES:

- To study the various processes involved in powder metallurgy and gear manufacturing
- To learn various metal forming techniques for manufacturing automotive components
- To learn various casting process followed by the machining techniques

MODULE I POWDER METALLURGY AND GEAR MANUFACTURING 10

Powder Metallurgy -Process flow chart - Production of metal powders and their raw materials - Manufacture of friction lining materials for clutches and brakes - Testing and inspection of PM parts.

Gear milling, Hobbing and shaping - Gear finishing of automobile gears and inspection.

MODULE II METAL FORMING 10

Forging - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles, Extrusions: Basic process steps, extrusion of transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets. Thermoforming, hydro forming& press forming, welding of body panels.

MODULE III METAL CASTING AND MACHINING 10

Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburettor other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins – piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

Total Hours: 30

REFERENCES:

1. Heldt.P.M., " High Speed Combustion Engines ", Oxford Publishing Co., New York, 1990

2. Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990.
3. Rusinoff, “Forging and Forming of metals ", D.B. Taraporevala Son & Co. PvtLtd., Mumbai, 1995.
4. Sabroff. A.M. & Others, “Forging Materials & Processes ", Reinhold Book Corporation, New York, 1988.
5. Upton, "Pressure Die Casting ", pergamon Press, 1985.
6. High Velocity " Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990
7. HMT handbook.

OUTCOMES:

Students will be able to

- Demonstrate powder metallurgy process to manufacture superior automotive components such as gears
- Recognize different metal forming techniques available for different products
- Evaluate various casting techniques for different applications

MECX50	PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To learn the different types of plant and process layout with essential requirements and safety aspects.
- To study the requirements of layout with standard work conditions
- To study the need and use of appropriate equipment for effective material handling.
- To analyse the different material handling equipments used in various industries

MODULE I PRODUCT AND PROCESS LAYOUT 12

Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions Safe location of chemical storages, -Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, nuclear power stations, thermal power stations, metal powders manufacturing and match works. Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers

MODULE II LAYOUT REQUIREMENTS 8

Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application. Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- Housekeeping, principles of 5S.

MODULE III MATERIAL HANDLING AND EQUIPMENT 10

Fiber rope, types, , lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection. Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, – conveyors, precautions, types, applications.

Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks – man lifts, construction, brakes, inspection.

Total Hours: 30

REFERENCES:

1. Spivakosky, "Conveyors and related Equipment", Vol. I and II Peace Pub. Moscow, 1982.
2. APPLE M. JAMES "Plant layout and material handling", 3rd edition, John Wiley and sons.
3. Accident prevention manual for industrial operations" N.S.C., Chicago, 1982.
4. Safety and good housekeeping", N.P.C. New Delhi, 1985.
5. Reymond, A.Kulwice, "Material Handling Hand Book - II", John Wiley and Sons, New York, 1985.
6. Rudenko, N., "Material handling Equipment", Mir Publishers, 1981.
7. "Industrial ventilation (A manual for recommended practice), American conference of Governmental Industrial Hygiene, USA, 1984.

OUTCOMES:

Students will be able to

- Design appropriate product layout for manufacturing considering safety.
- Evaluate layout procedures for different process
- Estimate proper maintenance procedures to handle various material handling equipment

MECX51	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To study the basics of industrial hazards, safety measures, safety analysis and safety management activities
- To bring the awareness on safety in material handling and manufacturing processes,
- To learn the ergonomics used in material handling.

MODULE I INDUSTRIAL SAFETY SYSTEM 10

Evolution of modern safety concept - industrial hazard - significant of safety - causes of industrial accidents - accident preventions - personal protective equipment - safety signs and colour at work - safety analysis - JSA – FMEA

Organizational safety culture - safety organization - safety committee - safety policy - Budgeting for safety - Safety education and training

MODULE II SAFETY IN MATERIAL HANDLING AND MANUFACTURING 10

Material handling basics - principles - classifications of material handling equipment - general safety considerations in material handling devices - ropes, chains, slinks, hoops, clamps, arresting gears and prime movers

Machine guarding - safety in metal working - safety in welding and gas cutting - safety in cold forming and hot working of metals - safety in finishing - safety in inspection and testing - health and safety regulations - OSHA

MODULE III ERGONOMICS IN MATERIAL HANDLING 10

Ergonomic and anatomy - ergonomic consideration in material handling, design, installation, operation and maintenance of conveying equipment, hoisting, traveling and slewing mechanisms - storage and retrieval of common goods of shapes and sizes in a general store of big industry

Total Hours: 30

REFERENCES:

1. Mahajan.M, “Industrial engineering and production management”, Dhanpat ray & co (p) ltd., 2001.
2. Krishnan N.V, “Safety management in industry”, Jaico publication house,

Bombay, 1997.

3. Blake R.B, “Industrial safety”, Prentice Hall, Inc., New jersey, 1973.
4. Edel Engineering consultancy (p) ltd., “Safety Manual”, Novena publications, 2000.
5. IAPA , “Safety Signs and Colour at Work”, Industrial Accident Prevention Association, 2007
6. Alexandrov M.P, “Material Handling Equipment”, Mir Publishers, Moscow, 1981.
7. Siddhartha ray, “Introduction to Materials Handling”, New age international publications, 2008

OUTCOMES:

Upon satisfactory completion of the course, the student will be able to:

- Identify safety hazards and implement appropriate safety measures in industries.
- Recognize the hazards in various material handling and manufacturing processes and provide suitable safety prevention through appropriate safety regulations
- Use the ergonomic considerations in material handling equipment

MECX52	OPERATIONS RESEARCH &SYSTEM ANALYSIS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To acquire knowledge in linear programming problems and transportation problem
- To impart knowledge on network analysis, assignment and sequencing problems
- To learn the replacement model, inventory models and simulation analysis

MODULE I LINEAR PROGRAMMING PROBLEMS AND TRANSPORTATION PROBLEM 10

Linear programming problem: Formulation of problem- Determination of unknown values by Simplex method – Graphical method- Big M method. Transportation Problem: Initial Basic feasible cost- MODI method- Non degeneracy type

MODULE II ASSIGNMENT, NETWORK ANALYSIS AND SEQUENCING PROBLEMS 10

Assignment Problems: Hungarian method for Minimization and Maximization type Network Analysis: Determination of Project duration and slack time for PERT and CPM type of problem Sequencing problem: Determination of Elapsed time and idle time for N Jobs 2 & 3 Machines

MODULE III REPLACEMENT MODELS, INVENTORY MODELS AND SIMULATION ANALYSIS 10

Replacement of items that deteriorate with time- Value of money changing with time- not changing with timenventory Model; Deterministic inventory model Simulation Analysis: Random number generation- Monte carlo simulation

Total Hours: 30

TEXT BOOKS:

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

REFERENCES:

1. Hira and Gupta, Problems in Operations research, S.Chand and Co. 2002

2. Panneerselvam, Operations Research, Prentice Hall of india, 2003.

OUTCOMES:

Students should be able to

- Solve problems on linear programming problems and transportation problem
- Discuss network analysis, assignment and sequencing problems
- Use the replacement model, inventory models and simulation analysis

MECX53 NANO MATERIALS & FABRICATIONS

	L	T	P	C
	2	0	0	2

OBJECTIVES:

- To study the nano material classes and properties
- To learn synthesis, characterization and production of nanomaterial
- To impart knowledge on inspection and applications of nanomaterial

MODULE I NANOMATERIAL CLASSES AND PROPERTIES 10

Classification of Nano materials– size effects-surface to volume ratio- surface curvature-strain confinement –quantum effects - Mechanical properties-Thermal-electrical-mechanical-optical-acousticproperties-study of carbon Nanotubes and Nano Composites

MODULE II SYNTHESIS , CHARACTERIZATION AND PRODUCTION OF NANOMATERIAL 10

Methods for making 0D,1D,2D and 3D Nanomaterial -Top down process-Intermediate process-Bottom up process-Nano profiling-Characterization of Nanomaterial.

Methods of production-Mechanical alloying- Sol-gel, Electro deposition, Inertgas condensation.

MODULE III INSPECTION AND APPLICATIONS OF NANOMATERIAL 10

Electron Microscopy, X- ray Diffraction-Scanning Probe Microscopy-contact mode-tapping mode- Atomic Force Microscopy-Scanning Tunnel Microscopy-Nano Indentation. Nano coatings-Nano films-self cleaning and easy cleaning materials-self healing materials-smart materials-Nano drugs and its delivery-Nano Tribology -Molecular Nanomachines

Total Hours: 30

REFERENCES:

1. Michel F.Ashby, Paulo J Ferreira and Daniel L Schodek “Nanomaterials, Nanotechnologies and design” Elsiever, 2009.
2. T.Pradeep “Nano: The essentials”, Tata Mcgraw Hill Education pvt. Ltd, New Delhi, 2007.
3. Mark Ratner and Daniel Ratner, “Nanotechnology”, Pearson Education, New Delhi, 2003.
4. Guozong Cao “Nano structures and Nanomaterials” Imperial college press, London, 2006.

OUTCOMES:

Students will be able to

- Explain the nano material classes and properties
- Discuss the synthesis, characterization and production of nanomaterial
- Relate the inspection and applications of nanomaterial.

MECX54 ADVANCED MATERIALS

L	T	P	C
2	0	0	2

Prerequisite : Fundamental knowledge on Materials

OBJECTIVES:

- To acquire knowledge on synthesis of ceramic and carbon materials.
- To learn the materials used in nuclear reactors.
- To impart knowledge on applications of polymers in bio-medical applications.

MODULE I CERAMIC AND CARBON SCIENCE 10

Crystal chemistry — structure and bonding in materials, ceramic raw materials, production of powders by chemical and physical mean, powder consolidation, addition in ceramic processing, sintering theory, cold and hot isostatic pressing, processing of electronic ceramic, sol-gel processing - Nano carbon materials

MODULE II NUCLEAR METALLURGY 10

Structure of nucleus- Radioactivity - Binding energy - Nuclear interaction - radiation effects on fissile and non fissile materials - Radiation damage and radiation growth - Types of reactors and classification - Materials for nuclear reactors: Considerations in selection and properties of common materials used as fuels, physical and chemical properties - Canning materials - Coolants - Control rods - Reflectors and shielding materials.

MODULE III POLYMERS FOR BIO MEDICAL APPLICATIONS 10

Introduction to classes of materials used in medicine - world-wide market for biomaterials - Types of materials-inert, toxic, bioactive, natural materials - collagen, biopolymers - Polymers as biomaterials - polymers for controlled drug delivery applications - Concepts of polymer composites - Biomimetic materials

Total Hours: 30

REFERENCES:

1. Y. V. C. Rao, “Introduction to Thermodynamics” Universities Press, 2004
2. Ahindra Ghosh, “Textbook of Materials and Metallurgical Thermodynamics”, PHI Learning Pvt. Ltd, 2002.
3. W. D. Kingry, “Introduction to Ceramics” , Jhon-Wiley Publications
4. Mohamed N. Rahaman, Ceramic Processing and Sintering, CRC Press, 2003.
5. J.C. Wright, “Metallurgy in Nuclear Power Technology, Iliffe Book Ltd.,

1962

6. J. Park and R.S.Lakes, “Biomaterials An Introduction” , 3rd Edn., Springer Science, New York, 2007
7. D.L.Wise et al. Eds., “Encyclopedic handbook of Biomaterials and Bioengineering”, Part A. Materials & part B. Applications, Volume 1 & 2, Marcel Dekker Inc., New York, 1995

OUTCOMES:

Students will be able to

- Explain the synthesis of ceramic and carbon materials.
- Identify the materials used in nuclear reactors.
- Use suitable polymers in bio-medical applications.

MECX55 PROTOTYPING TECHNIQUES

	L	T	P	C
	2	0	0	2

OBJECTIVES:

- To learn the fundamentals of rapid prototyping and RPT file generation
- To study the liquid based and solid based rapid prototyping systems
- To impart knowledge on applications on rapid prototyping

MODULE I INTRODUCTION AND RPT FILE GENERATION 10

Introduction to RP –Technology- Description -Definition to RP -Overview of RP - Benefits and Application

RP Processes: Process overviews, STL file Generation, File Verification & Repair, Build File Creation, Part Construction, Part Cleaning and finishing, Process Strength & limitations.

MODULE III LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10

Classes of RP systems: 3D Printers, Enterprise Prototyping centers, Direct digital tooling, Direct digital manufacturing, system classification, Stereo lithography, SL with photo polymerization, Selective Laser Sintering, Fused deposition modeling, Laminated object manufacturing, Laser powder forming. Prototype properties: Material, color, dimensional accuracy, stability, surface finish, machine-ability, environmental resistance, operational properties

MODULE IV RAPID PROTOTYPING APPLICATIONS 10

RP Applications: Design, Concept Models, Form & fit checking, Ergonomic Studies, Functional testing, Requesting Price quotes, CAD data verification, Rapid Tooling, rapid manufacturing, Science & Medicine, Archeology, Paleontology & forensic Science, miniaturization

Total Hours: 30

REFERENCES:

1. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2003.
2. Andreas Gebhardt, Hanser Gardener, Rapid prototyping, Publications, 2003.
3. Liou W. Liou, Frank W. Liou, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007.
4. Ali K. Kamrani, Emad Abouel Nasr, Rapid Prototyping: Theory and practice, Springer, 2006.

5. Peter D. Hilton, Hilton / Jacobs, Paul F. Jacobs, Rapid Tooling: Technologies and Industrial Applications, CRC press, 2000.

OUTCOMES:

Students will be able to

- Explain the fundamentals of rapid prototyping and RPT file generation
- Discuss the liquid based and solid based rapid prototyping systems
- Use rapid prototyping for various applications

MECX56	INDUSTRIAL MARKETING	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To acquire knowledge on concepts and frameworks which may be more relevant in industrial marketing situations
- To develop skills in identifying an interesting industrial marketing problem to study, as well as finding relevant facts.

MODULE I OVERVIEW AND PREPARATION 7

The Industrial Marketing system and the Industrial Marketing concept, Industrial goods demand and product characteristics market levels and product types, the industrial customer, buyer motives business and institutional buyers.

MODULE II INDUSTRIAL BUYER BEHAVIOUR AND INPUTS TO MARKETING 8

Analysis of micro and macro environment of industrial markets, BUYGRID MODEL, phases in purchasing decision process & their marketing implications, buying center - Webster and Wind model - Sheth model. Purchasing Agents in Industrial Buying; Negotiation in Industrial Marketing

Total Hours: 15

REFERENCES:

1. Krishna K. Havaldar, “Industrial Marketing,” Tata McGraw Hill Pub Co. Ltd, New Delhi, 2002.
2. Richard M. Hill, Ralph S. Alexander, James S.Cross, “Industrial Marketing”, AITBS, 2000
3. Robert R. Reeder, Edward G. Brittle and Pretty H. Reedier, “Industrial Marketing – Analysis Planning and Control,” Prentice Hall of India Limited, New Delhi, 2000.

OUTCOMES:

Students should be able to

- Take strategic decisions to promote marketing.
- Analyse the industrial market potential

MECX57 ENTREPRENEURIAL DEVELOPMENT

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study the importance of entrepreneurship opportunities available in the society for the entrepreneur
- To acquire knowledge on the challenges faced by the entrepreneur

MODULE I INTRODUCTION 8

Objectives, scope & philosophy, Characteristics and skills of a Successful Entrepreneur, Design Thinking for Customer Delight, creativity & entrepreneurship, harnessing locally available resources, Role of small Enterprise in Economic development, Problems of Small scale industrial units,

MODULE II BUSINESS REQUIREMENTS 7

Market Survey and Research - Feasibility Study –Preparation and Evaluation of report – Central and State Government Industrial Policies and Regulations – Taxes - Global Business, Sources of finance mobilization – External factors

Total Hours: 15

REFERENCES:

1. Hisrich, “Entrepreneurship”, Tata McGraw Hill, New Delhi, 2006.
2. P.C. Jain (ed.), “Handbook for New Entrepreneurs”, EDII, Oxford University Press, New Delhi, 1999.
3. Rabindra N. Kanungo, “Entrepreneurship and Innovation”, Sage Publications, New Delhi, 1998.

OUTCOMES:

Students should be able to

- Explain the importance of entrepreneurship opportunities available in the society for the entrepreneur
- Discuss the challenges faced by the entrepreneur

MECX58 DIGITAL MANUFACTURING

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study about principles of digital manufacturing process and geometric modelling used for different materials
- To educate about algorithmic design for digital manufacturing & future development

MODULE I OVERVIEW OF DIGITAL MANUFACTURING PROCESS AND GEOMETRIC MODELLING WITH MATERIAL PROPERTIES **09**

What makes a manufacturing process "digital" – The ten disruptive principles of digital manufacturing processes – Basic concept and Connotation of digital manufacturing science – Research method of digital manufacturing science - Solid representations – Boundary representations – Function representations – Voxel representations - Mechanical properties of printed materials – Post processing – Empirical and data driven models.

MODULE II ALGORITHMIC DESIGN FOR DIGITAL MANUFACTURING & FUTURE DEVELOPMENT **06**

Parametric models – Vibrational Geometry – Generative models – Topology optimization - Precision of digital manufacturing – Extremalization of digital manufacturing - Environmental protection of digital manufacturing -Safety, Liability and intellectual property – Environmental impact – On-demand fabrication models and mass customization

Total Hours: 15

TEXT BOOKS:

1. Zhou,Z .; Xie, S.; Chen,D, " Fundamentals of Digital Manufacturing Science", Springer Publications, 2012, ISBN:978-0-85729-563-7
2. Ian Gibson, David W Rosen, & Brent Stucker, "Additive Manufacturing Technologies ", Springer Publication, 2014. ISBN-10: 1489983643

REFERENCES:

1. Christoph Haag, Torsten Niechoj, "Digital Manufacturing: Prospects and Challenges", Metropolis Verlag, 2016
2. Lihui Wang , Andrew Yeh Ching Nee, "Collaborative Design and Planning

for Digital Manufacturing”, Springer; 2009 edition

3. Philip M. Parker, “The 2018-2023 World Outlook for Digital Manufacturing (DM) “,ICON Group International, Inc., 2017

OUTCOMES:

The students will be able to

- Demonstrate the principles of digital manufacturing process and geometric modelling used for different materials
- Create an algorithmic design for digital manufacturing

MECX59 ADDITIVE MANUFACTURING

L	T	P	C
1	0	0	1

OBJECTIVES:

- To gain the knowledge of importance of Additive manufacturing techniques in manufacturing
- To learn the various additive processes and their principles and applications

MODULE I INTRODUCTION 5

Introduction and basic fundamentals of AM technology- Traditional manufacturing Vs Additive manufacturing- Reverse Engineering: Introduction, From Scanner to Model validation - Development of Additive Manufacturing Technology-Classifications- Materials for Additive Manufacturing Technology – Additive manufacturing in medical applications- Bio-manufacturing.

MODULE II ADDITIVE MANUFACTURING PROCESS 10

Extrusion Based Additive Manufacturing Process- Fused Deposition Modeling (FDM), Shape Deposition Manufacturing (SDM), Laminated Object Manufacturing (LOM)-Photo-polymer vat Additive Manufacturing Process- Streolithography (SLA), Solid Ground Curing (SGC), Selective Laser Sintering (SLS)-Powder bed fusion and material jetting Additive Manufacturing Process- Electron Beam Melting (EBM), Laser Engineered Net Shaping (LENS), Three Dimensional Printing (3DP) - Hybrid Additive Manufacturing Process- Issues with additive manufacturing

Total Hours: 15

REFERENCES:

1. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.
3. Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering application: A tool box for prototype development”, CRC Press, 2011.
5. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.
6. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing:

Principles and Applications: Fourth Edition of Rapid Prototyping
7. Andreas Gebhardt, Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing
8. Jacobs, Paul F, Rapid Tooling: Technologies And Industrial Applications
9. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling

OUTCOMES:

Student will be able to:

- Explain the importance of Additive manufacturing techniques in manufacturing
- Discuss the various additive processes and their principles and applications

MECX60 FAILURE ANALYSIS AND TECHNIQUES

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study the concept of material failure analysis and Techniques
- To impart knowledge on failure analysis techniques

MODULE I FAILURE ANALYSIS INTRODUCTION 8

Historical background, origin, detection and prevention of failure, types of mechanical failure: Ductile and brittle fracture, fatigue fracture, buckling, creep rupture, stress concentration, statistical aspect of failure analysis, loading spectrum, metallurgical aspect of component failure.

MODULE II FAILURE ANALYSIS TECHNIQUES 7

Processing-structure-property relationship, metallurgical imperfection, processing defects, NDT methods, surface defects and corrosion, propagation of defects, tools for metallurgical failure analysis, Case study reports

Total Hours: 15

REFERENCES:

1. George E. Dieter, Mechanical metallurgy, McGraw-Hill Book Company, SI Metric Edition Printed in Singapore.

OUTCOMES:

Students should be able to

- Explain the concept of material failure analysis and techniques
- Discuss on failure analysis techniques

MECX61 Advanced System Simulation (1D Modeling)

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study the basics of modelling of engineering and simulation systems
- To impart knowledge on modelling of mechanical systems

MODULE I INTRODUCTION TO MODELLING AND SIMULATION 8

Dynamic systems, Modeling of dynamic systems, Formulation of models for engineering systems, solution of the differential equations, Input types, Engineering system similarity, Introduction to simulation, MATLAB as a simulation tool.

