REGULATIONS 2017

CURRICULUM AND SYLLABI

B.TECH.

AUTOMOBILE ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

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

MISSION

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

DEPARTMENT OF AUTOMOBILE ENGINEERING
VISION AND MISSION

VISION

- To be a leader for Education, Training, Consultancy and Research in Automobile Engineering for the progress of Automotive Industries and over-all Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To provide quality education to the students and to mould them as professionals with sound knowledge in the field of Automobile Engineering.
- To equip students to solve challenging problems in Automobile Engineering and related areas taking in to account their impact on the society.
- To facilitate students to develop good communication, leadership and managerial skills through team approach in conducting experiments and projects
- To pursue academic and collaborative research with industry and related research institutions.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES
B.Tech. (Automobile Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES

The Mission of the Automobile Engineering Program is achieved by student learning outcomes that prepare the graduate to be able to:

- To inculcate involvement in learning by adapting a holistic approach through well designed curriculum, pedagogy and evaluation for a successful professional career.
- To provide a strong foundation in physical sciences and analytics to enable comprehensive understanding of the basic principles of Automobile Engineering.
- To develop knowledge and skill in applying engineering principles to conceive, design, analyze, manufacture, maintain and recycle Automobile Engineering systems and components.
- To equip the students with essential fundamental knowledge from other relevant disciplines to infuse a multi-disciplinary approach.
- To empower the students through projects, internships leading to development of creativity, self confidence and team spirit.
- To create the ambience with scope for developing communication and life skills so as to meet the needs of the society in the globalized environment

PROGRAMME OUTCOMES

The following list of educational outcomes was chosen by the department to describe what the students are expected to know or be able to do at time for graduation from the program:

- Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
- Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- Model tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
- Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- Individual and team work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
- Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFICOUTCOMES

B. Tech Automobile Engineering graduates will be able to

- Design, model and analyze automobile components, sub systems and automotive electronic systems.
- Develop as professionals in automotive system design, validation, operation, testing with emission measurement and control and maintenance of vehicles

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
11. Polymer 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 3rd to 8th 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

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

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
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. Like wise 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. AUTOMOBILE ENGINEERING

CURRICULUM & SYLLABUS, REGULATIONS 2017

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC1181	Differential Calculus and Geometry	3	1	0	4	
2.	HS	ENC1181/ ISC1181/ LNC1181/ LNC1182/ LNC1183	English / Arabic / Mandarin / German / Japanese	3	0	0	3	
3.	BS	PHC1182	Physics	3	0	2	4	
4.	BS	CHC1181	Chemistry	3	0	2	4	
5.	ESF	GEC1101	Engineering Graphics	2	0	2	3	
6.	ESF	GEC1102	Engineering Design	2	0	0	2	
7.	ESF	GEC1103	Basic Engineering Practices Laboratory	0	0	2	1	
8.	ESF	GEC1104	Computer Programming I	1	0	2	2	**23**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC1281	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	GEC1212	Environmental Studies	2	0	0	2
6.	ESF	GEC1213	Computer Programming II	1	0	2	2
7.	ESF	EEC1281	Automobile Electrical Engineering	2	0	0	2

8.	EC	AUC1211	Applied Fluid Mechanics	3	0	0	3	
9.	ESF	EEC1282	Automobile Electrical Engineering Laboratory	0	0	3	1	**24**

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.	EC	AUC2101	Applied Thermal Engineering	3	1	0	4	
4.	EC	AUC2102	Vehicle Body Engineering	2	0	0	2	
5.	EC	AUC2103	Basic Manufacturing Process	2	0	2	3	
6.	EC	AUC2104	Strength of Materials	3	1	0	4	
7.	EC	AUC2105	Automotive Engines	2	0	2	3	
8.	HS	ENC2181	Oral Communication	0	0	2	1	
9.	EC	AUC2106	Applied Fluid Mechanics Laboratory	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.	EC	AUC2211	Automotive Chassis	3	0	0	3	
4.	EC	AUC2212	Mechanics of Machinery	3	1	0	4	
5.	EC	AUC2213	Automotive Electrical & Electronics	3	0	0	3	
6.	EC	AUC2214	Automotive Material & Metallurgy	2	0	2	3	
7.	EC	AUC2215	Production Process of Automotive Components	2	0	0	2	
8.	HS	ENC2282	Written Communication	0	0	2	1	
9.	EC	AUC2216	Automotive Chassis Laboratory	0	0	3	1	
10.	EC	AUC2217	Automotive Electrical and Electronics Laboratory	0	0	3	1	**24**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	MS	MSC3181/ MSC3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3
2.	EC	AUC3101	Design of Automotive Components	3	1	0	4
3.	EC	AUC3102	Automotive Transmission	3	0	0	3
4.	EC	AUC3103	Measurements and Instrumentation	1	0	2	2
5.	PE	-	Professional Elective I	3	0	0	3
6.	PE	-	Professional Elective II	3	0	0	3
7.	GE	-	General Elective I	3	0	0	3
8.	HS	ENC3181	Communication and Soft Skills - I Confidence Building	0	0	2	1
9.	EC	AUC3104	Heat Transfer Laboratory	0	0	3	1
10.	EC	AUC3105	Automotive Component Modeling Laboratory	0	0	3	1