MODULE II MODELLING OF MECHANICAL SYSTEMS 7

Translational systems, Rotational systems, Combined systems, Three dimensional motion, Properties of fluids, Reynolds number, Derivation of passive components, Basic thermal properties, Circuit analysis of static and dynamic thermal systems.

Total Hours: 15

TEXT BOOKS:

1. Woods Robert L. and Lawrence Kent L., "Modelling and Simulation of Dynamic Systems", Prentice Hall, 1997.

REFERENCES:

1. Philip D. Cha, James J. Rosenberg, and Clive L. Dym, "Fundamentals of Modelling and Analysis of Engineering Systems", Cambridge University Press, 2000.
2. R. Gentle, P. Edwards, B. Bolton, "Mechanical Engineering Systems", Butterworth Heinemann, 2001.
2. 3. Ashish Tiwari, "Modern Control Design with MATLAB and SIMULINK", John Wiley, 2002.

OUTCOMES:

Students will be able to

- Explain the basics of modelling of engineering and simulation systems
- Perform modelling of mechanical systems

MECX62	PROJECT MANAGEMENT	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To study project management design, development, and planning
- To learn the project management tools, techniques, and skills

MODULE I	Overview: Concept and Characteristics - Project Management: Importance, types of project - Organizational Structures and behavior -Project Planning: Project Planning and Scheduling techniques, Developing the project network (Using CPM/PERT).	**8**
MODULE II	Resource Scheduling- Project Quality Management- Project Performance Assessment and Control- Project Closure/ Termination- Management of Time And Stress.	**7**

Total Hours: 15

TEXT BOOKS:

1. Clifford F Gray, Erik W Larson, "Project Management-The Managerial Process" Tata Mcgraw-Hill Publishing Co Ltd.
2. Jack Meredith, Samuel J. Mantel Jr., "Project Management- A Managerial Approach" John Wiley and Sons.
3. John M Nicholas, "Project Management for Business and Technology" Prentice Hall of India Pvt Ltd.
4. James P Lewis, "Project Planning, Scheduling and Control" Tata Mcgraw-Hill Publishing Co Ltd.
5. K. Nagarajan, "Project management" New Age International, 2004

REFERENCES:

1. Principles & Practices of Management - Saxena
2. Principles and Practices of Management - Shejwalkar and Ghanekar Management Concepts & Practices - Hannagan
3. Essentials of Management – Koontz – TMGH
4. Organizational Behaviour - K.Aswathappa

OUTCOMES:

Students should be able to

- Explain the project management design, development, and planning
- Utilize the project management tools, techniques, and skills

MECX63 INTERNET OF THINGS FOR MANUFACTURING

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study the usage of Internet of things in various aspects of manufacturing system
- To learn for effective usage of data base in scheduling production system

MODULE I INTRODUCTION OF IOT & IIOT 10

Introduction- The concept of IoT, limitations, Applications of IoT in manufacturing system, Key features and limitations of IoT-MS - Overview of IoT-Enabled Manufacturing System- Overall architecture of IoT-MS, Integration framework of real-time manufacturing information, The worklogic of IoT-MS - Real-Time and Multisource Manufacturing Information Sensing System - Fundamentals of M2M Communication : Sensor Network and Wireless Protocols Hardware/Protocol-Elements of IIOT for manufacturing - Machine Learning for Intelligent IIoT - Analytic Engine for IIoT - Security in IoT Implementation

MODULE II PRODUCTION SCHEDULING SYSTEM 5

Cloud Computing-Based Manufacturing Resources Configuration Method - IoT-Enabled Smart Trolley -Real-Time Information-Driven Production Scheduling System - IoT-MS Prototype System

Total Hours: 15

TEXT BOOKS:

1. Alasdair Gilchrist , “Industry 4.0: The Industrial Internet of Things” 1st ed. Edition
2. Alec Ross, “The Industries of the Future”
3. Yingfeng Zhang Fei Tao, “Optimization of Manufacturing Systems Using the Internet of Things”, Academic press 2016

OUTCOMES:

Students will be able to

- Discusss the use of Industry Internet of things in manufacturing system
- Apply the resources for effective production scheduling system

SEMESTER I

PHC 1182 PHYSICS I

L	T	P	C
3	0	2	4

OBJECTIVES

To make students conversant with the

- basic concepts of crystal physics and its structures
- production and applications of ultrasonic waves
- study of thermal conductivities of good and bad conductors
- phenomenon of wave optics and its applications
- principle of fibre optic communication and its applications to sensors
- wave mechanics principle and its applications in electron microscopy
- green energy physics and its environmental impacts to society

MODULE I CRYSTAL PHYSICS 8

Crystalline and amorphous solids – Unit Cell – Seven Crystal Systems – Bravais Lattice – Miller Indices – Interplanar Spacing – Characteristics of Unit Cell - Calculation of Number of atoms per unit cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP and Diamond structures –Defects in crystals-Point defects –Edge and screw dislocations and their significance - Surface Defects.

MODULE II ULTRASONICS AND THERMAL PHYSICS 8

Introduction to Ultrasonics - Properties - Production methods - Magnetostriction Oscillator method- Piezoelectric Oscillator method – Detection of Ultrasonics – Thermal method – Piezoelectric method – Kundt's tube method – Applications of Ultrasonics – Acoustic Grating – SONAR – Depth of sea – Velocity of blood flow, Ultrasonic Flaw detector (qualitative).

Transmission of heat – Conduction, Convection and Radiation – Thermal Conductivity of good Conductor – Forbe's method- Thermal Conductivity of bad Conductor – Lee's Disc method.

MODULE III APPLIED OPTICS 8

Interference – Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet.

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action –

Types of Laser: He-Ne laser, CO_2 laser and Nd:YAG laser - Applications : Laser Materials Processing .

MODULE IV FIBRE OPTICS 7

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers - Applications – Fibre optic communication system (block diagram only)- Fibre optic sensors - displacement and pressure sensors (qualitative) - Medical endoscope.

MODULE V QUANTUM MECHANICS 7

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jean's law from Planck's theory –Dual nature of matter – de Broglie's wavelength- Physical significance of wave function – Schrodinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box – Harmonic oscillator(qualitative).

MODULE VI MODERN ENGINEERING AND BIOMATERIALS 7

Modern Engineering Materials: Shape memory alloys - Metallic glasses – Advanced Ceramics – Composites.

Bio-materials: Classification of bio-materials (based on tissue response) – Comparison of properties of some common biomaterials – Metallic implant materials (stainless steel, cobalt-based and titanium-based alloys) – Polymeric implant materials (Polyamides, polypropylene, Acrylic resins and Hydrogels) – Tissue replacement implants – Soft and hard tissue replacements.

L:45 periods

PRACTICALS

1. Determination of Velocity of Ultrasonic waves in a given liquid using Ultrasonic Interferometer.
2. Determination of wavelength of ultrasonic waves using Kundt's tube method.
3. Determination of thickness of a thin wire using Air Wedge method.
4. Determination of wavelength of light using spectrometer diffraction grating.
5. Determination of angle of divergence of a laser beam using He-Ne laser.
6. Determination of particle size of lycopodium powder using semiconductor laser.
7. Determination of wavelength of laser light using semiconductor laser diffraction.
8. Determination of Acceptance angle and Numerical Aperture using fiber optic cable.

9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Determination of thermal conductivity of a bad conductor by Lee's disc method.
11. Determination of solar cell characteristics.

P: 30 periods

Total: 75 periods

REFERENCES:

1. Gaur R.K. and Gupta S.L., "Engineering Physics'', 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.
3. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co., 2010.
4. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics", W.H. Freeman, 2007.
5. Markert J.T., Ohanian. H. and Ohanian, M. "Physics for Engineers and Scientists". W.W. Norton & Co. 2007.
6. Godfrey Boyle, "Renewable Energy: Power for sustainable future", 2nd edition, Oxford University Press, UK, 2009.

OUTCOMES:

At the end of the course, students will be able to

- understand the different types of crystal structures
- apply the concept of ultrasonic principle in engineering and medical field
- calculate thermal conductivities of good and bad conductors
- differentiate the various laser systems and its applications in engineering and medical field
- apply the principle of fibre optics for communication and sensor applications
- formulate wave mechanics principle for applications in electron microscopy
- Correlate the different renewable energy sources for societal needs.
- To complement the knowledge acquired in the theory class.
- To correlate the experimental results for application.

SEMESTER II
(ELECTIVE COURSES)

PHCX 01 FUNDAMENTALS OF ENGINEERING MATERIALS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To familiarize students with basic ideas of nanomaterials and its electrical, electronic, mechanical and magnetic properties.
- To help students acquire the properties and applications of magnetic materials and dielectric materials.
- To familiarize students with basics ideas about the properties of dielectric and its applications
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 7

Conductors: properties, Fermi distribution function, Fermi energy in metals- density of states- conducting polymers-properties-applications, semiconductors: intrinsic and extrinsic semiconductors-carrier concentrations, conductivity and energy band gap, semiconducting polymers- properties- applications.

MODULE II DIELECTRIC MATERIALS 8

Polarization- dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – Internal field - Clausius Mosotti relation - dielectric loss – dielectric breakdown – applications of dielectric materials (capacitors and transformers) – Pyroelectricity, Piezoelectricity, ferroelectricity and applications in FERAM - multiferroic materials and its applications.

MODULE III MAGNETIC MATERIALS 7

Origin of magnetism-magnetic moment, susceptibility, permeability – Bohr magneton – Dia, Para and Ferro magnetism –Spontaneous magnetization- Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its application -Giant Magneto-resistance effect(GMR) - Magnetic resonance imaging(MRI).

MODULE IV NANOMATERIALS 8

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials – quantum well, quantum wire, quantum dot - nanoporous materials - carbon nanotubes, grapheme - nanocomposites – applications.

L : 30 periods

PRACTICALS

1. Determination of energy band gap of a semiconductor.
2. Determination of resistivity of metals by four point probe method.
3. Determination of dielectric constant of dielectric material.
4. Determination of time constant of a capacitor using RC circuit.
5. Determination of paramagnetic susceptibility of given liquid.
6. Determination of hysteresis loss in a transformer using BH curve.
7. Analysis of size effect on the absorption spectrum of nanomaterials.

P: 30 periods

Total: 60 periods

REFERENCES:

1. William D.Callister, Material Science and Engineering, Wiley Publications, 2006.
2. Raghavan, V., Materials Science and Engineering, 5th edition, Printice Hall of India Pvt Ltd. New Delhi, 2004.
3. Wahab.M.A, Solid State Physics: Structure and Properties of Materials, Narosa Publishing House Pvt. Ltd., New Delhi , 2nd Edition, 2010.
4. Pillai, S.O., Solid State Physics, New Age International, New Delhi, 2005.
5. Charles P.Poole and Frank J. Owens, ”Introduction to nanotechnology”, Wiley (India), 2009.
6. Pradeep. T., “Textbook of Nanoscience and Nanotechnology”, McGraw Hill Education (India) Private Limited, New York, 2012.

OUTCOMES:

On completion of this course, the student will be able to

- differentiate between the properties of the nanomaterials compared to bulk materials.

- comprehend the significance of properties of magnetic materials and derive these properties from synthesized materials.
- apply the concepts of conducting and semiconducting materials for solid state devices.
- complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 02 HEAT AND THERMODYNAMICS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To familiarize students with basic concepts of heat.
- To help students acquire the fundamentals of heat conduction and radiation.
- To enable students acquaint with the basics of thermodynamic concepts.
- To make students understand the fundamentals of heat based experiments.

MODULE I CONCEPTS OF HEAT 10

Definition of temperature, thermal and thermodynamic equilibrium- relationship between temperature and kinetic energy- definition of solid, liquid, gas- Introduction to phase transitions, critical and triple points- definition of heat capacity, mechanical equivalent of heat -Joule's calorimeter- latent heat- Microscopic model of ideal gas- equation of state, internal energy, equipartition theorem- equation of state for non-ideal gases.

MODULE II CONDUCTION AND RADIATION 10

Thermal conductivity – rectilinear flow of heat – thermal conductivity of a good conductor – Forbe's method – thermal conductivity of a bad conductor – Lee's disc method – conduction of heat through compound media-radiation – Planck's law blackbody radiation – Wien's law – Stefan's law – Newton's law of cooling from Stefan's law – Solar constant – Pyrometry.

MODULE III FUNDAMENTALS OF THERMODYNAMICS 10

Thermodynamic equilibrium – zeroth law of thermodynamics – first law of thermodynamics – Reversible and irreversible processes – second law of thermodynamics -Heat engine – Carnot's engine – Carnot's theorem – Internal combustion engines – petrol and diesel engines(qualitative) – Entropy – entropy and available energy – temperature – entropy diagram for Carnot's cycle - Third Law of thermodynamics(qualitative).

L : 30 periods

PRACTICALS

1. Determination of mechanical equivalent of heat by Joule's calorimeter.
2. Relation between temperature of a body and time by plotting a cooling curve-Newton's law of cooling.

3. Determination of specific heat capacity of liquid by cooling.
4. Determination of thermal conductivity of a bad conductor-Lee's disc method
5. Determination of thermal conductivity of a good conductor-Forbe's method

P: 30 periods

Total: 60 periods

REFERENCES :

1. Mathur. D.S, “Heat & Thermodynamics”, S.Chand & Co., 2009.
2. Brijlal & Subramaniam, “Heat and Thermodynamics”, S.Chand & Co, Delhi., 2010.
3. Gupta. A.B and Roy. H, “Thermal Physics”, Books and Allied Ltd., 2002.
4. Sharma. J.K and Sarkar. K.K, “Thermodynamics and statistical Physics”, Himalaya Publishing House, 1988.

OUTCOMES:

On completion of this course, the student will be able to

- understand the concepts of heat and its properties.
- comprehend the ideas governing the conduction and radiation processes.
- understand and apply the ideas of laws of thermodynamics in thermodynamic systems.
- perform heat based experiments and determine its various properties.

PHCX 03 INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY

L	T	P	C
2	0	2	3

OBJECTIVES:

- To acquire basic knowledge about the nanomaterials and applications.
- To learn about the imaging techniques of nanomaterials.
- To gain the basic concepts of fabrication techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I NANOMATERIALS AND APPLICATIONS 10

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials – quantum well, quantum wire, quantum dot- nanoporous materials- zeolite, mesoporous materials, carbon nanotubes, graphene- nanocomposites - applications (qualitative): Molecular electronics-nanoelectronics – nanophotonics - single electron transistor-drug delivery.

MODULE II SYNTHESIS AND IMAGING TECHNIQUES 12

Top-down and bottom up approaches – mechanical alloying and mechanical ball milling-sol-gel approach-hydrothermal method-precipitation method-spray pyrolysis-spin coating-self assembled monolayer (SAM)-Chemical vapour deposition method – Physical vapour deposition method: laser ablation method, sputtering method.

Optical microscopy – Phase contrast and interference microscopy –confocal microscopy-high resolution Scanning electron microscope (HRSEM)- high resolution Transmission electron microscope (HRTEM)-Atomic force microscope-Scanning Tunnelling microscope (STM).

MODULE III NANOFABRICATION 8

Photolithgraphy - electron beam lithography - X-ray and Ion beam lithography-nanoimprint lithography - soft lithograpy - nanoelectromechnical systems (NEMS) - nanoindentation principles.

L : 30 periods

PRACTICALS

1. Synthesis of nanomaterials by sol-gel method.

2. Synthesis of nanomaterials by hydrothermal method.
3. Synthesis of nanomaterials by solid state reaction method.
4. Synthesis of nanomaterials by chemical bath deposition method.
5. Synthesis of nanomaterials by co-precipitation method.
6. Synthesis of nano thin films by spray pyrolysis method.
7. Synthesis of nano thin films by pulsed laser deposition (PLD) method.
8. Analysis of size effect on the absorption spectrum of nanomaterials.
9. SEM characterization of nanomaterials.
10. AFM characterization of nano thin films.
11. Phase confirmation by XRD.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Charles P.Poole and Frank J. Owens, ”Introduction to nanotechnology”, Wiley (India), 2009.
2. Cao. G., “Nanostructures & Nanomaterials: Synthesis, Properties & Applications”, Imperial College Press, 2004.
3. Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., “Handbook of NanoScience, Engineering and Technology”, CRC Press, 2002.
4. Pradeep. T., “Textbook of Nanoscience and Nanotechnology”, McGraw Hill Education (India) Private Limited, New York, 2012.
5. Chris Mack, “Fundamental Principles of Optical Lithography: The Science of Microfabrication”, John Wiley & Sons, 2008.
6. Bandyopadhyay A.K., “Nano Materials”, New Age International Publishers, New Delhi, 2008.

OUTCOMES:

At the end of the course, the students will be able to

- understand the importance and basic concepts of the nanomaterials.
- comprehend the imaging techniques for nanomaterials.
- illustrate the various nanofabrication techniques.
- complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 04 LASERS AND THEIR APPLICATIONS

L	T	P	C
2	0	2	3

OBJECTIVES

- To recognize the fundamentals of laser and its characteristics.
- To comprehend and compare the different laser systems.
- To apply lasers in metrology and material processing.
- To understand the working of laser instrumentation.
- To correlate the experimental results for applications.

MODULE I LASER THEORY 8

Spontaneous and stimulated emission - Population inversion – Einstein's A & B coefficients - Threshold condition – super-radiance Laser – Three level and four level laser systems -conditions for CW and pulsed laser action. Q-Switching - experimental methods - cavity dumping - Mode locking - experimental methods - Spatial and Temporal coherence.

MODULE II DIFFERENT LASER SYSTEMS 8

Laser systems – General description - Laser structure - excitation mechanism - Different laser systems- He-Ne laser, Carbon-dioxide laser - Excimer laser – Free electron laser- Alexandrite laser - Ti-Sapphire laser – Semiconductor diode laser - Diode pumped solid state laser - Pulsed-CW dye laser- Fibre laser.

MODULE III METROLOGICAL AND MATERIAL PROCESSING APPLICATIONS 8

CW and Pulsed laser beam characteristics and its measurements - Beam focusing effects - spot size - Power and Energy density Measurements - Distance measurement - Interferometric techniques - LIDARS - different experimental arrangements - Pollution monitoring by remote sensing - Laser gyroscope - Laser welding, drilling, machining and cutting - Laser surface treatment - Laser vapour deposition – Biophotonic applications.

MODULE IV LASER INSTRUMENTATION 6

Laser for measurement of length, current and voltage – Laser Doppler Velocimetry - Holography and speckle in displacement and deformation measurements - Laser for communication with fiber optics as channel.

L : 30 periods

PRACTICALS

1. Tuning of Dye Laser using DFDL Arrangement
2. Determination of Brewster Angle using He-Ne laser
3. Study of transversely Pumped Dye Lasers
4. Study of longitudinally Pumped Dye Lasers
5. Determination of power and wavelength using Distributed Feedback Dye Laser (DFDL)
6. Determination of fibre optic losses using semiconductor laser.
7. Bandgap determination of a semiconductor diode.

P: 30 periods

Total: 60 periods

REFERENCES:

1. William T. Silfvast, “Laser Fundamentals”, Cambridge University Press, 2009.
2. Ghatak. A. & Thyagarajan. K. “Optical Electronics”, Cambridge University, 1994.
3. Laud.B.B., “Laser and Non-Linear Optics”, Second Edition, New Age International (p) Limited Publishers, 2011.
4. Nambiar. K.R., “Lasers Principle, Types and Applications”, New Age International (p) Ltd, 2004.
5. Wilson. J. & Hawkes. J.F.B., “Opto Electronics - An Introduction”, Prentice Hall, 1992.
6. William M.Steen, ”Laser Material Processing”, Springer-Verlag, Berlin, Third Edn., 2005.

OUTCOME :

At the end of the course, the students will be able

- To complement the knowledge acquired in the theory class.
- To work with dye lasers for tunability of laser wavelength
- To measure the loss of information involved in fibre optic communication
- To correlate the results for application.

PHCX 05 **MATERIALS SCIENCE**

L	T	P	C
2	0	2	3

OBJECTIVES

- To gain basic knowledge in conducting and semiconducting materials and their properties.
- To provide a basis for understanding properties and applications of dielectric materials.
- To impart knowledge on magnetic and optical materials and their properties & applications.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 8

Quantum free electron theory of metals and its importance - Energy distribution of electrons in metals - Fermi distribution function - Density of energy states and carrier concentration in metals - Fermi energy – Classification of solids into conductors, semiconductors and insulators on the basis of Band theory – Introduction to Elemental and Compound semiconductors - Carrier concentration derivation for Intrinsic semiconductors - Density of electrons in conduction band & Density of holes in valence band- intrinsic carrier concentration - Fermi energy & Variation of Fermi energy level with temperature - Mobility and electrical conductivity - Band gap determination.