24

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	MS	MSC3181/ MSC3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3
2.	BS	-	Mathematics Elective II	2	0	0	2
3.	EC	AUC3211	Vehicle Dynamics	3	1	0	4
4.	EC	-	Professional Elective III	3	0	0	3
5.	PE	-	Professional Elective IV	3	0	0	3
6.	PE	AUC3212	Vehicle Design Data Characteristics	3	0	0	3
7.	HS	ENC3281	Communication and Soft Skills -II Career Choice	0	0	2	1

8.	EC	AUC3213	Vehicle Dynamics Laboratory	0	0	3	1	
9.	EC	AUC3214	Vehicle Components Analysis Laboratory	0	0	3	1	
10.	EC	AUC3215	Vehicle Maintenance Laboratory	0	0	3	1	**24**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	AUC4101	Finite Element Analysis of Automotive Components	3	1	0	4	
2.	EC	AUC4102	Two and Three Wheelers Technology	2	0	2	3	
3.	EC	AUC4103	Automotive Emissions and Control	3	0	0	3	
4.	PE	-	Professional Elective V	3	0	0	3	
5.	PE	-	Professional Elective VI	2	0	0	2	
6.	GE	-	General Elective II	3	0	0	3	
7.	EC	AUC4104	Engine Testing and Emission Laboratory	0	0	3	1	
8.	EC	AUC4105	Advanced Automobile Components Manufacturing Laboratory	0	0	3	1	
9.	EC	AUC4106	Internship.	0	0	0	1*	
10.	EC	AUC4107	Automotive Simulation Laboratory	0	0	3	1	
								22

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	AUC4211	Project Work	0	0	24	12	**12**

Total credits – 175

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

PROGRAMME ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	AUCX01	Homologation and Testing	1	0	0	1
2.	PE	AUCX02	Geometric Dimensioning and Tolrencing	1	0	0	1
3.	PE	AUCX03	Vehicle Engineering & Integration	1	0	0	1
4.	PE	AUCX04	Automotive HVAC(Heating Ventilation Air Conditioning)	2	0	0	2
5.	PE	AUCX05	Hybrid and electric vehicle	2	0	0	2
6.	PE	AUCX06	Vehicle diagnostics	2	0	0	2
7.	PE	AUCX07	Spark Ignition Engine Technology	3	0	0	3
8.	PE	AUCX08	Compression Ignition Engine Technology	3	0	0	3
9.	PE	AUCX09	Automotive Aerodynamics	3	0	0	3
10.	PE	AUCX10	Vehicle comfort system and ergonomics	3	0	0	3
11.	PE	AUCX11	Vehicle design data characteristics	3	0	0	3
12.	PE	AUCX12	Design of transmission system and characteristics analysis	3	0	0	3
13.	PE	AUCX13	Design of hydraulics pneumatics systems for automotives	3	0	0	3
14.	PE	AUCX14	Tractor and Agricultural Machineries	3	0	0	3
15.	PE	AUCX15	Vehicle control system	3	0	0	3
16.	PE	AUCX16	Modern and intelligent vehicle system	3	0	0	3
17.	PE	AUCX17	Alternative Fuels and Energy Systems	3	0	0	3
18.	PE	AUCX18	Vehicle Networking and Internet of things	3	0	0	3
19.	PE	AUCX19	Automotive Instrumentation & Embedded System	3	0	0	3

20.	PE	AUCX20	Advanced material testing and failure analysis	3	0	0	3
21.	PE	AUCX21	Computer aided design and manufacturing	3	0	0	3
22.	PE	AUCX22	Design of Jigs, Fixtures and Press Tools	3	0	0	3
23.	PE	AUCX23	Simulation of I.C. Engine Processes	3	0	0	3
24.	PE	AUCX24	Combustion thermodynamics and heat transfer	3	0	0	3
25.	PE	AUCX25	Unconventional energy sources	3	0	0	3
26.	PE	AUCX26	Computational flow and heat transfer	3	0	0	3
27.	PE	AUCX27	Motorsport Engineering	3	0	0	3
28.	PE	AUCX28	Composite Materials for Automobiles	3	0	0	3
29.	PE	AUCX29	Traffic Engineering	3	0	0	3
30.	PE	AUCX30	Surface Engineering	3	0	0	3
31.	PE	AUCX31	Advanced IC Engine	3	0	0	3
32.	PE	AUCX32	Fuel Cell Technology	3	0	0	3
33.	PE	AUCX33	Power Plant Engineering	3	0	0	3
34.	PE	AUCX34	Heat And Mass Transfer	3	0	0	3
35	PE	AUCX35	Automotive Safety Systems	3	0	0	3