MODULE II DIELECTRIC MATERIALS 7

Introduction to dielectric materials & basic definitions – Electronic, Ionic, Orientation & space charge polarizations - Total polarization – Frequency and temperature dependence of polarization - Internal field in a dielectric material - Deduction of Clausius - Mosotti's relation - dielectric loss & loss tangent – Different types of dielectric breakdown – Applications of dielectric materials : Capacitors and Transformers.

MODULE III MAGNETIC MATERIALS 7

Introduction to magnetic materials & origin of magnetic moment - Different types of magnetic materials and their properties - Ferromagnetism & Domain theory of ferromagnetism - Hysteresis, Soft and Hard magnetic materials - Antiferromagnetic materials - Ferrites and its applications – Applications of magnetic materials : Data storage.

MODULE IV OPTICAL MATERIALS 8

Optical properties of semiconductors - Direct and Indirect bandgap semiconductors – Traps, recombination centre, color center and exciton – Luminescence : Fluorescence and Phosphorescence - Liquid crystal display : twisted nematic crystal display – Applications of Optical materials - Optical Sources : light emitting diode and laser diode - Photo detectors : PIN photodiode and Avalanche Photodiode - Pyroelectric devices - Electro optic effect : Kerr effect and Faraday effect.

L : 30 periods

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination dielectric constant of a given non-polar liquid.
5. Determination of magnetic susceptibility of a given paramagnetic liquid using Quincke's method.
6. Determination of energy loss of a given transformer core using hysteresis method.
7. To study the I-V characteristics of a photodiode.

P: 30 periods

Total: 60 periods

REFERENCES

1. Palanisamy P.K., ''Physics II'', Material Science for ECE, Scitech Publications (India) Pvt Ltd., 2006.
2. Kasap. S.O., ''Principles of Electronic materials and devices'', McGraw Hill Publishers, 3rd Edition, 2007.
3. Arumugam. M, "Physics II'', Material Science for ECE, Anuradha Publishers, 5th Edition, 2005.
4. Sze. S.M., ''Semiconductor Devices – Physics and Technology'', John Wiley, 2nd Edition. 2002.
5. Raghavan. V, ''Materials Science and Engineering'', Prentice Hall of India, 5th Edition, 2004.

OUTCOMES

On the completion of this course, the students will be able to

- Gain knowledge about fundamentals of conducting and semiconducting materials

- Understand the concepts and applications of Dielectric, Magnetic materials
- Familiarize Optical materials and their applications in Engineering and Medical fields.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 06 NON-DESTRUCTIVE TESTING

L	T	P	C
2	0	2	3

OBJECTIVES:

- To study the process and applications of ultrasonic inspection method.
- To understand the basic concepts of radiographic inspection method.
- To acquire the knowledge about the various surface Non-Destructive Testing (NDT) techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I ULTRASONIC INSPECTION METHOD 10

Ultrasonic Testing- Principle of operations- types of sound waves -types of Transducers-transmission and pulse-echo method- straight beam and angle beam, instrumentation-calibration methods-ultrasonic testing technique- data representation, A Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction-thickness determination-, advantages, disadvantages and applications.

MODULE II RADIOGRAPHIC INSPECTION METHOD 10

Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography-method of generation-industrial radiography inspection techniques- Equipment-Exposure charts-Types of films-Fluoroscopy- Xero-Radiography –Limitations-Gamma radiography-Equipment, radiation sources- method of generation- film processing- interpretations of radiography-safety in industrial radiography.

MODULE III SURFACE NDT TECHNIQUES 10

Liquid Penetrant Testing – Principles, Characteristics and types of liquid penetrants-developers- advantages and disadvantages of various methods- Inspection Procedure and Interpretation of results. Applications of Liquid Penetrant testing.

Magnetic Particle Testing- Principle-magnetizing technique-procedure –equipment-Interpretation and evaluation of test indications-.applications and limitations-demagnetization.

L : 30 periods

PRACTICALS

1. Inspection of welds using solvent removable visible dye penetrant.
2. Inspection of welds using solvent removable fluorescent dye penetrant.
3. Inspection on non magnetic materials by eddy current method.

4. Inspection on magnetic materials by eddy current method.
5. Inspection of welds by Eddy current Testing.
6. Inspection of welds by Magnetic Particle Testing - Dry method.
7. Inspection of welds by Magnetic Particle Testing - Wet method.
8. Ultrasonic flaw detector- Inspection of defects.
9. Demonstration of Radiographic inspection.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Baldev Raj., Jayakumar T.,Thavasimuthu., “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Ravi Prakash., “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.
3. ASM Metals Handbook of Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, Volume-17, 2000.
4. Paul E Mix.,”Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005.
5. Charles J., Hellier, “Handbook of Nondestructive evaluation”, McGraw Hill, New York, 2001.

OUTCOMES:

Upon completion of this course, the students will be able to

- illustrate the ultrasonic inspection methods of NDT.
- understand the basic concept of radiographic inspection method.
- test the surfaces by the various surface NDT techniques.
- complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 07	PROPERTIES OF MATTER AND ACOUSTICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand principles and properties of elasticity.
- To understand the basic concepts and application of viscosity.
- To analysis acoustic of building.
- To know about photoelasticity and its applications.

MODULE I ELASTICITY **8**

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment - Cantilever–Expression for depression - Uniform bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II VISCOSITY **8**

Viscosity- Newton’s formula for viscous flow- Streamline and turbulent motion- Reynolds number - Poiseuille's formula- Determination of coefficient of viscosity- factors affecting viscosity - capillary flow method - Stoke's formula- viscosity of highly viscous liquids – Stoke’s method - Lubricants and its applications –viscosity measurements- Viscometer- Variation of Viscosity with Temperature.

MODULE III ACOUSTICS OF BUILDING **7**

Basic requirement for the acoustically good halls - Reverberation and time of reverberation – Sabine’s formula for reverberation time - Absorption coefficient and its measurement -Transmission of sound and transmission loss - Factors affecting the architectural acoustics and their remedy-sound absorbing materials-vibration and noise control systems for buildings.

MODULUE IV PHOTOELASTICITY **7**

Polarization- double refraction-Theory of Plane, Circularly and Elliptically polarized light- Quarter wave plate and half wave plate- photo elasticity- Theory of photo-elasticity- Stress optic relations- model materials-analysis techniques- Photo elastic bench.- Three dimensional photo elasticity-Digital photo elasticity- Photo elastic coatings.

L : 30 periods

PRACTICALS

1. Determination of viscosity of liquid by Poiseuille's method.
2. Determination of viscosity of liquid by Stoke's method.
3. Analysis of stress by photo elastic method.
4. Verification of Hooke's law by spring method.
5. Determination of Young's modulus of the cantilever beam.
6. Determination of rigidity modulus by static torsion method.
7. Visit to acoustically good auditorium and identifying the sound absorbing materials in the auditorium.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Mathur D.S., "Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Gaur R.K., Gupta S.L.,"Engineering Physics", Dhanpat Rai Publishers, 2010.
3. Brijlal and Subramaniam.," Properties of Matter", Eurasia Publishing Co, New Delhi, 2002.
4. Smith C.J.," General Properties of Matter", Orient & Longman,1960.
5. Kenneth G. Budinski and Michel K., Budinski, "Engineering Materials Properties and Selection", Pearson, Singapore, 2002.

OUTCOMES:

Upon completion of this course, the students will be able to

- understand the basic concepts of the elasticity of materials.
- comprehend the concepts of viscosity of liquid and measurement.
- demonstrate the acoustical aspects of building and its importance in construction.
- illustrate the fundamental concept of photo elasticity and its use for the stress analysis of the object.

PHCX 08 PROPERTIES OF MATTER AND NONDESTRUCTIVE TESTING

L	T	P	C
2	0	2	3

OBJECTIVES:

- To impart knowledge about the principles and properties of elasticity.
- To learn the laws governing the dynamic of rigid bodies.
- To acquire the knowledge of the various techniques of Non-Destructive Testing (NDT) of materials.
- To understand the principle and basic concept of low temperature applications.

MODULE I ELASTICITY **8**

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment-Cantilever–Expression for depression - Uniform Bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II DYNAMICS OF RIGID BODIES **8**

Rigid bodies - angular acceleration - Torque on a particle - angular momentum - law of conservation of angular momentum - moment of inertia and its significance -Theorem of parallel and perpendicular axis - moment of inertia of a thin uniform bar - moment of inertia of a rectangular lamina - moment of inertia of uniform circular disc - Moment of inertia of hollow and solid cylinders – flywheel (qualitative) - kinetic energy of rotating body – Routh rule.

MODULE III NDT TECHNIQUES **6**

Ultrasonic Testing- types of Transducers-transmission and pulse-echo method-Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography-method of generation-industrial radiography inspection techniques- Liquid Penetrant Testing-Inspection Procedure and Interpretation of results.

MODULE IV LOW TEMPERATURE PHYSICS **8**

Definition of Refrigeration and Air-Conditioning - Types of Refrigeration Systems-Applications- Comfort Air Conditioning, Industrial Refrigeration, Food processing and food chain - Cryogenic treatment - Low temperature properties of engineering materials: Mechanical properties, Thermal properties, Electrical properties.

L : 30 periods

PRACTICALS

1. Verification of Hooke's law by spring method.
2. Determination of Young's modulus of the beam by bending method.
3. Inspection of welds using solvent removable visible dye penetrant.
4. Inspection of welds using solvent removable fluorescence dye penetrant.
5. Inspection of welds by Magnetic Particle Testing.
6. Determination of moment of inertia of the disc by torsion pendulum method.
7. Determination of moment of inertia of the disc by static torsion method.
8. Demonstration of working of flywheel.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Mathur D.S.,"Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Brijlal & Subramaniam," Properties of Matter", Eurasia Publishing Co, Delhi,2002.
3. Gaur R.K., Gupta S.L., "Engineering Physics" Dhanpat Rai Publishers, 2010.
4. Baldev Raj.,Jayakumar T., Thavasimuthu M.,"Practical Non-Destructive testing", Narosa Publishing House, 2009.
5. Brijlal & Subrahmanyam., "Heat and Thermodynamics" S.Chand & Company Ltd, 2002.
6. Paul E Mix.," Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition, New Jersey, 2005.
7. Charles J., Hellier.," Handbook of Nondestructive evaluation", McGraw Hill, New York, 2001.

OUTCOMES:

Upon completion of this course, the students will be able to

- understand the basic of concept of elasticity of materials.
- comprehend the basic concepts of motion of rigid bodies and its applications.
- Demonstrate the various NDT techniques and its importance.
- Illustrate the low temperature systems and its applications.

PHCX 09 SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS	L	T	P	C
	2	0	2	3

OBJECTIVES:

- To understand the Physics of Semiconductor devices.
- To make the students learn the fundamentals of Photoluminous - semiconductors, Optoelectronic devices, Optical modulators/detectors.
- To make them understand the technology behind latest Display devices like LCD, Plasma and LED Panels.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I PHYSICS OF SEMICONDUCTORS 8

Elemental and compound semiconductors – Drift and diffusion current - Intrinsic semiconductors – Carrier concentration (derivation) – Fermi energy – Variation of Fermi energy level with temperature – Mobility and electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductor (derivation) – Variation of Fermi level with temperature and impurity concentration – Variation of Electrical conductivity with temperature – Hall effect – Experiment and applications of Hall effect.

MODULE II OPTOELECTRONIC DEVICES 7

Light Emitting Diodes (LED) – power and efficiency - double hetero LED - LED structure - LED characteristics - White LED – Applications. Liquid crystal displays – Dynamic scattering and Twisted nematic display, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers.

MODULE III OPTICAL MODULATORS 7

Modulation of light – birefringence –Modulation Techniques - Electro optic effect –Electro optic materials –Types of Electro optic Modulators : Kerr and Pockel modulators — Magneto optic effect - Magneto optic Modulators – Acousto Optic modulators.

MODULE IV OPTICAL DETECTORS 8

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode – Avalanche Photodiode (APD) characteristics - APD design of detector arrays – Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells.

L : 30 periods

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination of the wavelength of a given laser source using diffraction grating.
5. Determination of Planck's constant using LED.
6. To study the I-V characteristics of photodiode and phototransistor.
7. To study the characteristics of a solar cell.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Arumugam. M, "Physics II", Anuradha Publishers, 5th Edition, 2005.
2. Sze. S.M., "Semiconductor Devices – Physics and Technology", 2nd edn. John Wiley, 2002.
3. Wilson & J.F.B. Hawkes, "Optoelectronics – An Introduction", Prentice Hall, India, 1996.
4. Bhattacharya, "Semiconductor optoelectronic devices", Second Edn, Pearson Education, 2002.
5. Safa O. Kasap, "Optoelectronics & Photonics:Principles & Practices", Second Edn, Pearson Education,2013.
6. Palanisamy P.K., "Semiconductor physics and optoelectronics" Scitech Publications, 2003.

OUTCOMES:

On completion of this course, the student will be able to

- Understand the principles of Physics behind semiconductor devices.
- Choose the correct semiconductors for electronic devices and display.
- Differentiate the working principle of LED and Diode Laser.
- Apply the knowledge of modulation of light for different types of optical modulators.
- Select suitable photodetectors for different types of applications.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

CHC1181	CHEMISTRY	L T P C
		3 0 2 4

OBJECTIVES

To make the students conversant with

- the basic problems like hardness, alkalinity, dissolved oxygen associated with the water and treatment processes involved.
- types of electrodes, determination of pH, emf measurement, conductometric and potentiometric titration.
- the basic analytical techniques like colorimetry, UV-Visible, flame photometry and AAS.
- concepts of photochemistry related to physical processes and chemical reactions induced by photon absorption and their applications.
- the non-renewable sources such as thermal and nuclear energy, importance of renewable energy sources like solar, wind, biogas, biomass, geothermal, ocean with their advantages and limitations.
- the synthesis, properties and applications of nanomaterials.

MODULE I WATER TECHNOLOGY 9

Impurities present in water – hardness : types of hardness, demerits of hard water in boilers, estimation of hardness by EDTA method (problems) – alkalinity : estimation of alkalinity (problems) – dissolved oxygen: estimation of dissolved oxygen – conditioning methods : external treatment :– zeolite process (principle only), ion-exchange process – internal treatment :– colloidal, carbonate, phosphate and calgon methods – drinking water standards (BIS), treatment of domestic water {screening, sedimentation, coagulation, filtration and disinfection} – desalination by reverse osmosis.

MODULE II ELECTROCHEMISTRY 8

Types of electrodes (principle and working) : gas (SHE), metal/metal ion electrode, metal-metal insoluble salt (calomel electrode), ion-selective (glass electrode) – pH determination using glass electrode – concentration cells (problems) – standard cell (Weston-cadmium) – EMF measurement (problems) – conductometric titrations – potentiometric titrations.

MODULE III ANALYTICAL TECHNIQUES 7

Spectroscopy: (relation between interaction of electromagnetic radiation with matter and type of spectroscopy), electromagnetic spectrum – types of transitions – types of spectra (atomic and molecular) – Beer-Lamberts law (problems) – principles, instrumentation (block diagram only) and applications of: colorimetry (includes estimation of concentration of a solution) – UV-Vis spectrophotometer – atomic absorption spectroscopy – flame photometry (includes estimation of concentration of alkali metal).

MODULE IV PHOTOCHEMISTRY 7

Introduction: absorption and emission – laws of photochemistry: Grotthus-Draper law, Stark Einstein law – quantum efficiency – determination of quantum yield (problems) – photochemical decomposition of HI – photo physical processes: fluorescence and phosphorescence – Jablonski diagram (electronic states and transitions) – quenching – photosensitization: principle and applications – chemiluminescence – bioluminescence.

MODULE V ENERGY SOURCES 8

Renewable and non-renewable energy: comparison, advantages and limitations – non-renewable energy : thermal energy (principle only) – nuclear reactor (components and functions) – nuclear energy (problems) – renewable energy: needs of renewable energy – solar energy : solar photovoltaic, advantages and limitations – wind energy: wind resources, wind turbines, advantages and limitations – bioenergy: biogas generation, factors affecting biogas generation, biomass gasifier, advantages and limitations – geothermal energy: principle, types of geothermal resources, advantages, limitations and applications – ocean energy: tidal and ocean thermal energy (principle, advantages and limitations).

MODULE VI NANOCHEMISTRY 6

Introduction – distinction between molecules, bulk materials and nanoparticles – classification based on dimension with examples – synthesis :– top-down approach: chemical vapour deposition, laser ablation, electrodeposition – bottom-up approach: precipitation, thermolysis (hydrothermal and solvothermal) – properties and applications of nanomaterials.

L:45 periods

PRACTICALS

1. Estimation of hardness in the given water sample.
2. Estimation of the alkalinity of the given water sample.
3. Estimation of dissolved oxygen in the given water sample.
4. Determination of EMF of the cell.
5. Estimation of a strong acid by conductometry.
6. Estimation of Fe^{2+} present in the given sample by potentiometry.

7. Verification of Beer-Lamberts law and estimation of metal ion concentration of the given sample.
8. Estimation of sodium and potassium present in the given sample by flame photometry (demonstration).

P:30 periods

Total: 75 periods

REFERENCES

1. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India Ltd., New Delhi, 2011.
2. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, Thomas Graham House, Cambridge, 2005.
3. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.
5. G.D.Rai, “Non conventional energy sources,” Khanna Publishers, New Delhi, 2011.
6. John Twidell and Tony Weir, “Renewable Energy Resources, Taylor & Francis Ltd, London, United Kingdom, 2005
7. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

OUTCOMES

The students will be able to

- solve problems related to hardness, alkalinity, dissolved oxygen associated with the water and describe the treatment processes.
- describe the various types of electrodes, determine pH, measure EMF, explain and determine the concentration of acid and ions using conductometric and potentiometric titrations.
- verify and derive Beer-Lambert’s law, state the principle and illustrate the instrumentation of various analytical techniques.
- apply the concepts of photochemistry to elaborate various photo-physical and photochemical reactions.

- describe the various components and functions of nuclear reactor, explain the principle and enumerate the advantages and limitations of various renewable energy sources.
- classify nanomaterials and discuss their properties & applications; and apply nanochemistry approach to synthesize the nanomaterials.

CHCX01 ANALYTICAL INSTRUMENTATION

L	T	P	C
2	0	2	3

OBJECTIVES

To make the student conversant with

- principles, instrumentation and applications of different electroanalytical techniques
- different chromatographic techniques
- principles, instrumentation and applications of various types of absorption and emission spectroscopy
- different thermal analytical methods and their applications

MODULE I ELECTROANALYTICAL TECHNIQUES 7

Principle and applications: conductometric titrations – potentiometrIc titrations, ion-selective electrodes and pH-metry – coulometry – voltammetry - polarography, amperometric titrations.

MODULE II CHROMATOGRAPHY 8

Basic concepts of chromatography – paper chromatography – column chromatography – thin layer chromatography – gas chromatography – high performance liquid chromatography – gel permeation chromatography.

MODULE III SPECTROSCOPY 8

Absorption spectroscopy (principle, instrumentation and applications): Colorimetric analysis – UV-Visible spectroscopy – FTIR spectroscopy - Emission Spectroscopy (principle, instrumentation and applications): fluorescence, phosphorescence and chemiluminescence – Atomic absorption spectroscopy – flame emission spectroscopy.

MODULE IV THERMAL ANALYSIS 7

Principle, instrumentation and applications: Thermogravimetric analysis – Differential thermal analysis – Differential scanning calorimetry

L: 30 periods

PRACTICALS

1. Conductometric titrations: acid-base and precipitation titrations
2. Potentiometric titrations
3. Determination of pH of the unknown solution
4. Estimation of alkali metals using flame emission spectroscopy
5. Estimation of metal ions of coloured solutions using colorimetric analysis
6. Separation of compounds using gas chromatography
7. Separation of compounds using high performance liquid chromatography

8. Analysis of the given sample and interpretation of the data using IR, UV-Visible spectroscopy
9. Demonstration of TGA/DTA and DSC and interpretation of data.

P:30 periods

Total: 60 periods

REFERENCES

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8th Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.
3. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Prentice Hall, London, 2008.
4. Christian G.D., Analytical Chemistry, 6th Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

OUTCOMES

The student will be able to

- state the principle and applications of various electro-analytical techniques
- identify the right separation method for a given sample using different chromatographic techniques
- explain the principle, instrumentation & applications of various spectroscopic methods and also to interpret the data
- elaborate the principle, instrumentation and applications of various thermal analytical techniques and interpret the data.

CHCX02 CORROSION AND ITS CONTROL

L	T	P	C
2	0	2	3

OBJECTIVES

To make the student conversant with

- Basic concepts, principles and factors affecting corrosion
- Types and mechanism of corrosion
- Control measures of corrosion by material selection, proper design and by applying organic coatings
- Control of corrosion by applying inorganic coatings

MODULE I BASIC CONCEPTS OF CORROSION 8

Corrosion – causes and impacts of corrosion – mechanism of corrosion: Dry corrosion-oxidation corrosion - corrosion by other gases – Pilling-Bedworth rule- Corrosion by hydrogen: hydrogen blistering, hydrogen embritttlement, decarburization and hydrogen attack – corrosion of silver and copper by sulphur compounds – liquid metal corrosion (embritttlement or cracking) – Wet corrosion : hydrogen evolution – presence and absence of oxygen and absorption of oxygen –difference between dry and wet corrosion-factors influencing corrosion-polarization-passivity-emf series and galvanic series-corrosion current -rate of corrosion.

MODULE II FORMS OF CORROSION 7

Forms of corrosion-conditions for electrochemical corrosion –galvanic corrosion – differential aeration corrosion: pitting, water line, wire fencing, crevice and filiform corrosion – stress corrosion – Intergranular corrosion- erosion corrosion – soil corrosion – microbiological corrosion- fretting corrosion- corrosion in composites.

MODULE III CORROSION CONTROL AND ORGANIC COATINGS 8

Corrosion control – selection of materials and designing- cathodic protection – sacrificial anode and impressed current cathodic protection – corrosion inhibitors: anodic, cathodic and vapour phase inhibitors.

Organic protective coatings – paints: constituents – functions – varnishes : types-constituents – functions – lacquers : constituents – functions –enamels- constituents – functions – special paints : fire retardant, water repellant, heat resistant, temperature indicating and luminous paints.

MODULE IV INORGANIC COATINGS 7

Treatment of metal surface-inorganic coatings- classification- metallic coatings : anodic and cathodic coatings-hot dipping : galvanizing and tinning- electroplating—electroless plating – cementation (diffusion) : sherardizing, calorizing and chromizing – metal cladding-metal spraying – non metallic coatings (chemical conversion coatings) : phosphate, chromate, oxide coatings and anodizing – comparison of anodic and cathodic protection.

L : 30 periods

PRACTICALS

1. Determination and comparison of rate of corrosion of metals in the presence of acid, base and neutral medium by weight loss method.
2. Determination of rate of corrosion of iron in the presence of various acids by weight loss method.
3. Determination of rate of corrosion of iron in the presence and absence of anodic Inhibitor by weight loss method.
4. Determination of rate of corrosion of iron in the presence and absence of cathodic Inhibitor by weight loss method.
5. Electroplating of base metal with copper.
6. Electrolessplating of base metal with copper
7. Chemical conversion coatings such as chromate and phosphate coatings.
8. Demonstration on the study of rate of corrosion by using cyclic voltametry.

P:30 periods

Total: 60 periods

REFERENCES

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.
3. M.G. Fontana and N.G. Green, Corrosion Engineering, McGraw Hill Book Company, NewYork, 1984.
4. S. Banerjee, A.K. Tyagi, Functional Materials- Preparation, Processing and Applications, ELSEVIER Publications, London ; Waltham, MA : 2011

OUTCOMES

The students will be able to

- explain the mechanism, compare and enumerate the factors affecting corrosion

- describe and identify the place and types for a given situation.
- choose and elaborate the suitable organic coating method for a given real time situation.
- apply a suitable metallic coating for a given situation

CHCX03 ELECTRICAL MATERIALS AND BATTERIES

L	T	P	C
2	0	2	3

OBJECTIVES

To make the student conversant with

- preparation, properties and applications of plastics used in electrical and electronic applications
- properties and uses of electrical engineering materials
- classification and description of different types of batteries.
- classification and types of fuel cells

MODULE I POLYMERS FOR ELECTRICAL AND ELECTRONIC APPLICATIONS 8

Preparation, properties and applications **:** polyethylene, polypropylene, EPDM, Nylon-6,6, PVC, PTFE, polycarbonates, ABS, phenol formaldehyde, urea formaldehyde, epoxy resins – polymer blends and alloys.

MODULE II ELECTRICAL ENGINEERING MATERIALS 7

Conductors**:** Silver, Copper, Gold, Aluminum **–** Semiconductors: Germanium, Silicon, Gallium Arsenic **–** Insulating Materials: Rubbers, Mica, Plastics, Ceramics, Insulating papers **–** Magnetic Materials**:** ferromagnetic materials, paramagnetic materials, diamagnetic materials, antiferromagnetic materials, ferrites

MODULE III BATTERIES 7

Electrochemical and electrolytic cell – batteries**:** types (primary, secondary and flow cell) – primary batteries**:** dry cells, alkaline batteries – secondary batteries**:** nickel-cadmium cell – lead acid storage cell, lithium battery**:** primary and secondary type – solar cell – dye sensitized solar cell.

MODULE IV FUEL CELLS 8

Difference between batteries and fuel cells - chemistry of fuel cells - types of fuel cell (based on temperature and electrolyte) – principle, characteristic features, advantages, disadvantages and applications of polymer electrolyte membrane or proton exchange membrane fuel cell (PEMFC), direct methanol fuel cell (DMFC), alkaline fuel cell (AFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC) and solid oxide fuel cells (SOFC).

L:30 periods

PRACTICALS

1. Free radical polymerization of styrene.
2. Free radical polymerization of PMMA.
3. Preparation of phenol-formaldehyde.
4. Preparation of urea-formaldehyde.
5. Synthesis of epoxy resin.
6. Demonstration of mechanical properties of insulating materials using UTM
7. Demonstration of electrical properties of insulating materials
8. Construction of batteries using natural resources
9. Measurement of EMF for different batteries.

P:30 periods

Total: 60 periods

REFERENCES

1. Jain P.C. and Renuka Jain, Engineering Chemistry, Dhanpat Rai Publication Co. (P) Ltd., New Delhi, 2013.
2. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
3. H.F. Mark and N. Gaylord, Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV Interscience, 2nd Ed. 1988.
4. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.
5. R.K. Rajput, A Textbook of Electrical Engineering Materials, Firewall Media, 2004
6. Vladimir S. Bagotsky, Fuel Cells: Problems and Solutions, 2nd Edition, John Wiley and Sons, 2012.
7. B. Viswanathan and M. Aulice Scibioh, Fuel Cells: Principles and Applications, Taylor and Francis Group, 2007.

OUTCOMES

The student will be able to

- summarise the preparation, properties and applications of plastics used in electrical and electronic applications
- enumerate the properties and uses of electrical engineering materials
- illustrate various types of batteries with the aid of a diagram
- classify the fuel cells and elaborate the different types of fuel cells.

CHCX04 ENGINEERING MATERIALS L T P C
2 0 2 3

OBJECTIVES

To make the student conversant with

- properties and uses of different types of refractories and abrasives
- adhesives, cements and lime, setting of cements and their chemical behaviors.
- types, properties and uses of lubricants.
- various types of composite materials.

MODULE I REFRACTORIES AND ABRASIVES 8

Introduction refractory: -classification - based on chemical nature- characteristic and selection of good refractory - general manufacture of refractory- preparation properties and uses of: silica refractory - magnesite refractory - zirconia refractory, properties of refractories: refractoriness - refractoriness under load - thermal spalling - porosity and dimensional stability, Cermets - super refractory.

Abrasives : introduction - Moh's scale - natural abrasives: diamond – corundum – emery - garnet and quartz, synthetic abrasives: preparation properties and uses: carborundum (silicon carbide)– alundum - boron (norbide) carbide,

MODULE II ADHESIVES AND BINDING MATERIALS 8

Introduction - classification of adhesives –advantage –limitation of adhesive bonding – development of adhesive- factors influencing adhesive action: chemical and physical, application techniques of adhesive – Lime: classification – manufacture - setting and hardening, Gypsum: -Manufacture and properties and uses - Cement : chemical composition- Manufacture – setting and hardening – concrete – weathering of cement and concrete and its prevention- special cements: high alumina cement - sorel cement - white portland cement – water proof cement.

MODULE III LUBRICANTS 7

Introduction –functions of lubricant- mechanism of lubrication - classification of lubricant – liquid lubricant: vegetable and animal oils – mineral oils, semisolid: grease(calcium, lithium, aluminium) – petroleum jelly, solid lubricant: graphite - molybdenum disulphide, Properties of lubricant: viscosity - viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue.

MODULE IV COMPOSITE MATERIALS 7

Introduction – advantageous characteristics of composites, applications of composites, main constituent of composites, types and applications of composites: RCC fibre-reinforced plastics (glass , carbon and aramid) - particulate composite - metal matrix composite - layered composites - failures in fibre-reinforced composites, ceramic matrix composites (CMC) – properties and applications.

L:30 periods

PRACTICALS

1. Preparation of refractory bricks
2. Preparation of abrasive papers/cloth
3. Preparation of simple adhesives
4. Estimation of alkalinity in cements
5. Determination of cloud point and pour point
6. Determination of flash point and fire point
7. Preparation of fibre-reinforced composite

P:30 periods

Total: 60 periods

REFERENCES

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. B.Sivasnakar, “Engineering Chemistry”, Tata McGrow-Hill Publication Limited, New Delhi, second reprint 2008.
3. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.

OUTCOMES

The student will be able to

- classify and describe the manufacture the refractories and enumerate the properties and uses of abrasive materials.
- elaborate the manufacture, properties and uses of various adhesives and binding materials.
- classify lubricants and describe the properties and uses of them
- enumerate the properties and uses of various composite materials.

CHCX05 FUELS AND COMBUSTION **L T P C**

2 0 2 3

OBJECTIVES

To make the students conversant with the

- three types of fuels available and the different processes involved in it.
- analysis of fuel characteristics and manufacture of fuels
- calculations involved in calorific values and minimum air requirement for complete combustion.
- classification, functions, mechanism and properties of lubricants.

MODULE I SOLID FUELS 7

Characteristics of good fuel. Solid fuel – Wood, Coal – Ranking of coal – selection of coal. Analysis of coal – Proximate analysis. Pulverized coal – Metallurgical coke – Carbonization of coal – types. Manufacture of metallurgical coke – Beehive oven and Otto Hoffman's by-product oven methods.

MODULE II LIQUID AND GASEOUS FUELS 8

Liquid fuel: Petroleum: Refining of petroleum, Liquid fuels derived from petroleum – Cracking: Thermal (Liquid and Vapour phase) – Catalytic (fixed bed and moving bed cracking – Synthetic petrol: Fischer-Tropsch method– Knocking in petrol and diesel engine: octane number and antiknocking – cetane number and improvement of cetane number – biodiesel (trans-esterification) – Gaseous fuels: Compressed natural gas (CNG) – LPG – oil gas – producer gas – water (blue) gas – biogas.

MODULE III COMBUSTION 8

Calorific value: Gross and net caloric value – Bomb Calorimeter, Gas calorimeter - Definition of combustion – calculation of minimum requirement of air (problems) – theoretical calculation of calorific values (Dulong's formula), Gross and net calorific values ((problems) – Analysis of flue gas: Orsat's gas analysis method, explosive range, Ignition temperature. Introduction to air pollution from IC (Internal combustion) engines, photochemical smog, primary and secondary pollutants.

MODULE IV LUBRICANTS 7

Friction and wear – lubricants: definition, functions and mechanism of lubrication (thick film and thin film) –classification: liquid lubricants: animal and vegetable origin, mineral oil, blended oils, lubricating emulsions and silicones – properties of lubricating oils: viscosity and viscosity index; Flash and fire-point, Cloud and pour point, oiliness, emulsification number, volatility, carbon residue, aniline point – semisolid lubricant: greases and waxes – solid lubricant: graphite and molybdenum disulphide –nanolubricants.

L:30 periods

PRACTICALS

1. Testing of fuels - proximate analysis (moisture, volatile matter, ash content and fixed carbon present in coal, coke, charcoal etc)
2. Ash content and carbon residue test
3. Biodiesel synthesis by trans-esterification method (from coconut, groundnut, mustard oil, palm oil)
4. Determination of calorific value of a solid fuel using Bomb calorimeter (coal, charcoal, coke etc)
5. Determination of calorific value of a liquid fuel using Bomb calorimeter (petrol, diesel, biodiesel etc)
6. Determination of cloud point and pour point of a lubricant
7. Determination of flash and fire point of diesel.
8. Aniline Point of diesel
9. Viscosity Index of lubricants and Fuels by Viscometer
10. Flue gas analysis by Orsat’s gas analysis method – Demonstration
11. Working of internal combustion engine - Demonstration

P:30 periods
Total: 60 periods

REFERENCES

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi, 2001.
2. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
3. John Griswold, Fuels Combustion and Furnaces, Mc-Graw Hill Book Company Inc. University of Michigan, 1946.
4. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill International Editions, 1989.
5. Bahl B.S., Tuli and Arun Bahl, Essentials of Physical Chemistry, S. Chand and Company Ltd., New Delhi, 2004.

OUTCOMES

The students will be able to

- compare and contrast the solid, liquid and gaseous fuels and also describe the processes involved in liquid and gaseous fuels.
- analyse the fuel properties such as moisture, votalite matter, ash content, calorific value etc
- calculate minimum air required for complete combustion and calorific values of fuels.
- categorize different lubricants into three types, explain the preparation and determine their properties.

CHCX06 FUNDAMENTALS OF PHYSICAL CHEMISTRY **L T P C**

2 0 2 3

OBJECTIVES

To make the student conversant with the

- various thermodynamic terms and relate the laws of thermodynamics in chemical processes
- molecularity and order of reaction and derive the rate constant for different order of reactions
- basics of adsorption of different materials and propose mechanisms and surface area measurement
- conditions for equilibrium and learn different components at equilibrium

MODULE I BASIC THERMODYNAMICS 8

Introduction - Thermodynamic terms - Thermodynamic equilibrium and processes - 1st law of thermodynamics: internal energy, enthalpy, heat capacity, isothermal and adiabatic expansion, Joule-Thomson effect - Zeroth law of thermodynamics: absolute temperature - 2nd law of thermodynamics: - spontaneous and cyclic process, Entropy in isothermal, isobaric and isochoric processes, work and free energy function, Maxwell's relation - 3rd law of thermodynamics

MODULE II CHEMICAL KINETICS 8

Rate of chemical reaction - order and molecularity of a reaction - Rate constant - kinetics of opposing, parallel and consecutive and chain reactions - isotope effects - effect of temperature on reaction rate - collision theory - absolute reaction rate theory - kinetics in enzyme catalysis

MODULE III SURFACE SCIENCE AND CATALYSIS 8

Adsorption - adsorption isotherms - uni and bimolecular adsorption reactions - parahydrogen conversion - factors affecting adsorption – Langmuir adsorption isotherm - Hinshelwood mechanism and *Eley-Rideal* mechanism with example - adsorption of gases on solids and surface area measurement by BET method - Terms in catalysis - homogeneous and heterogeneous and enzyme catalysis with example

MODULE IV PHASE RULE 6

Terms involved - Conditions for equilibrium - application of phase rule to water, lead-silver system, freezing mixtures, thermal analysis: cooling curves.

L:30 periods

PRACTICALS

1. Determination of the heat capacity of benzoic acid, internal energy of combustion of camphor using Bomb calorimeter. Calculation of enthalpy of combustion and formation for camphor.
2. Determination of adsorption isotherm of (i) acetic acid on charcoal (ii) oxalic acid on charcoal.
3. Kinetics *of* first and second order reactions.
4. Phase rule experiments with organic compounds: (i) naphthalene and p-dichloro benzene (ii) naphthalene and diphenyl (iii) m-dinitrobenzenzene and p-nitro toluene.

P:30 periods
Total: 60 periods

REFERENCES

1. Rajaram J. and Kuriacose J.C., Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson Education, India, 2013.
2. Samuel Glasstone, Thermodynamics for Chemists, Read Books, United Kingdom, 2007.
3. James E. House, Principles of Chemical Kinetics, 2nd Edition, Academic Press, United States of America, 2007.
4. Keith J. Laidler, Chemical Kinetics, Pearson Education, India, 1987.
5. Douglas M. Ruthven, Principles of Adsorption and Adsorption Processes, John Wiley & Sons, 1984.
6. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th Edition, Vishal Publishing Co. India, 2016.

OUTCOMES

The student will be able to

- calculate entropy, enthalpy and free energy change for different chemical processes
- calculate the rate constant for any chemical and biochemical processes
- differentiate the adsorption processes and calculate the surface area and predict the suitability of catalysts for different chemical processes
- predict the equilibrium conditions for water, alloys, freezing mixtures and draw the thermal curves for phase transition

CHCX07 GREEN TECHNOLOGY **L T P C**
2 0 2 3

OBJECTIVES

To make students conversant with the

- basic principles of green chemistry and green technology.
- wastes that causes hazards to human health
- chemicals that harms our environment
- need for green processes in various industries

MODULE I GREEN CHEMISTRY PROTOCOL 7

Need – Significance – 12 Principles with examples – R4 model – Life cycle analysis – sustainable and cleaner production - Green Technology: definition, examples: CFC free refrigerants, green building, energy, 3D printers, nanotechnology – Awards for Green chemistry – organization promoting green chemistry.

MODULE II WASTE & WASTE MINIMISATION 8

Source of wastes: domestic, industrial, medical, nuclear, e-waste; problems; prevention – economy of waste disposal – Waste minimization techniques: general waste treatment and recycling – alternate waste water treatment technologies: hybrid process – Green computing: goals, green cloud, green ICT - Pollution statistics from various industries (Industrial case studies).

MODULE III GREEN SYNTHESIS 7

Introduction - Solvent free reactions - green reagents, green solvents in synthesis - microwave and ultrasound assisted reactions – supercritical fluid extraction – green oxidation and photochemical reactions – catalyst and biocatalysts.

MODULE IV GREEN INDUSTRIAL PROCESSES 8

Polymer industry: biodegradable polymer - textile industry: greener approaches of dyeing, waste disposal – ecofriendly agrochemicals: biofertilizers, biopesticides – Pharmaceutical industry: atom economy, reduction of toxicity, use of biocatalyst, zero waste disposal – Leather industry: greener process in tanning, crusting, surface coating – ecofriendly batteries & fuel cells.

L:30 periods

PRACTICALS

1. Synthesis of an ionic liquids (Ex: imidazolium) and testing the solubility of organic chemicals.
2. Green bromination of stilbene (using pyridine hydrobromide).
3. Green synthesis: Photocatalytic reactions, solvent-free organic reaction – Aldol; green oxidation, green reduction.
4. Microwave assisted chemical reaction. (synthesis of aspirin, pinacol-pinacolone reaction, etc).
5. Comparison of conventional reaction with microwave assisted reactions (atom economy, solvent, etc) [Ex: aldehyde and ketones with hydrazines to give hydrazones].
6. Diels-Alder reaction in eucalyptus oil (green process).

P:30 periods

Total: 60 periods

REFERENCES

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
2. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
3. Paul Anastas, John C.Warner, John Warner Joint; Green Chemistry: Theory & Practice New Ed Edition; Oxford University press, USA, 2000.
4. Rashmi Sanghi, M. M. Srivastava, Green chemistry, Narosa publishers, New Delhi, 2003.

OUTCOMES

The students will be able to

- outline the principles and implications of green chemistry.
- comprehend the potential risks of waste generated and analyse the threats to human and environment.
- integrate information into design of molecules to avoid/eliminate toxic solvents & reagents or reduce toxic products.
- identify various alternate greener technologies for various industries.

CHCX08 ORGANIC CHEMISTRY OF BIOMOLECULES

L	T	P	C
2	0	2	3

OBJECTIVES

To make students conversant with the

- basic concepts in organic chemistry
- types and structure of carbohydrates and lipids
- formation of different structures of proteins from amino acid
- structure of nucleic acids

MODULE I BASIC CONCEPTS IN ORGANIC CHEMISTRY 8

Classification and IUPAC nomenclature of organic compounds – stereochemistry – optical, stereo and geometrical isomerism – types of reagents: electrophiles and nucleophiles – types of reactions: addition, substitution, elimination and rearrangement reactions.

MODULE II CARBOHYDRATES, LIPIDS AND VITAMINS 7

Structure and functions of carbohydrates: mono, di, oligo and polysaccharides – lipids: phospholipids, glycolipids, sphingolipids – cholesterol – steroids – Structure, functions and deficiency disorders of fat soluble vitamins: A, D, E & K - Water soluble vitamins B & C: Thiamine, riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid and ascorbic acid.

MODULE III AMINO ACIDS, PEPTIDES AND PROTEINS 7

Aminoacids: classification, properties - peptides – polypeptides – proteins: primary, secondary, tertiary and quaternary structure – glycoproteins – lipoproteins – Enzymes: classification and functions

MODULE IV NUCLEIC ACIDS 8

Nucleic acids – importance - structure of purines and pyrimidines – nucleotides – polynucleotides - RNA – types & structure - DNA – phosphodiester bonds – chemical, helical structure and functions – DNA replication – gene modification.