Physics Elective Courses

(to be offered in II Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	PHCX01	Fundamentals of Engineering Materials	2	0	2	3
2.	PHCX02	Heat and Thermodynamics	2	0	2	3
3.	PHCX03	Introduction to Nanoscience and Technology	2	0	2	3
4.	PHCX04	Lasers and their applications	2	0	2	3
5.	PHCX05	Materials Science	2	0	2	3
6.	PHCX06	Non-Destructive Testing	2	0	2	3
7.	PHCX07	Properties of Matter and Acoustics	2	0	2	3
8.	PHCX08	Properties of Matter and Nondestructive Testing	2	0	2	3
9.	PHCX09	Semiconductor Physics and Optoelectronics	2	0	2	3

Chemistry Elective Courses

(to be offered in II Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CHCX01	Analytical Instrumentation	2	0	2	3
2.	CHCX02	Corrosion and its Control	2	0	2	3
3.	CHCX03	Electrical Materials and Batteries	2	0	2	3
4.	CHCX04	Engineering Materials	2	0	2	3
5.	CHCX05	Fuels and Combustion	2	0	2	3
6.	CHCX06	Fundamentals of Physical Chemistry	2	0	2	3
7.	CHCX07	Green Technology	2	0	2	3
8.	CHCX08	Organic Chemistry of Biomolecules	2	0	2	3
9.	CHCX09	Polymer Science and Technology	2	0	2	3

Maths Elective Courses

(to be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX01	Discrete Mathematics And Graph Theory	3	1	0	4
2.	MACX02	Probability And Statistics	3	1	0	4
3.	MACX03	Random Processes	3	1	0	4
4.	MACX04	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.	MACX05	Mathematical Programming	2	0	0	2
2.	MACX06	Statistical Methods for Data Analysis	2	0	0	2
3.	MACX07	Numerical Methods for Integration and Differential Equations	2	0	0	2
4.	MACX08	Mathematical Modelling	2	0	0	2
5.	MACX09	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 Systemsand 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" (43^{rd} 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 Abridged 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 equipments..

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 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 & 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.

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 – 30; TOTAL HOURS – 75

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 – 30; TOTAL HOURS – 45

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" (43^{rd} 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", 4^{th} 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" (7^{th} 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 07

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 06

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 06

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 08

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- Frictionalforce – simple contact friction – Rolling resistance –ladder friction

MODULE VI LAWS OF MOTION 10

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.

		L	T	P	C
GEC 1213	**COMPUTER PROGRAMMING II**	**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 – 30; TOTAL HOURS – 45

REFERENCES:

1. Bjarne Stroustrup," The C++ Programming Language", Addison Wesley, 4th 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, 2nd 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, 2nd 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.

EEC 1281 AUTOMOBILE 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 operationand applications of engine starting systems
- Basics of charging systems
- Concepts of Transformers and Induction motors.

MODULE I DC AND AC CIRCUITS 8

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, definition of average value, R.M.S value, form factor, peak factor. 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 ENGINE STARTING SYSTEMS 7

Requirements of the starting system-Choosing a starter motor -Starter motors and circuits: Starting system circuits -Principle of operation of starter motor - DC motor characteristics - Types of starter motor: Inertia starters - Pre-engaged starters - Permanent magnet starters - Heavy vehicle starters -Integrated starters.

MODULE III AUTOMOBILE CHARGING SYSTEMS 7

Basic principles - Charging voltages -Alternators and charging circuits- Generation of electricity - Rectification of AC to DC -Regulation of output voltage - Charging circuits.

MODULE IV 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.

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 starter- motors.
- Explain the structure of Engine starting systems.
- Understand the working of automobile charging system.
- Understand the concept of Voltage Regulation
- Explain the operation of Transformers and Induction motors

AUC 1211 APPLIED FLUID MECHANICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the properties of the fluid.
- To understand and solve the fluid flow problems.
- To understand the mathematical techniques of practical flow problems.
- To understand the energy exchange process in fluid machines.