L: 30 periods

PRACTICALS

1. Qualitative tests to identify carbohydrates.
2. Quantitative estimation of carbohydrates.

3. Separation of sugars – TLC and/or paper chromatography.
4. Quantitative estimation of lipids.
5. Separation of amino acids – TLC and/or paper chromatography.
6. Quantitative estimation of proteins by Lowry's method.

P:30 periods
Total: 60 periods

REFERENCES

1. V. K. Ahluwalia, Organic Reaction Mechanism, Narosa Publishers, New Delhi, 2002.
2. Johnson Arthur T., Biology for Engineers, CRC Press, Finland, 2011.
3. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
4. David L. Nelson, Michael M. Cox, Lehninger Principles of biochemistry, Macmillan press, London, 2010

OUTCOMES

The students will be able to

- classify organic compounds and explain the mechanism of various organic reactions.
- draw the structures and enumerate the functions of carbohydrate, lipids and vitamins.
- correlate the relationship among amino acids, peptides and proteins.
- recognize the role of nucleic acid in the formation of RNA & DNA and differentiate DNA & RNA using their structure and function.

CHCX09 POLYMER SCIENCE AND TECHNOLOGY

L	T	P	C
2	0	2	3

OBJECTIVES

To make the student conversant with the

- basic concepts of polymers, classification, types of polymerization and molecular weight & its distribution
- preparation, properties and applications of thermoplastics and introduction to biodegradable polymers
- properties and applications of thermosets, elastomers and FRP
- different types of moulding techniques

MODULE I BASIC CONCEPTS OF POLYMERS 8

Definitions: monomer, polymer, functionality, degree of polymerization – classification of polymers: source, structure, application, thermal processing behavior (thermoplastics and thermosets), composition and structure (addition and condensation), mechanism (chain growth and step-wise growth) – copolymer: types – Definition –nomenclature of polymers – tacticity – types of polymerization : free radical, cationic and anionic polymerization (concepts only) – average molecular weight of polymer: number, weight – molecular weight distribution (problems)

MODULE II THERMOPLASTICS AND BIODEGRADABLE POLYMERS 8

Preparation, properties and applications : LDPE, HDPE, polypropylene, PVC, PTFE, PET, polyamides (Nylon-6 and Nylon 6,6) and polycarbonates – polymer blends and alloys – basics of biodegradable polymers.

MODULE III THERMOSET RESINS, ELASTOMERS AND FRP 7

Thermoset resins : phenolic resins, amino resins (urea and melamine formaldehyde), epoxy resins, unsaturated polyesters – polyurethanes – elastomers : vulcanization of natural rubber, diene based elastomers –fibre reinforced plastics: glass, aramid and carbon.

MODULE IV MOULDING TECHNIQUES 7

Moulding constituents: functions – moulding techniques: compression, injection, extrusion (single screw), blow moulding, thermoforming, (mechanical and vacuum forming), lamination.

L: 30 periods

PRACTICALS

1. Determination of molecular weight and degree of polymerization using Oswald's viscometer.
2. Free radical polymerization of styrene.
3. Free radical polymerization of PMMA.
4. Preparation of phenol-formaldehyde.
5. Preparation of urea-formaldehyde.
6. Synthesis of epoxy resin.
7. Synthesis of unsaturated polyester.
8. Preparation of FRP laminates.
9. Demonstration of injection moulding, compression moulding and blow moulding.

P:30 periods

Total: 60 periods

REFERENCES

1. Billmeyer F.N., Text Book of Polymer Science, 3rd Edition, John Wiley and Sons, New York, 1994.
2. George Odian, Principles of Polymerisation, 3rd Edition, McGraw Hill Book Company, New York, 1991.
3. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
4. Jacqueline I., Kroschwitz, Concise Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, New York, 1998.
5. Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV, H.F. Mark and N. Gaylord, Interscience, 2nd Ed. 1988.
6. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.

OUTCOMES

The student will be able to

- classify various polymers, name the polymers and types of polymerization reactions, calculate molecular weight of polymers,
- summarise preparation, properties and applications of thermoplastics and give examples of biodegradable polymers
- elaborate the properties and applications of thermosets, elastomers and FRP
- select the appropriate moulding technique for a given polymer, based on the application

GEC 1212 ENVIRONMENTAL STUDIES

L	T	P	C
2	0	0	2

OBJECTIVES

To make the student conversant with the

- various natural resources, availability, utilisation and its current scenario
- different ecosystems, energy transfer, values, threats and conservation of biodiversity
- levels of different pollutants and its impact and the causes and effects of natural disasters
- impacts of human population, impact assessment, human rights and environmental acts and sustainable development

MODULE I NATURAL RESOURCES 8

Land resources: land degradation, soil erosion and desertification - Forest resources: use and over-exploitation, deforestation - Water resources: use and over-utilisation of surface and ground water, conflicts over water (inter-state and international), dams (benefits and problems), water conservation (rainwater harvesting and watershed management) - Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, mining - Food resources: world food problems, changes in land use by agriculture and overgrazing, modern agriculture and its effects, fertilizer and pesticide problems, water logging and salinity - Energy resources: increasing energy needs, renewable and non-renewable, use of alternate energy sources.

MODULE II ECOSYSTEM AND BIODIVERSITY 8

Ecosystem- energy flow in the ecosystem - food chains, food webs and ecological pyramids - characteristics, structure and function of (a) Terrestrial ecosystems (forest, grassland, desert) and (b) Aquatic fresh water ecosystems (pond, lake, river) (c) Aquatic salt water ecosystems (ocean, estuary) - ecological succession.

Biodiversity - genetic, species and ecosystem diversity – hot-spots of biodiversity – biogeographic classification of India - endangered, endemic, extinct and invasive species of India - red data book - values of biodiversity: consumptive, productive, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - conservation of biodiversity: in-situ and ex-situ conservation of biodiversity

MODULE III ENVIRONMENTAL POLLUTION AND NATURAL DISASTER 8

Definition, cause, effects and control measures of (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards - ill-effects of fireworks and upkeep of clean environment - solid waste management: types (urban, industrial, biomedical and electronic wastes), collection, processing and disposal (incineration, composting and land-fill) - natural disaster and management: flood, cyclone, drought, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6

Population and population growth, population variation among nations, population explosion, family welfare programme.

Human health: air-borne, water borne diseases, infectious diseases, risks due to chemicals in food and environment.

Sustainable development - environmental legislation and laws: water act, air act, wildlife protection act, forest conservation act, environment protection act - environmental impact assessment, steps in EIA - human rights - women and child welfare.

Case studies related to current situation

L:30 periods

Total: 30 periods

TEXT BOOKS

1. Erach Bharucha, Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education for University Grants Commission, Orient Blackswan Pvt Ltd, Hyderabad, India, 2013.
2. Benny Joseph, Environmental Studies, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, Environmental Science and Engineering, Sri Krishna Publications, Tamil Nadu, India, 2015.
4. Raman Sivakumar, Introduction to Environmental Science and Engineering, McGraw Hill Education, India, 2009.
5. Venugopala Rao P, Principles of Environmental Science and Engineering, Prentice Hall India Learning Private Limited; India, 2006.
6. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International Pvt Ltd., New Delhi, India, 2009.

REFERENCES

1. Masters G.M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 1997.
2. Henry J.G. and Heike G.W., Environmental Science and Engineering, Prentice Hall International Inc., New Jersy, 1996.
3. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. Boston, USA, 2016.

OUTCOMES

The student will be able to

- predict the scenario of various natural resources and suggest remedies to curb the exploitation of these resources.
- identify food chain and web and its role in various ecosystems, assess the impacts on biodiversity and provide solutions to conserve it.
- analyse the impacts of pollutants in the environment and propose suitable method to alleviate the pollutants and the natural disasters.
- assess on the impact of human population and the health related issues and the ethics to be followed for sustainable life.

General Elective Courses

Group I courses

(To be offered in V Semester)

GECX101 DISASTER MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:

- To give an exposure to various environmental hazards and disasters: and various concepts and principles to manage disaster.
- To give exposure to various environmental policies & programs in India for disaster management

MODULE I ENVIRONMENTAL HAZARDS 7

Environmental hazards, Environmental Disasters and Environmental stress- Meaning and concepts. Vulnerability and disaster preparedness.

MODULE II NATURAL DISASTERS 7

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire.

MODULE III MAN-MADE DISASTERS 7

Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion

MODULE IV DISASTER MANAGEMENT 8

Emerging approaches in Disaster Management- Preparing hazard zonation maps, Predictability / forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication. Disaster resistant house construction, Population reduction in vulnerable areas, Awareness - Rescue training for search & operation at national & regional level - Immediate relief, Assessment surveys, Political, Administrative, Social, Economic, Environmental Aspects.

MODULE V NATURAL DISASTER REDUCTION & 8 MANAGEMENT

Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards

MODULE VI ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA 8

Regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.

L – 45; Total Hours –45

REFERENCES:

1. Satender, “Disaster Management in Hills”, Concept Publishing Co., New Delhi, 2003.
2. Singh, R.B. (Ed.), “Environmental Geography”, Heritage Publishers, New Delhi,1990.
3. Savinder Singh, “Environmental Geography”, Prayag Pustak Bhawan,1997.
4. Kates, B.I. and White, G.F., “The Environment as Hazards”, Oxford

University Press, New York, 1978.

5. Gupta, H.K., (Ed), “Disaster Management”, University Press, India, 2003.
6. Singh, R.B.,“Space Technology for Disaster Mitigation in India (INCED)”, University of Tokyo, 1994.
7. Bhandani, R.K., “An overview on Natural & Manmade Disaster & their Reduction”, IIPA Publication, CSIR, New Delhi, 1994.
8. Gupta, M.C., “Manuals on Natural Disaster management in India”, National Centre for Disaster Management, IIPA Publication, New Delhi, 2001.

OUTCOMES:

At the end of the course, the students will

- achieve sufficient knowledge on the disaster prevention strategy, early warning system, disaster preparedness, response and human resource development.
- be familiar with the National Policy on Disaster Management.

GECX102 TOTAL QUALITY MANAGEMENT

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To understand the various principles, practices of TQM to achieve quality.
- To get acquainted with the various statistical tools and approaches for quality control and continuous improvement.
- To get aware of the importance of ISO and Quality Systems.

MODULE I INTRODUCTION 8

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs

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

MODULE II TQM PRINCIPLES 7

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement

– Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits.

MODULE III TQM IMPROVEMENT PROCESS 8

Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

MODULE IV STATISTICAL PROCESS CONTROL (SPC) 8

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

MODULE V TQM TOOLS 7

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

MODULE VI QUALITY SYSTEMS 7

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System– Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits

L – 45; Total Hours –45

TEXT BOOKS:

1. Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education, Inc. 2003.

REFERENCES:

1. James R.Evans & William M.Lidsay, “The Management and Control of Quality”, 5th Edition, South-Western (Thomson Learning), 2002.
2. Feigenbaum.A.V., “Total Quality Management”, McGraw-Hill, 1991.
3. Oakland.J.S., “Total Quality Management”, Butterworth Hcinemann Ltd.,

Oxford, 1989.

4. Narayana V. and Sreenivasan. N.S., “Quality Management – Concepts and Tasks”, New Age International, 1996.
5. Zeiri, “Total Quality Management for Engineers”, Wood Head Publishers, 1991.

OUTCOMES:

The student should be able to

- apply the various statistical tools and approaches for Quality control.
- achieve continuous process improvement through TQM.

GECX103 **ENERGY STUDIES** **L T P C**

3 0 0 3

OBJECTIVES:

- To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.
- To understand the basic need for energy conservation and waste heat recovery.
- To learn the important aspects of energy audit and management.
- To get acquainted with the global environmental issues and carbon credits.

MODULE I GLOBAL AND NATIONAL ENERGY SCENARIO 7

Role of energy in economic development, various energy resources - overall energy demand and availability- Energy consumption in various sectors and its changing pattern - Exponential increase in energy consumption and projected future demands. Need for renewable energy.

MODULE II SOLAR ENERGY 8

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

MODULE III OTHER RENEWABLE ENERGY SOURCES 8

Power from wind – wind turbine working and types, solar thermal power plants – low medium and high power generation, power from wave , tidal, geothermal sources, OTEC system. MHD power plants – working, types, merits and demerits. Energy from biomass.

MODULE IV COGENERATION, WASTE HEAT RECOVERY AND COMBINED CYCLE PLANTS 8

Cogeneration principles- topping and bottoming cycles, role in process industries. Energy from wastes- waste heat recovery- heat recovery from industrial processes. Heat exchange systems – recuperative and regenerative heat exchangers – commercially available waste heat recovery devices. Combined cycle plants – concept, need and

MODULE V ENERGY CONSERVATION AND MANAGEMENT 7

Need for energy conservation – use of energy efficient equipment. Energy conservation opportunities - in educational institutions, residential, transport, municipal, industrial and commercial sectors – concept of green building. Energy audit in industries – need, principle and advantages. Case studies.

MODULE VI GLOBAL ENERGY ISSUES AND CARBON CREDITS 7

Energy crisis, fossil consumption and its impact on environmental climate change. Energy treaties – Montreal and Kyoto protocols - Transition from carbon rich and nuclear to carbon free technologies, carbon foot print – credits – clean development mechanism.

L – 45; Total Hours –45

TEXT BOOKS:

1. S.S. Rao and B.B. Parulekar, “Energy Technology”, 3rd Edition, Khanna Publishers, New Delhi, 2011.
2. O. Callaghn. P.W., “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.

REFERENCES:

1. G.D. Rai, “Non Conventional Energy Sources”, Khanna Publishers, New

Delhi, 2011.

2. Archie, W Culp. “Principles of Energy Conservation”, McGraw Hill, 1991.
3. D Patrick and S W Fardo, “Energy Management and Conservation”, PHI,1990
4. P. O’Callaghan: “Energy Management”, McGraw - Hill Book Company, 1993.
5. Kenney, W. F., “Energy Conservation in Process Industries”, Academic Press, 1983.

OUTCOMES:

The student should be able to

- Realize the global and national energy status and need to switch over to renewable energy technology.
- Energy audit and suggest methodologies for energy savings.
- Utilize the available resources in an optimal way.
- Concern about the global environmental issues & promote carbon credits.

GECX104 ROBOTICS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

To learn about the robots, various components, of Robots, programming and their applications.

MODULE I 8

Definition- Need - Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence- basic parts - functions – specifications. of robot, degrees of freedoms, end effectors – types, selection

MODULE II ROBOT DRIVES AND CONTROL 8

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

MODULE III ROBOT SENSORS 8

Transducers and Sensors – Tactile sensor – Proximity and range sensors

– Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

MODULE IV ROBOT PROGRAMMING & AI TECHNIQUES 7

Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

MODULE V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS 7

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots – Application of robots in surgery, Manufacturing industries, space and underwater.

MODULE VI ROBOT KINEMATICS AND DYNAMICS 7

Forward and inverse Kinematic equations, Denvit – Hartenbers representations Fundamental problems with D-H representation, differential motion and velocity

of frames - Dynamic equations for sing, double and multiple DOF robots – static force analysis of robots.

L – 45; Total Hours –45

REFERENCES:

1. Yoram Koren," Robotics for Engineers", Mc Graw-Hill, 1987.
2. Kozyrey, Yu, "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R. "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", Mc

Graw- Hill, Int. 1986.

6. Timothy Jordanides et al,”Expert Systems and Robotics”, Springer – Verlag, New York, May 1991.

OUTCOMES:

Students would be able to

- Understand about the robots, its various components.
- Design Robots for industrial applications.
- Do programming for robots and apply them in real time applications.

GECX105 TRANSPORT MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the transport fleet and their related activities for minimizing operational cost.
- To understand the need of maintenance and its importance.
- To understand the functions and applications of various types of transport system.

MODULE I INTRODUCTION 7

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

MODULE II ORGANISATION AND MANAGEMENT 7

Forms of Ownership – principle of Transport Management – Staff administration

– Recruitment and Training – welfare – health and safety. Basic principles of supervising. Organizing time and people. Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing - Vehicle operation and types of operations.

MODULE III TRANSPORT SYSTEMS 9

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

MODULE IV SCHEDULING AND FARE STRUCTURE 8

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

MODULE V MOTOR VEHICLE ACT 7

Traffic signs, fitness certificate, registration requirements, permit insurance,

constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

MODULE VI MAINTENANCE 7

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

L – 45; Total Hours –45

TEXT BOOKS:

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.

2. Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992

REFERENCES:

1. Government Motor Vehicle Act, Publication on latest act to be used as on date.

OUTCOMES:

Upon completion of the course, students will

- Know about different aspects related to transport system and management.
- Features of scheduling, fixing the fares
- Know about the motor vehicle act and maintenance aspects of transport.

GECX106	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the system modeling and to derive their transfer function.
- To provide adequate knowledge of time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of Control systems.

MODULE I BASIC CONCEPTS AND SYSTEM 8 REPRESENTATION

Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

MODULE II TIME RESPONSE ANALYSIS AND DESIGN 8

Time response – Time domain specifications – Types of test input – First and Second order system - Type I and Type II System – Response - Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

MODULE III FREQUENCY RESPONSE ANALYSIS AND DESIGN 7

Performance specifications - correlation to time domain specifications - bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

MODULE IV STABILITY 8

Characteristics equation – Location of roots in s plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

MODULE V COMPENSATOR DESIGN 8

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus technique.

MODULE VI CONTROL SYSTEM COMPONENTS AND APPLICATION OF CONTROL SYSTEMS 6

Synchros – AC servomotors - DC Servo motors - Stepper motors - AC Tacho generator - DC Tacho generator - Typical applications of control system in industry.

L – 45; Total Hours –45

REFERENCES:

1. K. Ogata, “Modern Control Engineering”, 4th Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath & M. Gopal, “Control Systems Engineering”, New Age International Publishers, 2003.
3. C.J.Chesmond, “Basic Control System Technology”, Viva student edition, 1998.
4. I.J.Nagarath and M.Gopal, “Control System Engineering”, Wiley Eastern Ltd., Reprint, 1995.
5. R.C.Dorf and R.H.Bishop, “Modern Control Systems”, Addison-Wesley (MATLAB Reference), 1995.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Proper understanding of basics of Control Systems.
- Ability and skill to carry-out time domain and frequency domain analysis.
- Capable of determining stability of the system using Routh Hurwitz criterion, Root locus and Nyquist criterion.
- Ability to design lag, lead and lag lead compensator networks.

GECX107 INTRODUCTION TO VLSI DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- Basic concepts of HDL.
- Verilog language and its syntax constructs.
- Programmable Logic Devices and FPGAs
- MOS devices theory
- CMOS based combinational and sequential circuits

PREREQUISITES:

Fundamentals of Electronics

Basics knowledge in Digital Electronics.

MODULE I REVIEW OF BASIC DIGITAL SYSTEMS 7

Boolean algebra, Building blocks of combinational logic design-Adders, multiplexer, encoder, decoder, comparator, Latches & flip-flops, counters, shift registers.

MODULE II LOGIC DESIGN USING VERILOG HDL 8

Overview of Digital Design with Verilog HDL, Levels of Design Description, Concurrency, Hierarchical Modeling Concepts, Modules and Ports, Component instantiation Data flow and RTL, structural, gate level, switch level modeling and Behavioral Modeling.

MODULE III LANGUAGE CONSTRUCTS OF VERILOG HDL 7

Identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments, conditional statements Variable types, arrays and tables, Tasks and functions, Test bench.

MODULE IV BUILDING BLOCKS OF DIGITAL VLSI SYSTEMS 8

HDL Design -Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements. Programmable logic elements and AND-OR arrays, FPGAs programming methods.

MODULE V TRANSISTOR THEORY 7

Introduction to MOS Transistors-NMOS & PMOS Characteristics, Current Equations, Complementary CMOS Inverter-DC Characteristics, Static Load MOS

MODULE VI BASICS OF DIGITAL CMOS DESIGN 8

NMOS & PMOS Logic Gate, CMOS Logic Gate, Basic layout design of simple gate-stick diagram, CMOS Logic Structures-full adder, multiplexers.

Total Hours –45

TEXT BOOKS:

1. M.Morris Mano "Digital Design", 3rd Edition, Prentice Hall of India Pvt. Ltd New Delhi, 2003

REFERENCES:

1. Michael D. Ciletti“Advanced Digital Design with the Verilog HDL" (2nd Edition) Hardcover – January 31, 2010

2. J.Bhasker: Verilog HDL primer, BS publication, 2001.

3. J. P. Uyemura, "Introduction to VLSI Circuits and System", Wiley, 2002

4. Neil Weste and K. Eshragian, “Principles of CMOS VLSI Design: A System Perspective,” 2nd edition, Pearson Education (Asia) Pvt.Ltd., 2000

5. Douglas A Pucknell& Kamran Eshragian , “Basic VLSI Design” PHI 3rd Edition

(original edition – 1994)

OUTCOMES:

At the end of the course the students will be able to

- Create basic Register Transfer Level (RTL) models for combinational circuits & Sequential circuits using Verilog HDL.
- Create basic behavioral models for combinational circuits & Sequential circuits using Verilog HDL.
- Describe the usage of Programmable Logic Devices and FPGAs.
- Describe MOS devices theory and inverter circuit DC characteristics
- Design the basic digital building blocks using MOS circuit.
- Apply VLSI design concepts based on the requirements to conduct experiments or projects

GECX108	PLANT ENGINEERING	L	T	P	C
		3	0	0	4

OBJECTIVES:

- To provide in depth knowledge on Plant Engineering
- To introduce detail engineering and P&ID
- To learn about the support to Instrumentation from other disciplines
- To study about the Installation and commissioning

MODULE I INTRODUCTION OF PLANTS 7

General Project Cycle – Feed – Sales - Plant Description, Component / Areas of Plant, Plant Layout, Plant Interfaces, Plant Location

MODULE II ELEMENTS OF PLANT 8

Main Elements of a Plant, Process Flow Scheme (PFD – Process Flow Diagram) P&ID's, Plant Legend Finalization.

MODULE III DETAIL ENGINEERING 10

P& ID Development with PFD's, Major Discipline Involvement & Inter discipline Interaction, Major Instrumentation & Control Systems - Development Phase – Instrument List , I/O Count, Specification Sheets, Instrument Installation (Hook ups) , Control Philosophy – Detail Engineering.

MODULE IV SUPPORT FROM OTHER DISCIPLINE 8

Other Discipline Supports to Instrumentation – Plot Plan, Piping / Equipment Plan, Electrical Area Classification, Fire Hazardous Classification Telecommunication Systems - Control Network architecture.

MODULE V INSTALLATION AND COMMISSIONING 7

Plant Construction - Key Drawings for Construction Support Construction Activities, System Testing, Startup / Commissioning, Production.

MODULE VI CASE STUDIES 5

Case studies of Water Treatment Plant - Paper Industry – Power Plant etc

L – 45; Total Hours –45

REFERENCES:

1. Duncan C Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2014 McGraw-Hill Education
2. Gabriel Salvendy, Handbook of Industrial Engineering – Technology and operations Management, John Wiley & Sons, 2001.
3. Robert C Rosaler , Standard Handbook of Plant Engineering, Mc Graw Hill third Edition, 2004
4. R. Keith Mobley, Plant Engineer's Handbook, Technology and Engineering, 2001.

OUTCOMES:

At the end of the course, the student will be able to

- Review and correct P&IDs
- Do installation and commissioning of new plants
- Apply plant engineering in design and maintenance of water treatment plant / power plant etc

GECX109	NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students should be able to

- Discuss the basic concepts of computer security, model and attacks
- Examine the major types of threats and the associated attacks
- Identify the encryption techniques in real time applications
- Understand the special requirements for wireless security and how authentication is implemented in wireless systems
- Understand the functions of Network Security Device Firewall and its types
- Interpret the various network intrusion such as computer viruses, network worms etc

MODULE I INTRODUCTION 6

Computer Security Concepts - The OSI Security Architecture - Security Attacks - Security Services - Security Mechanisms - A Model for Network Security - Standards – classical encryption techniques.

MODULE II SYMMETRIC ENCRYPTION AND MESSAGE CONFIDENTIALITY 7

Symmetric Encryption Principles - Symmetric Block Encryption Algorithms - Random and Pseudorandom Numbers - Stream Ciphers and RC4 - Cipher Block Modes of Operation

MODULE III PUBLIC KEY CRYPTOGRAPHY AND MESSAGE AUTHENTICATION 8

Approaches to Message Authentication - Secure Hash Functions - Message Authentication Codes - Public-Key Cryptography Principles - Public-Key Cryptography Algorithms - Digital Signatures

MODULE IV KEY DISTRIBUTION ,USER AUTHENTICATION AND TRANSPORT-LEVEL SECURITY 8

Symmetric Key Distribution Using Symmetric Encryption - Kerberos - Key Distribution Using Asymmetric Encryption - X.509 Certificates - Public-Key Infrastructure -Federated Identity Management - Web Security Considerations -

Secure Socket Layer and Transport Layer Security - Transport Layer Security

MODULE V WIRELESS NETWORK SECURITY, ELECTRONIC MAIL SECURITY AND IP SECURITY 8

IEEE 802.11 Wireless LAN Overview -IEEE 802.11i Wireless LAN Security - Wireless Application Protocol Overview - Wireless Transport Layer Security - WAP End-to-End Security - Pretty Good Privacy - S/MIME – Domain Keys Identified Mail- IP Security Overview -IP Security Policy - Encapsulating Security Payload - Combining Security Associations - Internet Key Exchange - Cryptographic Suites

MODULE VI SYSTEM SECURITY 8

Intruders -Intrusion Detection -Password Management - Types of Malicious Software - Viruses Virus Countermeasures – Worms - Distributed Denial of Service Attacks- The Need for Firewalls - Firewall Characteristics - Types of Firewalls - Firewall Basing - Firewall Location and Configurations

L – 45; Total Hours –45

REFERENCES:

1. William Stallings,”Network security Essentials:Applications and standards“, Prentice Hall, Fifth Edition , ISBN-13: 978-0134527338, 2013

2. William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson, ISBN-13:978-0-273-79335-9,2013

3. Behrouz Forouzan, Debdeep Mukhopadhyay,Cryptography and network security (sie) 2nd edition, ISBN-13: 978-0070702080, 2016

4. Wikipedia, “Network Security and Management” , https://en.wikipedia.org/wiki/Book:Network Security and Management, 2014.

5. Nitesh Dhanjani, Justin Clarke, “Network Security Tools”, O'Reilly Media, ISBN-13: 9780596007942, 2005.

OUTCOMES:

Students who complete this course will be able to

- Recognize the computer security concepts, architecture attacks and model
- Distinguish the symmetric and asymmetric encryption techniques
- Apply the cryptographic algorithms in different applications
- Express the network security designs using available secure solutions such as PGP,SSL, IPSec, etc.
- Describe the firewalls principles and different types of firewalls applied in organization
- Identify abnormalities within the network caused by worms, viruses and Network related security treats.

GECX110	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit

  knowledge of highly mobile individual employees.

- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's

  knowledge base.

- Brings out the paradigm in terms of information technology and intellectual capital.

MODULE I KNOWLEDGE MANAGEMENT 6

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

MODULE III CAPTURING KNOWLEDGE AND SHARING 9

Tacit knowledge capture - Explicit knowledge codification – Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

MODULE IV KNOWLEDGE MANAGEMENT TOOLS 9

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery – Content management tools - Knowledge sharing and dissemination tools – Group ware and Collaboration tools - Intelligent filtering tools.

MODULE V KNOWLEDGE APPLICATION 6

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels – Knowledge repositories - Knowledge reuse -Case study: e-learning.

MODULE VI VALUE OF KNOWLEDGE MANAGEMENT 6

KM return on investment and metrics - Benchmarking method – Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

L – 45; Total Hours –45

TEXT BOOKS:

1. Elias M. Awad, Hassan M. Ghaziri, “Knowledge Management”, Prentice Hall, 2nd Edition, 2010.
2. Jay Liebowitz, “Handbooks on Knowledge Management”, 2nd Edition,

2012.

3. Irma Becerra-Fernandez, Rajiv Sabherwal, ”Knowledge Management: Systems and Processes”, 2010.

OUTCOMES:

Students who complete this course will be able to

- Describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
- Explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
- Critically evaluate current trends in knowledge management and apply it for e-learning

GECX111	**CYBER SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the basics of Cyber Security Standards and Policies.
- To know the legal, ethical and professional issues in Cyber security.
- To understand Cyber Frauds and Abuse and its Security Measures.
- To know the technological aspects of Cyber Security.

MODULE I FUNDAMENTALS OF CYBER SECURITY 7

Security problem in computing – Cryptography Basics – History of Encryption – Modern Methods – Legitimate versus Fraudulent Encryption methods – Encryption used in Internet.

MODULE II CYBERCRIME AND CYBEROFFENSES 8

Cybercrime and Information Security – Cybercriminals – Classifications of Cybercrimes – Email Spoofing – Spamming – Cyber defamation – Internet Time Theft – Forgery – Web jacking – Hacking – Online Frauds – Software Piracy – Mail Bombs – Password Sniffing – Cyberoffenses – Categories – Planning the attacks – Cyberstalking – Cybercafe and Cybercrimes – Botnets.

MODULE III CYBERCRIME: MOBILE AND WIRELESS DEVICES 8

Proliferation of Mobile and Wireless Devices – Trends in Mobility – Credit card frauds in Mobile and Wireless Computing – Security Challenges – Authentication Service Security – Attacks on Mobile Phones.

MODULE IV TOOLS AND METHODS USED IN CYBERCRIME 8

Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers and Spywares – Virus and Worms – Trojan Horses and Backdoors – Steganography – DoS and DDoS Attacks.

MODULE V SECURITY POLICIES 7

Introduction - Defining User Policies – Passwords – Internet Use – Email Usage

– Installing/ Uninstalling Software – Instant Messaging – Defining System Administrative Policies – Defining Access Control Developmental Policies Standards, Guidelines and Procedures – Basics of assessing a system

MODULE VI COMPUTER FORENSICS 7

General Guidelines – Finding Evidence on the PC - Finding Evidence in System Logs – Windows Logs – Linux Logs – Getting Back Deleted Files – Operating System Utilities – The Windows Registry.

L – 45; Total Hours –45

TEXT BOOKS:

1. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley, 2011.

2. Chuck Easttom, “Computer Security Fundamentals”, 2nd Edition, Pearson Education, 2012.

REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, 3rd Edition, Pearson Education, 2003.
2. William Stallings, “Cryptography and Network Security – Principles and Practices”, 3rd Edition, Pearson Education, 2003.
3. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill, 2000.

OUTCOMES:

Upon completion of this course, students will be able to

- Explain the general security issues.
- Discuss various cybercrimes and offenses.
- Outline the occurrence of Cybercrime in mobile and wireless environment.
- Use relevant tools and methods in cybercrime
- Apply security policies in cyber forensics.
- Outline the strategies adopted in computer forensics.

GECX112	GENETIC ENGINEERING	L	T	P	C
		4	0	0	4

OBJECTIVES:

The course aims to provide an advanced understanding of the core principles and topics of Cell and Organism reproduction and the Principles of heredity and their experimental basis, and to enable students to be able to apply these principles in assessment of pedigrees to identify genotypes and predict the mating outcomes.

MODULE I GENETICS AND ORGANISM 10

Genetics and human affairs, Genetics and Biology, Genes and Environment, Techniques of genetic analysis, The chromosome theory of heredity, Sex chromosomes, Sex linkage, The parallel behaviour of autosomal genes and chromosomes.

MODULE II MENDELISM AND LINKAGE 12

Mendel's laws of inheritance, Interaction of genes, Variations on dominance, Multiple alleles, Lethal alleles, Several genes affecting the same character, Penetrance and expressivity, Linkage- Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Examples of linkage maps.

MODULE III FINE STRUCTURE OF GENES 10

The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. The concept of extranuclear genome in higher plants and animals, Overview of mitochondrial genome, Chloroplast genome.

MODULE IV RECOMBINATION IN BACTERIA AND VIRUSES 10

Conjugation recombination and mapping the E.coli chromosomes, Transformation, Transduction, Chromosome mapping. Population genetics:

Darwin's revolution, Variation and its modulation, The effect of sexual reproduction on variation, The sources of variation, Selection quantitative genetics

MODULE V PRINCIPLES OF PLANT BREEDING 9

Objectives, Selfing and crossing techniques, Male sterility,Incompatability, Hybrid vigour.

MODULE VI HUMAN GENOME PROJECT 9

Genetic diseases in humans, Genetics and society

L – 45; T – 15; Total Hours –60

REFERENCES:

1. In Introduction to genetic analysis, Griffiths, Miller, Suzuki, Lewontin and Gelbart, Freeman and Company.
2. Genetics, A.V.S.S. Sambamurty, Narosa Publishing House.
3. Concepts of Genetics, Klug & Cummings, Prientice Hall.
4. Molecular Cloning, Moniatisetal, Cold Spring Harbor Laboratory.

OUTCOMES:

At the end of the course students will be able to

- Describe the structure, function and replication of DNA as the genetic material
- Describe gene structure, expression and regulation
- Describe the chromosomal basis of inheritance and how alterations in chromosome number or structure may arise during mitosis and meiosis

GECX113 FUNDAMENTALS OF PROJECT MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:

The students would gain knowledge on

- Technicalities attached to Project Management and Significance of Quality Consideration
- Project management methodologies – tools and techniques, supplemented with examples from case studies
- The importance of Efficient HR team and role of Communication in executing Projects.
- Managing Risks in Project Management

MODULE I INTRODUCTION TO PROJECT MANAGEMENT 9

Introduction to Project and Project Management-Project Management as a Career-Project Management Skill Sets-Project Scope Management: Project Charter, Scope Creep, Scope Validation, Scope Change Control-Type of Organization: Organization Structure-Influence of Organization Structure on Project, Project Stakeholders and Organizational Productivity.

MODULE II PROJECT MANAGEMENT PROCESS, TOOLS AND TECHNIQUES 8

Project life cycle-Initiation, Planning, Execution, Monitoring and Closing Phase; - Link between project management process, process groups and knowledge areas; Project management tools and techniques- Project Stakeholders description and mapping - Stakeholder Management Process

MODULE III PROJECT QUALITY, COST AND SCHEDULE MANAGEMENT 10

Triple constraints of project-quality, cost and schedule-Quality Planning, Quality Assurance and Quality Control, Process Control, Cost of Quality, Seven Tools of Quality Control- Cost Management: Cost Estimating Methods, Estimating Completion Cost, Earned Value Management, Budgeting, Life-Cycle Cost analysis- Project Time Management: Duration Estimation Method, FS/FF/SS/ SF Relations, Lead/Lag, Arrow Diagram Method and Precedence Diagram Method for Scheduling-Resource Allocation

MODULE IV PROJECT HR MANAGEMENT 5

Organizational Goals- (MBO/MBE/MBP)-Responsibility Assignment Matrix (RAM)-Types of Powers- Manage or Lead-Conflict management Techniques-Performance Evaluation Process-Motivation Theories and its Application for execution of Projects-Leadership Styles-Project Team Building-Project Staffing Constraints/Policies

MODULE V COMMUNICATION MANAGEMENT 5

Communication Management: Understanding Body languages of Project Personnel-Effective Communications- Interpersonal Skills for project Managers-PMIS-Communicating with the Customer-Communicating with Management- Formal vs. Informal Communications-Written, Verbal and Non-Verbal Communications.

MODULE VI PROJECT PROCUREMENT & RISK MANAGEMENT 8

Introduction to Project Procure Management: Soliciting RFQ/RFP-Contract Proposals-Contract Negotiation-Contract Closure-Risk Management: Defining risks-Risk management process-Risk identification-Qualitative and Quantitative Risk-Probability and Decision trees-Risk Response strategies / methods-Expected monetary value-Risk vs. life cycle phases

L – 45; Total Hours –45

REFERENCES:

1. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015
2. Bob Hughes, Mike Cotterrel “Software Project Management”, Tata

McGraw-Hill, 2009

OUTCOMES:

- Learners will be able to identify the Key Knowledge Areas and apply PM process in hypothetical project assignments given as continuous assessment.
- They would be able to suitably recognize tools and techniques required for various phases included in a project.
- They would also be able to manage scope, time, cost and other major components that would help them to execute the project efficiently.

GECX114	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge and training in optimization techniques.
- To get knowledge about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations

MODULE I LINEAR PROGRAMMING PROBLEM 8

Linear programming – formulation of the problem - graphical interpretation of optimality - Simplex method – to obtain basic feasible solution – types of linear programming solution – complications and their resolution.

MODULE II ARTIFICIAL VARIABLE AND TWO PHASE METHOD, DUALITY 6

Artificial variable - Big M method – Two phase method – alternative optimal solution – unbounded solution - Duality – primal dual relationships - rules of constructing the dual from primal.

MODULE III TRANSPORTATION PROBLEM & ASSIGNMENT PROBLE 8

Transportation problems – Initial basic feasible solutions, MODI method, Unbalance in transportation, Degeneracy in transportation models, Assignment problem – Minimization and Maximization type of problems by Hungarian method.

MODULE IV NETWORK AND SEQUENCING PROBLEMS 8

PERT and CPM – Network diagram – Fulkerson's rule - CPM Probability of achieving completion date – Crash time – Cost analysis. Sequencing N jobs through 2 machines and 3 machines.

MODULE V QUEUING THEORY & SIMULATION 7

Poisson arrivals and exponential service times – characteristics of Queuing models – single channel – Introduction to multi channel models – Random number generation – Monte Carlo Simulation.

MODULE VI INVENTORY CONTROL, REPLACEMENT MODELS AND GAME THEORY 8

Types of inventory- Inventory cost - EOQ - Deterministic inventory problems – Introduction to probabilistic models & system level inventory control - Replacement models – Replacement of items that deteriorate with time – value of money changing with time – not changing with time – Individual and group replacement policy - Game theory – simple games.

L – 45; Total Hours –45

TEXT BOOKS:

3. Hamdy ATaha, “Operations Research an introduction”, 8th edition, Phil Pearson, 2007.
4. Winston.W.L., “Operations Research”, 4th edition, Thompson-Brooks/Cole, 2003.

REFERENCES:

1. Wayne.L. Winston, “Operations Research applications and algorithms”, 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald.J.Lieberman, “Operations Research

concepts and cases", 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.

3. A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research:Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.

4. Robertazzi. T.G., "Computer networks and systems-Queuing theory and performance evaluation", 3rd edition, Springer, 2002.

OUTCOMES:

At the end of the course students will be able to

- solve linear programming problems
- solve transportation and assignment problems.
- solve network and sequencing problems.
- apply the operations research techniques to solve industrial problems.

GECX115	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of Nanoscience relevant to the field of engineering.
- To provide an exposure about the importance of various synthesis method.
- To enrich the knowledge of students in various characterisation techniques.

MODULE I INTRODUCTION & CLASSIFICATION OF NANOMATERIALS 9

Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic,transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

MODULE II TYPES OF NANOMATERIALS 9

Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

MODULE III PRODUCTION OF NANOPARTICLES 7

Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV CARBON BASED NANOMATERIALS 6

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

MODULE V NANOPHOTONICS 7

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

MODULE VI CHARACTERISATION TECHNIQUES 7

Basic principles of scanning Electron Microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

L – 45; Total Hours –45

TEXT BOOKS:

1. Hari Singh Nalwa, “Handbook of Nanostructured Materials and Nanotechnology”, Academic Press, 2000.
2. Guozhong Cao, “Nanostructures and Nano materials-Synthesis, Properties and Applications”, Imperial College Press (2011).
3. Zhong Lin Wang, “Handbook of Nanophase and Nanomaterials (Vol 1 and II)”, Springer, 2002.
4. Mick Wilson, Kamali Kannangara, Geoff smith, “Nanotechnology: Basic Science and Emerging Technologies”, Overseas press, 2005.

REFERENCES:

1. A. Nabok, “Organic and Inorganic Nanostructures”, Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: “Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, “Nano Technology – Basic Science and Emerging Technologies”, 1st

Edition, Overseas Press, New Delhi,2005.

4. M.S. Ramachandra Rao, Shubra SinghH, “Nanoscience and Nanotechnology: Fundamentals to Frontiers”, Wiley, 2013.

OUTCOMES:

At the end of this course, the students will be able to:

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

GECX116 VEHICLE MAINTENANCE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know about the various methods of maintaining procedure, vehicle insurance and basic problems in a vehicle.
- The student able to impart knowledge in maintaining of engine components and subsystems.
- The student able to impart knowledge in maintaining of transmission, driveline, steering, suspension, braking and wheels.
- The student able to impart **carefully maintaining their vehicle and can increase driving safety.**

MODULE I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS 7

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

MODULE II ENGINE AND ENGINE SUBSYSTEM 8 MAINTENANCE

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls.

MODULE III TRANSMISSION AND DRIVELINE 8 MAINTENANCE

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

MODULE IV STEERING AND SUSPENSION MAINTENANCE 7

Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, and power steering system.

MODULE V BRAKE AND WHEEL MAINTENANCE 7

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, parking brake. Bleeding of brakes. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation.

MODULE VI AUTO ELECTRICAL AND AIR CONDITIOING MAINTENANCE 8

Maintenance of batteries, starting system, charging system and body electrical - Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

L – 45; Total Hours –45

TEXT BOOKS:

1. Ed May, "Automotive Mechanics Volume One" , Mc Graw Hill Publications, 2003

2. Ed May, "Automotive Mechanics Volume Two" , Mc Graw Hill Publications, 2003
3. Vehicle Service Manuals of reputed manufacturers
4. Vehicle maintenance and garage practice by Jigar A.Doshi Dhru U.Panchal,Jayesh P.Maniar. 2014
5. A Practical Approach to Motor Vehicle Engineering and Maintenance 3rd Edition by Allan Bonnick.

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition, 2004.
2. Advanced Automotive Fault Diagnosis by Tom Denton 2011.
3. Nissan Patrol Automotive Repair Manual: 1998-2014 by Haynes Manuals Inc.
4. Automobile electrical manual a comprehensive guide by Haynes manual car repair.

OUTCOMES:

On completion of the course student should be able to

- Prepare maintenance schedules and procedures with appropriate tools.
- Demonstrate the procedure and methods to repair and calibrate the engine.
- **Analyze the causes and remedies for fault in transmission and drive line systems.**
- **Analyze the causes and remedies of steering and suspension systems.**
- **Analyze the causes and remedies of brake system.**
- **Demonstrate the procedure for wheel alignment and wheel balanced.**

GECX117 FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- Describe and explain basic principles of digital image processing
- Design and implement algorithms that perform basic image processing
- Design and implement algorithms for advanced image analysis
- Assess the performance of image processing algorithms and systems

PRE-REQUISITES:

- Basic knowledge of transforms in Mathematics

MODULE I DIGITAL IMAGE FUNDAMENTALS 8

Elements of Image Processing System, Fundamentals steps in Digital Image Processing, Image Sampling & Quantization, Spatial and Gray Level Resolution.

MODULE II COLOR IMAGE PROCESSING 8

Fundamental of color image processing, color models- RGB, CMY, HIS, Pseudo color image processing

MODULE III IMAGE ENHANCEMENT 7

Basic gray level Transformations, Histogram Processing, Spatial Filtering

MODULE IV IMAGE TRANSFORMS 7

2D-DFT, DCT, Haar Transform, Fundamentals of 2D-wavelet transform, sub-band coding

MODULE V IMAGE SEGMENTATION AND RESTORATION 8

Point, line and edge detection methods ,Image Segmentation and its types, Restoration: Noise model, Inverse filter and Wiener filter.

MODULE VI IMAGE COMPRESSION 7

Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, JPEG and MPEG Compression standards.

TOTAL HOURS 45

TEXT BOOKS

1. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
2. Anil. K. Jain, "Fundamentals of Digital Image Processing"; 4th Edition, PHI, 2007

REFERENCES

1. Pratt William, "Digital Image Processing", John Wiley & Sons, 2007.
2. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", PHI, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Explain the fundamental concepts of digital image processing.
- Discuss about color image processing
- Recognize & apply various image enhancement techniques.
- Apply various transforms for image processing.

- Apply various techniques for image segmentation and restoration.
- Identify and use appropriate image compression techniques

Group II courses

(To be offered in VII Semester)

GECX201 GREEN DESIGN AND SUSTAINABILITY L T P C 3 0 0 3

OBJECTIVES:

- To impart knowledge to face challenges, the technology poses for water, energy, and climate change by implementing sustainable design.

MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 7

Objectives of Sustainable Development - Need for sustainable development-Environment and development linkages - Globalisation and environment-Population, poverty and pollution- global, regional and local environment issues-Green house gases and climate change.

MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO 8 ECONOMIC SYSTEMS

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth- Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

MODULE III FRAME WORK FOR ACHIEVING SUSTAINBAILITY 7

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

MODULE IV GREEN BUILDINGS 8

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

MODULE V ENERGY CONSERVATION AND EFFICIENCY 7

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation-Energy conservation measures for buildings- Energy wastage- impact to the environment.

MODULE VI GREEN BUILDINGS DESIGN 8

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

L – 45; Total Hours –45

TEXT BOOKS:

1. Kirby, J., Okeefe, P., and Timber lake, “Sustainable Development”, Earthscan Publication, London, 1995.

REFERENCES:

1. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 2^{nd} Edition, John Wiley and sons, 2007.

OUTCOMES:

At the end of the course, the students will be able to

- Explain the relationship between sustainability and emergence of green building practices.
- Address the economic, environmental, and social concerns.

GECX202	APPROPRIATE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart students knowledge about the basics and applications of various appropriate technologies in the field of civil engineering.

MODULE I BASICS CONCEPTS 7

Back ground, Tools, Choices and Implications, Appropriate Technology Movement (an overview) - Basic design process, basic financial analysis-discounted cash flow, and energy fundamentals.

MODULE II APPROPRIATE TECHNOLOGY WITH REFERENCE 7 TO BUILDING DESIGN

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

MODULE III WATER, HEALTH AND SANITATION 7 MANAGEMENT

Water Storage: Designing Dams and Pipelines, Appropriate Selection for Sanitation Technique, Sewerage, Communal Health and Waste Water Recycling.

MODULE IV WASTE MANAGEMENT 8

Types of Waste - Sources - Collections and On-Site Processing -Transferring Stations - Disposal Systems - Recycling.

MODULE V ENERGY EFFICIENT TECHNIQUES 8

Green building concepts-renewable energy sources- Solar – Steam and wind-Biofuels - Biogas – Electricity.

MODULE VI TECHNOLOGY POLICY 8

Government Policies- Energy Policy-Appropriate technology Development Centre-its function and responsibilities-Building policies-Case Studies.

L – 45; Total Hours –45

TEXT BOOKS:

1. Barrett Hazeltine and Christopher Bull, "Appropriate Technology: Tools Choices and Implications", Academic Press, Orlando, USA, 1998.

2. Ken Darrow and Mike Saxenian, "Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology", Stanford, 1986.

REFERENCES:

1. Richard Heeks, "Technology and Developing Countries: Practical Applications Theoretical Issues", 1995.

2. John Pickford, "The Worth of Water : Technical Briefs on Health, Water and Sanitation", Intermediate Technology Publications, 1998.

OUTCOMES:

- At the end of the course, the students will be able to use suitable technologies for various conditions for sustainable development.

GECX203 ENGINEERING SYSTEM MODELLING AND SIMULATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the concepts, techniques, tools for modeling and simulation systems and environments through the use of computers.
- To study the various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

MODULE I INTRODUCTION 6

Systems – Modelling – types – systems components – Steps in model building-Simulation Algorithms and Heuristics; Simulation Languages.

MODULE II RANDOM NUMBERS / VARIATES 7

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc. – Testing of Random variates – Monte Carlo Simulation.

MODULE III MODELLING PROCESS 7

Primitive Models : Establishing relationships via physical laws; Establishing relationships via curve fitting; Parameters estimation problems; Elementary state transition models.

MODULE IV DESIGN OF SIMULATION EXPERIMENTS 9

Steps on Design of Simulation Experiments – Development of models using of Highlevel language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

MODULE V SIMULATION LANGUAGES 10

Need for simulation Languages – Comparisons & Selection of Languages – GPSSARENA- EXTEND – Study of any one of the languages.

MODULE VI CASE STUDIES USING SIMULATION LANGUAGES 6

Case Study using simulation languages

L – 45; Total Hours –45

REFERENCES:

1. Law, A.M., & W.D. Kelton, "Simulation Modelling and Analysis", McGraw Hill, Singapore, 2000.

2. Harrel, C.R., et. al., "System Improvement Using Simulation", 3rd Edition, JMI Consulting Group and ProModel Corporation, 1995.

3. Harrel, C.R. & T. Kerim, "Simulation Made Easy, A Manager's Guide", IIE Press, 1995.

4. Geoffrey Gordon, "Systems Simulation", Prentice Hall, 2002.

5. David Kelton, Rondall P Sadowski, David T Sturrock, "Simulation with Arena", Mc Graw Hill, 2004.

OUTCOMES:

The student should be able to

- Model and simulate systems and environments through the use of computers.
- Conduct experiments with discrete dynamic, stochastic system models on a computer.

GECX204 VALUE ANALYSIS AND ENGINEERINGL T P C

3 0 0 3

OBJECTIVES:

- To get acquainted with value analysis and engineering tool for productivity improvement.
- To understand and analyze the theory and methodology of Value Engineering.

MODULE I VALUE ENGINEERING BASICS 8

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity In Value Engineering.

MODULE II VALUE ENGINEERING JOB PLAN AND PROCESS 6

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

MODULE III ORIENTATION AND INFORMATION PHASES 8

Launching Value Engineering project work - Objectives and Targets - VE Project work: a time-bound programme - Projects and Teams - Time Schedule - Co-ordination - Consultant. Technical data - Marketing related information - Competition profile - Cost data - Materials Management related information - Quality related information - Manufacturing data.

MODULE IV FUNCTION ANALYSIS AND CREATIVE PHASES 9

Objectives - Function definition - Classification of functions - Higher level functions – Function – Cost – Function – Worth - Value Gap - Value index - How to carry out Function Analysis? – Fast Diagraming - Cost Modelling.

Creativity - How to improve creativity of an individual? – How to promote creativity in the organisation? - Obstacles to Creativity - Mental road blocks - Creativity killer phrases. Positive thinking - Ideas stimulators - Creativity techniques - Brainstorming.

MODULE V EVALUATION, INVESTIGATION AND RECOMMENDATION 6

Paired comparison and Evaluation Matrix techniques - Criteria for selection of VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES 8

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

L – 45; Total Hours –45

TEXT BOOKS:

1. Mudge, Arthur E. “Value Engineering- A systematic approach”, McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), “Value Engineering”, Narosa Publishing House, 2005.

REFERENCES:

1. Park RJ, “Value Engineering: A Plan for Invention”, St.Lucie Press, New York, 1999.

2. Lawrence, D.M., “Techniques of Value Analysis and Engineering”, McGraw Hill 1988.

3. George, E.D., “Engineering Design: a Material and Processing Approach”, McGraw Hill, 1991.

4. Heller, D.E., “Value Management, Value Engineering and Cost Reduction”, Addison Wesley, 1988.

OUTCOMES:

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.

GECX205	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various safety measures to be taken in different industrial environments.

MODULE I SAFETY MANAGEMENT 7

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

MODULE II SAFETY IN MANUFACTURING 7

Safety in metal working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

MODULE III SAFETY IN CONSTRUCTION 8

General safety consideration in Excavation, foundation and utilities – Cordoning

– Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

MODULE IV ELECTRICAL SAFETY 8

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

MODULE V SAFETY IN MATERIAL HANDLING 8

General safety consideration in material handling devices - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.

Storage and Retrieval of common goods of shapes and sizes in a general store of a big industry.

MODULE VI SAFETY EDUCATION AND TRAINING 7

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

L – 45; Total Hours –45

REFERENCES:

1. Krishnan N.V, “Safety Management in Industry”, Jaico Publishing House, Bombay, 1997.

2. Blake R.B., “Industrial Safety”, Prentice Hall, Inc., New Jersey, 1973.
3. Fulman J.B., “Construction Safety, Security, and Loss Prevention”, John Wiley and Sons, 1979.
4. Fordham Cooper W., “Electrical Safety Engineering”, Butterworths, London, 1986.
5. Alexandrov M.P., “Material Handling Equipment”, Mir Publishers, Moscow, 1981.

OUTCOMES:

Students would be able to

- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.

GECX206	ADVANCED OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the various advanced optimization tools.
- To provide an understanding to deal with ill identified and fuzzy problems.

MODULE I INTRODUCTION 7

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

MODULE II HEURISTICS METHODS 8

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming

– Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing.

MODULE III GENETIC ALGORITHM 7

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation -genetic algorithms in search, optimization and machine learning-practical genetic algorithms.

MODULE IV ANT COLONY OPTIMIZATION 8

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History

– The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant

colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring – Advantages & Disadvantages

MODULE V FUZZY LOGIC AND ANN 8

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations

– Design example – Biological foundations to intelligent systems: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

MODULE VI IMPLEMENTATIONS & APPLICATIONS 7

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

L – 45; Total Hours –45

REFERENCES:

1. Singiresu S. Rao, “Engineering optimization – Theory and practices”, John Wiley and Sons, 1996.
2. Ravindran – Phillips –Solberg, “Operations Research – Principles and Practice, John Wiley and Sons, 1987.
3. Fredrick S.Hillier and G.J.Liberman, “Introduction to Operations Research”, McGraw Hill Inc. 1995.
4. Kalymanoy Deb, “Optimization for Engineering Design”, PHI, 2003
5. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006

OUTCOMES:

At the end of the course student will be able to

1. Formulate a real life situation as an optimization the problem.
2. Identify the appropriate solution methodology and provide a solution

GECX207	MATLAB SIMULINK	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

MODULE I INTRODUCTION MATLAB DATA PRESENTATION 7

Vectors, Matrices -Vector/Matrix Operations & Manipulation- Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically- Least squares regression -Curve fitting.

MODULE II MATLAB PLOT FUNCTION 7

Introduction- Plot Function – Animation- 3D Plots-Customizing Plots – Plot Applications- Saving &Painting Plots.

MODULE III ROOT FINDING AND COMPUTER 7 REPRESENTATION OF NUMBERS

Linearization and solving non-linear systems of equations- The Newton-Rapson method- Integers and rational numbers in different bases- Floating point numbers- Round off and errors in basic arithmetic-Significant digits when reporting results

MODULE IV ORDINARY DIFFERENTIAL EQUATIONS 8

Numerical integration and solving 1st order, ordinary differential equations (Euler's method and Runge-Kutta)- Use of ODE function in MATLAB

MODULE V NON-LINEAR DIFFERENTIAL EQUATIONS 8

Converting 2nd order and higher ODEs to systems of 1st order ODEs- Solving systems of ODEs via Euler's method and Runge-Kutta)- Solving single and systems of non-linear differential equations by linearization-Use of the function ODE in MATLAB to solve differential equations

MODULE VI INTRODUCTION OF SIMULINK 8

Simulink & its relations to MATLAB – Modeling a Electrical Circuit- Modeling a fourth order differential equations- Modeling the solution of three equations with three unknowns- Representing a model as a subsystem-Simulink demos.

L – 45; Total Hours –45

REFERENCES:

1. Griffiths D V and Smith I M, Numerical Methods for Engineers, Blackwell, 1991.
2. Laurene Fausett, Applied Numerical Analysis Using MATLAB, Pearson 2008.
3. Moin P, Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB. CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving , Mathematical Exploration with MATLAB, Cambridge University Press, 1999.

OUTCOMES:

At the end of this unit students will be able to:

1. Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
2. Write programs using first principles without automatic use of built-in ones.
3. Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
4. Be fluent in exploring Matlab's capabilities, such as using matrices as the fundamental data-storage unit, array manipulation, control flow, script and function m-files, function handles, graphical output.
5. Make use of Maltab visual capabilities for all engineering applications.
6. An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering fields

GECX208	EMBEDDED SYSTEMS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a detailed overview of embedded system.
- To equip students with the software development skills necessary for practitioners in the embedded systems field.
- To understand entire software development lifecycle and examine the various issues involved in developing software for embedded systems.

MODULE I EMBEDDED SYSTEMS OVERVIEW 8

Introduction –Embedded Systems vs. General computing systems- Fundamental Components of embedded systems- Characteristics- Challenges-Examples-Embedded System design process.

MODULE II EMBEDDED COMPUTING PLATFORM 8

Overview of Processors and hardware units in an embedded system-CPU buses –

Memory devices –Memory types- I/O devices – Designing with computing platforms-

Consumer electronics architecture-Design example: Alarm clock.

MODULE III REAL TIME EMBEDDED SYSTEMS 8

Programming embedded systems in assembly and C – Real time systems – Hard and Soft real time systems- Need for RTOS in Embedded Systems- Multiple tasks and processes –Context switching-Scheduling policies- Interprocess communication and synchronization.

MODULE IV EMBEDDED SOFTWARE DEVELOPMENT PROCESS 8 and TOOLS

Development process of an embedded system-software modules and tools for implementation of an embedded system- Integrated development environment- Host and target machines-cross compiler-cross assembler-Choosing right platform.

MODULE V PROGRAM MODELING IN EMBEDDED SYSTEMS 8

Program Models – Data Flow Graph model-control DFG model-Synchronous DFG model- Finite state machines- UML modeling – UML Diagrams.

MODULE VI EMBEDDED SYSTEMS APPLICATION 5

Application specific embedded system – case study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card.

Total Hours –45

TEXT BOOKS:

1. Marilyn Wolf , "Computers as components", Elsevier 2012.

2. Shibu. K.V, “Introduction to Embedded Systems”, Tata Mcgraw Hill,2009.

3. Rajkamal, "Embedded Systems Architecture, Programming and Design",1st Reprint,Tata McGraw-Hill, 2003

4. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.

REFERENCES:

1. Sriram V Iyer and PankajGupta ,”Embedded Realtime Systems Programming ”Tata McGraw-Hill,2008

2. Qing Li and Carolyn Yao," Real-Time Concepts for Embedded Systems", CMPBooks, 2003

3. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003

OUTCOMES:

On completion of this course, the students will be able to

- Identify the suitable processor and peripherals in embedded applications
- Develop embedded programs in assembly and c
- Choose the right platform for designing an embedded system
- Explore different scheduling mechanism in rtos
- Design the program model for embedded applications.
- Analyze different domain specific applications in embedded systems.

GECX209	USABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

MODULE I INTRODUCTION 6

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

MODULE II USER INTERFACES 8

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

MODULE III INTERACTION DESIGN 8

Process of Interaction Design - Establishing Requirements – Design,Prototyping and Construction - Evaluation and Framework.

MODULE IV USABILITY TESTING 8

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability

Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

MODULE V USABILITY ASSESSMENT METHODS 8

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual Use, User Feedback, Usability Methods – Interface Standards - National, International and Vendor Standards, Producing Usable In-House Standards.

MODULE VI USER INTERFACES 7

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces

– Future Developments – Case Study.

L – 45; Total Hours –45

TEXT BOOKS:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, "Interaction Design: Beyond Human - Computer Interaction", John Wiley & Sons, 3rd Edition, 2011 (Module I, II, III).

2. Jakob Nielsen, "Usability Engineering", Morgan Kaufmann Academic Press, 1994. (Module I – VI).

REFERENCES:

1. Ben Shneiderman, Plaisant, Cohen, Jacobs, "Designing the User Interface: Strategies for Effective Human Interaction", Pearson Education,

5th Edition, 2010.

2. Laura M. Leventhal, Julie A. Barnes, “Usability Engineering: Process, Products, and Examples”, Pearson/Prentice Hall, 2008

OUTCOMES:

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

GECX210 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

MODULE I INTRODUCTION TO SUPPLY CHAIN 7

Understanding Supply Chain - Decision phases - Supply chain performance - Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

MODULE II SUPPLY CHAIN DRIVERS AND DESIGN 7

Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

MODULE III AGGREGATE PLANNING AND MANAGING 8

SUPPLY, DEMAND AND INVENTORY

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

MODULE IV MANAGING INVENTORY IN SUPPLY CHAIN 8

Managing Economies of Scale in a Supply Chain : Cycle Inventory- Managing uncertainty in a Supply Chain Safety Inventory- Determining optimal level of Product Availability

MODULE V SOURCING AND TRANSPORTATION 8

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers

- Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

MODULE VI INFORMATION TECHNOLOGY IN A SUPPLY CHAIN 7

Information technology in a supply chain – CRM, ISCM, SRM in supply chain - Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

L – 45; Total Hours –45

REFERENCES:

1. Sunil Chopra and Peter Meindl, “Supply Chain Management-Strategy Planning and Operation”, Pearson Education, 5th Indian Reprint, 2013.
2. Jananth Shah “Supply Chain Management – Text and Cases“ Pearson Education, 2008.
3. Altekar Rahul V, “Supply Chain Management-Concept and Cases”, Prentice Hall India, 2005.
4. Monczka et al., “Purchasing and Supply Chain Management”, Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

OUTCOMES:

- After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.
- The student decision making capability specific to supply chain issues in an industry is improved.
- The student can plan a well defined execution of supply chain strategy in companies.
- The student will be able to design a optimal distribution network as per the demands of the industry.
- The student can also determine the most favorable transportation plan for a company.
- The student will also be able to bring in company from paper environment to paperless environment.

GECX211	SYSTEMS ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the phases of the systems development life cycle
- To teach the automated tools for system development
- To develop and evaluate system requirements.
- To explain the organizational issues in system implementation
- To teach the usability testing and electronic data interchange
- To elucidate the importance of System analysis and design in electronic commerce.

MODULE I FUNDAMENTALS OF SYSTEM DEVELOPMENT 8

System Concept – Characteristics – Elements of System – Types of System – Modern Approach to System Analysis and Design – System Development Life Cycle – Approaches to Improving Development – Tools for System Development – Succeeding as a System Analyst – Skills – Managing the Project.

MODULE II AUTOMATED TOOLS FOR SYSTEMS 7 DEVELOPMENT

What is requirements determination? Fact finding techniques, Tools for documenting procedure and decision-CASE Tools-Need for CASE tools-Reverse engineering and reengineering- phases of the software life cycle-Ranking projects-Value Chain Analysis- Corporate Strategic Planning vs. Information Systems Planning.

MODULE III SYSTEM ANALYSIS 8

Determining System Requirements – Traditional Methods - Modern Methods – Radical Methods – Structuring System Requirements – Process Modeling – Data Flow Diagramming – Logic Modeling – Conceptual Data Modeling – E-R Modeling.

MODULE IV SYSTEM DESIGN 8

System Implementation – Software Application Testing – Installation – Documentation – Training and Support – Organizational Issues in Systems Implementation – Maintaining Information System – Conducting System - Maintenance

MODULE V USABILITY AND MEASURING USER SATISFACTION 7

Usability Testing-User satisfaction test- A tool for analyzing user satisfaction – Unified Modeling Language(UML)- Case study: System Design: Application in Human Resource-Financial Applications

MODULE VI SAD IN E-COMMERCE 7

Systems analysis and design in the era of electronic commerce: B2B, B2C and C2C e-commerce -advantages and disadvantages of e-commerce. E-commerce system architecture – physical networks, logical network, World Wide Web, web-services - HTML, XML - case studies-EI electronic data interchange: EDI standards - virtual private networks - XML and EDI

L – 45; Total Hours –45

REFERENCES:

1. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, “Modern Systems Analysis and Design”,Fifth Edition, Prentice Hall,March 2007.

2.Ned Kock, “Systems Analysis & Design Fundamentals” Sage South Asia, May

2008.

3. Joseph S. Valacich, Jeffrey A. Hoffer, Joey F. George, “Essentials Of System Analysis And Design” Prentice Hall , August 2005.

4. Rumbaugh et al, “Succeeding with Booch and Rambaugh Methods”, Addisson Wesley, second Edition, 1998.

5.Larman, C.,” Applying UML and Patterns. An introduction to Object-Oriented Analysis and Design”. Prentice-Hall PTR, 2002.

OUTCOMES:

- List the characteristics of the system and specify the approaches in the development of the system.
- Summarize the phases of the software life cycle
- Differentiate Corporate Strategic Planning and Information Systems Planning.
- Illustrate the system requirements through various modeling diagrams.
- Use tools and techniques for process and data modeling.
- Solve realistic systems analysis problems and perform user satisfaction test.

GECX212 ADVANCED MATERIALS L T P C 3 0 0 3

OBJECTIVES:

To make the student conversant with

- Dielectric materials
- Magnetic materials
- Energy materials
- Nano materials
- Semi conductors
- Smart materials

MODULE I 8

Dielectric Materials- Polarization and Mechanism-Internal or local field-Clausius-Mossotti relation- Dielectric loss- Temperature and Frequency effect-Measurement of Dielectric constant and loss using Scherring bridge- electric break down- ferro, piezo, pyroelectric materials and its application.

MODULE II 8

Magnetic Materials- Terminology and classification of magnetic materials (Dia, Para, Ferro & Ferri) – Magnetic moments due to electrospin – Domain theory of Hysteresis – Heisenberg theory of Exchange Interaction (without derivation)-Structure and properties of Ferrites- Properties of Soft and Hard Magnetic Materials- Application: floppy disk, CD ROM, Magneto optical recording.

MODULE III 8

Energy Materials (Nuclear) - Introduction to nuclear materials- Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials- Control &

Construction Materials for Nuclear reactors, Moderators, Heat Exchangers- Radiation proof materials- Brief discussion of safety and radioactive waste disposal.

MODULE IV **7**

Nano Materials- The nanosize range- classification of nanomaterials-processing of nanomaterials-properties of nanomaterials- mechanical, electrical, magnetic properties- other properties- carbon based nanomaterials- other nanomaterials and its application.

MODULE V **7**

Semiconductors- The energy gap in solids-Extrinsic Semiconductors- Intrinsic Semiconductors- Hall Effect in semiconductors- Application of Hall Effect- Basic ideas of compound semiconductors -Semiconductor materials- Fabrication of Integrated Circuits- Some semiconductor Devices

MODULE VI **7**

Smart materials- aerospace materials Ni and Co based super alloys, Special steels, Titanium alloys, Intermetallics, ceramics and their composites, New High strength material, Properties of Materials, Materials in Medical Applications, Stainless steel alloys,Cobalt based alloys, titanium based alloys, polymers

L – 45; Total Hours –45

REFERENCES:

1. Materials science and Engineering: A first course by V. RAGHAVAN, 6th ed., Eastern Economy edition,Prentice Hall of India,2015
2. Materials science and Engineering: An Introduction by William D. Callister Jr., 7th ed. John Wiley & Sons Inc. 2007
3. Material science by Dr.M.Arumugam, Anurasha agencies ,third revised edition ,2002

OUTCOMES:

Students will be able to know

- significance of dielectric materials
- types and applications of magnetic materials
- applications of nuclear materials for energy harvesting
- applications of nano materials
- significance of semi conductor devices
- applications of smart materials

GECX213 NATIONAL SERVICE SCHEME

L	T	P	C
2	0	0	2

OBJECTIVES:

Primary Objective: Personality development through community service.

To achieve the above objective, the following should be adhered:

1. To provide an understanding about the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
2. To develop certain basic skills for personality development through community development.
3. Understand the community in which they work and their relation
4. Identify the needs and problems of the community and involve them in problem-solving and
5. Practice national integration and social harmony.

MODULE I INTRODUCTION TO NSS 8

Orientation and structure of NSS,-Aims and Objectives of National Service Scheme- The history of NSS- Symbol and meaning- NSS hierarchy from national to college level – Role and responsibilities of various NSS functionaries

MODULE II PERSONALITY AND COMMUNITY DEVELOPMENT 8 SKILLS

Importance of youth Leadership, Traits of Good Leadership and Personality Development. Role of youth in creating awareness through NSS Programmes on Health & Hygiene; Environmental Conservation and Enrichment for Sustainable Development; Sanitation and Swachh Bharat.

MODULE III UNDERSTANDING YOUTH 7

Definition and Profiles of youth categories, Youth Issues, Challenges and Opportunities for Youth, Youth as agent of social change & Community Mobilization .Role of Youth in Nation Building. National Youth Policy.

MODULE IV SOCIAL HARMONY AND NATIONAL INTEGRATION 7

National Integration, Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc. Role of youth in Peace building and conflict resolution- Globalization and its Economic Social Political and

Cultural impacts.

L – 30; Total Hours –30

TEXT BOOKS:

1. National Service Scheme – A Youth Volunteers Programme for Under Graduate students as per UGC guidelines J.D.S.Panwar et al. Astral International. New Delhi.
2. National Service Scheme Revised Manual, 2006.Govt. of India. Ministry of Youth Affairs & Sports. New Delhi.
3. Social Problems in India, *Ram Ahuja.*

REFERENCES:

1. National Youth Policy-2014. Ministry of Youth Affairs & Sports. .Govt. of India

OUTCOMES:

On successful completion of this course-

- Students will have exposure to the the aims, structure and programmes and activities of National Service scheme in terms of Nation Building

- Students will be trained to skills for personality development through community development.

- Students will gain knowledge about national integration and social harmony.

- Students will be exposed to the role of youths in Nation building Students will gain

GECX214	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To have a fair knowledge in automotive pollution control.
- To understand the concept of formation and control techniques of pollutants like UBHC, CO, NOx, particulate matter and smoke for both SI and CI engine will be taught to the students.
- To know about the instruments for measurement of pollutants
- To get introduced about emission standards

MODULE I EMISSION FROM AUTOMOBILES 8

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of ollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

MODULE II SI ENGINE EMISSIONS AND CONTROL 9

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, Positive Crank case ventilation system, Secondary air injection, thermal reactor

MODULE III CI ENGINE EMISSION AND CONTROL 8

Formation of White, Blue, and Black Smokes, NOx, soot, Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

MODULE IV NOISE POLLUTION FROM AUTOMOBILES 8

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aerodynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction —Silencer Design.

MODULE V TEST PROCEDURES 6

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dynamometers - Seven mode and thirteen mode cycles for Emission Sampling.

MODULE VI EMISSION MEASUREMENTS 6

Emission analysers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

L – 45; Total Hours –45

TEXT BOOKS:

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.

2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company., Newyork 1993.

REFERENCES:

1. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York. 1986.
2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.
3. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
4. C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.
5. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise',

   Applied science publisher ltd., London,1987.

OUTCOMES:

On completion of the course student should be able to

- Identify the sources of emission from vehicles.
- Analyse the causes and effects of emissions.
- Analyse causes and effects of noise pollution
- Bring out solutions for control of emissions.
- Demonstrate the test procedures and emission norms.
- Select suitable instruments for measurement of emissions.

GECX215 MOTOR VEHICLE ACT, INSURANCE & POLICY

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To learn about basic act and regulation followed for road vehicle
- To learn about systematic steps involved to get licence and registration of motor vehicle
- To learn arbour various types of motor vehicle polices and insurances

MODULE I BASIC RULES FOR ROAD VEHICLE 8

Display and Use of Number Plates- Attachment of number plates- Number plates in horizontal position- Removal of number plates on transfer- Hours prescribed for lighted lamps- Mounting of lamps and reflectors- Multiple beam headlamps- Daytime running lamps- Auxiliary driving lamps- Parking lamps- Brakes- Stopping distances- Emergency or parking brakes- Horn- Muffler- Mirrors- Inspection of motor vehicles- Standards of safety and repair

MODULE II LICENSING OF DRIVERS OF MOTOR VEHICLES 8

Necessity of driving licence- Age limit in connection with driving of motor vehicle-Responsibility of owners of motor vehicles-Restriction on the holding of driving licence-Grant of learner's licence-Grant of driving licence-Addition to driving licence- Renewal of driving licence-Revocation of driving licence on grounds of disease or disability-Driving licence to drive motor vehicle belonging to the central government- power of court to disqualify- suspension of driving licence in certain cases- suspension or cancellation of driving licence on convection- Endorsement.

MODULE III REGISTRATION OF MOTOR VEHICLE 7

Necessity for registration – Registration Where and how to be made- Special provision for registration of motor vehicle of diplomatic officers-Temporary registration- Production of vehicle at the time of registration- Refusal of registration- renewal of certificate of registration- effectiveness in India of registration- Change of residence or place of business-transfer of ownership-Suspension of registration – cancellation of registration suspended under section 53- certificate of fitness of transport vehicle-cancellation of registration.

MODULE IV INSURANCE OF MOTOR VEHICLE 8

Necessity for insurance against third party – Requirements of policies and limits of liability- - Duty of insurers to satisfy judgements and awards against person insured in respect of third party risks-Duty to give information as to insurance-Settlement between insurers and insured persons- transfer of certificate of insurance-production of certain certificates, licences and permit in certain cases-Special provisions as to compensation in case of hit and run motor accident – Types of motor polices

MODULE V CONTROL OF TRANSPORT VEHICLES 7

Power to State Government to control road transport- Transport authorities-General provision as to applications for permits- Application for stage carriage permit- Procedure of Regional Transport Authority in considering application for stage carriage permit- Scheme for renting of motor cabs- Application for private service vehicle permit- Procedure in applying for and granting permits- Duration and renewal of permits- Transfer of permit- Replacement of vehicles-Temporary permits

MODULE VI OFFENCES AND PUNISHMENT 7

Driving without holding an effective driving licence- Driving by an under-aged person (Minor driving vehicle)- Holding of a driving licence permitting it to be

used by other person.- Driving a vehicle at an excessive speed- Driving or permitting to drive a vehicle carrying excess load- Driving dangerously / its Abetment Driving an uninsured vehicle

Rider and pillion rider failing to wear protective head gear (Helmet) -Violation of Mandatory Signs -.e-challan and spot challan

L – 45; Total Hours –45

TEXT BOOKS:

1. The motor vehicle act 1988, Universal law publishing co.cpvt ltd. Newdelhi 2011
2. A Commentary On The Motor Vehicles Act, 1988 by SUKHDEV AGGARWAL The Bright Law House, New Delhi

REFERENCES:

1. The Motor Vehicles Act, 1988 Along with Latest Case Law, Notifications & Table of Offences and Punishments Asia Law House; 15th edition (2014)
2. Assessment of Compensation in Accidents under Motor Vehicles Act by Karkara Delhi Law House (2013)

OUTCOMES:

On completion of the course students should be able to

- Explain the analysis of rules and regulations for road vehicles
- Analyze the procedure for getting driving license for vehicles at national and international level
- Analyze the procedure for registration of vehicles.
- Analyze the procedure for Insurance of vehicles and claims.
- Analyze the procedure for obtaining Government Permits and renewal
- Analyze the consequences of not following the rules and regulations

GECX216	PRINCIPLES OF COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To introduce the analog and digital modulation techniques.

To elaborate the working of communication receivers in the presence of noise.

To give an overview of various communication systems.

MODULE I LINEAR MODULATION 8

Baseband signals, Amplitude Modulation – Modulation Index, Power Transmitted, Double Side Band and Single Side Band AM, AM Modulators and AM Receivers, AM Radio systems, Frequency Division Multiplexing.

MODULE II ANGLE MODULATION 8

Frequency Modulation and Phase Modulation, Frequency deviation and modulation index, Bandwidth of FM, FM Modulators and FM receivers, FM Radio and FM Stereo Systems

MODULE III SAMPLING AND PULSE MODULATION 7

Sampling, Nyquist's Sampling Theorem, Pulse Modulations - PAM, PPM and PWM, Time Division Multiplexing, Bandwidth of TDM systems.

MODULE IV DIGITAL COMMUNICATION 7

Digital baseband data, Digital Modulations – ASK, FSK, PSK and QPSK. Digital Communication Transmitters and Receivers.

MODULE V NOISE 8

Sources of Noise, Thermal Noise, shot noise, White noise, Narrow band Noise, Effect of noise in communication, SNR, Receiver Noise Temperature and Noise Equivalent Bandwidth.

MODULE VI COMMUNICATION SYSTEMS & NETWORK 7

FM Radio Systems, Cellular Mobile network, Satellite Communications, Optical Fiber Communication.

L – 45; T – 0; Total Hours – 45

TEXT BOOKS:

1. A. Bruce Carlson, Paul B. Crilly, "Communication Systems", 5th Edition, McGraw Hill Int., 2011.
2. B.P. Lathi, Zhi Ding, Hari M. Gupta, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2017.

REFERENCES:

1. Herbert Taub, Donald L. Schilling, Goutam Saha, "Principles of Communication Systems" 4th Edition, McGraw Hill Int. 2013.
2. Simon Haykin, "An Introduction To Analog And Digital Communications", 1st Edition, Wiley India, 2010.
3. Simon Haykin , "Communications Systems" 4th Edition, Wiley India, 2006.
4. Hwei P. Hsu, "Analog and Digital Communications" 3rd Edition,

OUTCOMES:

On completion of the course students will be able to

1. Identify various communication systems and the corresponding modulation schemes.
2. Predict the characteristics of various analog and digital modulation schemes.
3. Interpret the effect of noise and bandwidth in a communication systems
4. Apply the Nyquist criteria for a given baseband signals.
5. Evaluate the performance of communication receivers.
6. Demonstrate the applications of common communication systems.

GECX217	LEAN MANAGEMENT	L	T	P	C
		3	1	0	4

OBJECTIVES:

The objective of the Course to make the student know about

- the basics of lean production management,
- how Lean principles are applied to the Construction industry to improve the operation management and product development.

MODULE I **8**

lean production? – Introduction, background, and lean thinking. Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production System.

MODULE II **8**

Manufacturing systems – an overview of manufacturing strategies. Job shops, batch flow, and flexible manufacturing systems Flow production and lean production systems

MODULE III **7**

Value stream mapping in process design and product development Waste reduction - lead time reduction

Process cycle time and value-added vs. non-value added activities Optimum lot sizing

MODULE IV **8**

Lean production processes, approaches and techniques.—Importance of focusing upon flow. Tools -. Workplace organization – 5S. - Stability. - Just-In-Time – One piece flow – Pull. - . Cellular systems. - . Quick change and set-up reduction methods. f. Total productive maintenance. -. Poka-Yoke – mistake proofing, quality

improvement. Standards. - . Leveling. - . Visual management. Just-in-time techniques – SMED and Takt Times - Standard work processes and line balancing Poka-yoke and pull systems material handling reduction and facilities planning

MODULE V **8**

Managing change in the lean organization Human resource management and the lean enterprise Employee involvement – Teams – Training – Supporting and encouraging involvement – Involving people in the change process -- communication -- Importance of culture. Startup of lean processes and examples of applications. Sustaining improvement and change, auditing, follow-up actions.

7

MODULE VI

The lean enterprise and supply chain management Costs and risks of lean initiatives - Measuring lean initiatives

L – 45; Total Hours –45

TEXT BOOKS:

1. The Toyota Way Fieldbook, Jeffrey Liker and David Meier, McGraw-Hill, 2006. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.
2. Womack, James P., and Daniel T. Jones. Lean Thinking. New York, NY: Simon and Schuster, 2003. ISBN: 0743249275.
3. Murman, Earll. Lean Enterprise Value. New York, NY: Palgrave Macmillan, 2002. ISBN: 0333976975.

REFERENCES:

1. Readings at http://www.leanconstruction.org/readings.htm
2. Hopp, W. J., and Spearman, M. L. (2011). Factory Physics, Third Edition, Waveland Press, Long Grove, Il. 720 pp.

OUTCOMES:

The student will be able to

- Describe the manufacturing approaches employed and the background and philosophy of lean production.
- Illustrate the concept of waste reduction
- Apply evaluation techniques that can be used in preparation for and use in learn production activities.
- Select the tools that can be used implementing lean production in production operations.
- Discuss the importance of workplace organization, pull production, cellular arrangement and employee involvement, need for employee creativity
- Describe about the Methods for promoting success in implementing lean transformations

GECX218	GEOSPATIAL MODELING & ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To equip the students with fundamental representation and analysis of geospatial phenomena and provides foundations in methods and algorithms used in GIS analysis.
- To focus is on terrain modeling, geomorphometry, watershed analysis and introductory GIS-based modeling of landscape processes (water, sediment). The course includes analysis from lidar data, coastal change assessment and 3D visualization.

MODULE I INTRODUCTION TO GEOSPATIAL DATA 7

Mapping natural phenomena –Concept of continuous fields and discrete sampling – Units, projections, coordinate transformation – Georeferencing, geospatial formats, conversions, geospatial data abstraction library – Raster and vector representation, raster and vector conversions and resampling.

MODULE II DATA DISPLAY AND VISUALIZATION 7

Display of continuous and discrete data, use of color, shading, symbols, to extract the spatial pattern and relationships – 3D visualization: multiple surfaces and volumes, 3D vector objects – visualization for data analysis (lighting, scaling, transparency, cutting planes, animations) – view/create maps/post your data on-line (Google Earth/Maps, GPS visualizer)

MODULE III GEOSPATIAL ANALYSIS 7

Foundations for analysis of continuous and discrete phenomena – neighborhood operations and buffers – analysis and modeling with map algebra – cost surfaces and least cost path – spatial interpolation and approximation (gridding)

MODULE IV TERRAIN MODELING AND ANALYSIS 9

terrain and bathymetry mapping – mathematical and digital representations (point clouds, contour, raster, TIN) – DEM and DSM, working with multiple return lidar data

– spatial interpolation of elevation data and topographic analysis, line of sight, view shed analysis – solar irradiation, photovoltaic energy potential, time series of elevation data, analysis of coastal change.

MODULE V FLOW TRACING, WATERSHED ANALYSIS AND LANDFORMS 8

Methods for flow routing and flow accumulation – Extraction of stream networks – Extraction of watershed boundaries and building watershed hierarchies – feature extraction, types of landforms.

MODULE VI MODELING OF GEOSPATIAL PROCESSES 7

Model formulation, input data processing – introduction to GIS-based hydrologic, erosion and environmental modeling – Geocomputational methods, including agent-based modeling, artificial neural networks and evolutionary computing.

L – 45; T – 0; Total Hours –45

TEXT BOOKS:

1. Hassan A, Karimi (2017), *Geospatial Data Science Techniques and Applications*, CRS Press & Co.

2. Sudipto Banerjee, Bradley P, Carlin, Alan E. Gelfand (2014), *Hierarchical Modeling and Analysis for Spatial Data*, CRS Press & Co.

REFERENCES:

1. Maguire, D., M. Batty, and M. Goodchild. 2015. GIS, Spatial analysis, and modeling. ESRI Press (G70.212 .G584 2005)

2. Zeiler, M. 2010. Modeling Our World: The ESRI Guide to Geodatabase Design. Second Ed. ESRI Press, Redlands, California

OUTCOMES:

On successful completion of this course,

- Students will be able to apply the basic concepts of Conceptualize models as representations of real life systems with inputs, outputs, and processes.
- Students will have gained knowledge in spatial tools to make simulations and predictions of real life phenomena.
- Students will have synthesized knowledge about Apply, integrate, and develop models with geospatial data through a GIS.
- Students will have an overview of Evaluate models in terms of accuracy, sensitivity, and uncertainty.
- Students will have Use of a system-based approach for problem solving, with an emphasis on sustainability.