MODULE I FLUID PROPERTIES AND HYDROSTATICS 8

Fluid properties: Mass density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, compressibility, surface tension and capillarity. Fluid statics: fluid pressure at a point, variation of pressure within a static fluid, hydrostatic law - Pressure head, Pascal's law. Measurement of pressure - Piezometric tube, manometry.

MODULE II FLUID DYNAMICS 8

Control volume – Fluid Kinematics - Types of flows; Steady flow, Unsteady flow, Uniform and Non Uniform flow, Rotational flow, Irrotational flow, 1-D, 2-D, 3-D flows–Streamline and Velocity potential lines- Euler and Bernoulli's equations and their applications – moment of momentum – Momentum and Energy correction factors –Impulse – Momentum equation-Navier-Stokes Equations-Applications.

MODULE III OPEN CHANNEL FLOW 7

Flow through pipes – Open Channels and Measurement pipe flow: Darcy's law – Minor losses – Multi reservoir problems – pipe network design – Moody's diagram – Hagen Poiseuille equation – Turbulent flow. Specific Energy – Critical flow concept – specific force – Hydraulic jump – uniform flow and gradually varying flow

MODULE IV DIMENSIONAL ANALYSIS 7

Dimensional homogeneity – Raleigh and Buckingham theorems – Non-dimensional numbers – Model laws and distorted models-Unit quantities-Specific quantities

MODULE V BOUNDARY LAYERS 8

Boundary layer development on a flat plate and its characteristics - Boundary layer thickness, displacement thickness, momentum thickness, energy thickness .Momentum equation for boundary layer by Vonkarman, drag on flat plate, boundary layer separation and its control. Aerofoil theory, lift and drag coefficients, stream lined and bluff bodies.

MODULE VI **TURBOMECHINERY** **7**

Hydraulic turbine: Classification, difference between impulse and reaction turbine. Construction and working of Pelton turbine, Francis turbine and Kaplan turbine, velocity triangle, heads and efficiencies. Pumps: classification, difference between positive and non-positive displacement pumps. construction and working of reciprocating pump. Centrifugal pump-heads of a centrifugal pump, priming, velocity triangle, work done, efficiencies of centrifugal pump.

Total Hours – 45

TEXT BOOKS:

1. Rajput.R.K, "A text book of Fluid Mechanics and Hydraulic Machines", S. Chand & Company Ltd., New Delhi, Fourth edition, 2010.
2. Dr.R.K. Bansal, (2000), Fluid Mechanics and Hydraulic Machines, Laxmi Publication (P) Ltd., New Delhi.

REFERENCES:

1. P.N.Modi and S.M.Seth (1999), Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House, Naisarak, Delhi.
2. Vijay Gupta and S.K.Gupta, (1999), Fluid Mechanics and Applications, New-Age International Ltd.
3. D.S. Kumar,(2004), Fluid Mechanics and Fluid Power Engineering, Katson Publishing House, Delhi.

OUTCOMES:

Student will be able to

- To find frictional losses in a pipe when there is a flow between two places.
- Calculate the conjugate depths in a flow.
- Analyse the model and the prototype.
- Find the dependent and independent parameters for a model of fluid flow.
- Explain the various methods available for the boundary layer separation.

EEC 1282	AUTOMOBILE ELECTRICAL ENGINEERING LABORATORY	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. Study of battery chargers.

Total Hours – 45

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 opto - coupler 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", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Grewal B.S., "Higher Engineering Mathematics", 42nd 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", 5th edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
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.

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.

AUC 2101	APPLIED THERMAL ENGINEERING	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To gain knowledge on the concept of systems and energy transfer
- To understand analyze and apply the basic laws of thermodynamics
- To understand the principle of steam power cycle and its improvement
- Perform air-standard analysis of IC engines based cycle and Refrigeration cycle
- To understanding of basic concept of hear transfer
- To learn the fundamental concepts of heat exchanger.

MODULE I　BASIC CONCEPT AND FIRST LAW　8+2

Basic concepts - concept of continuum, macroscopic approach, types of thermodynamic systems. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipment.

MODULE II　SECOND LAW, ENTROPY AND AVAILABILITY　8+3

Second law of thermodynamics – Kelvin's and Clausius 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 gas, principle of increase of entropy – Carnot theorem, absolute entropy, availability, Concept of Exergy analysis.

MODULE III　P R O P E R T I E S OF PURE SUBSTANCE AND VAPOUR PROCESSES　8+2

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of steam quality

MODULE IV VAPOR AND GAS CYCLES 8+3

Rankine Cycle - Rankine Cycle Efficiency - Reheat Cycle- Regenerative Cycle - Vapor Refrigeration Cycle - Air-Standard Cycle - Otto Cycle - Diesel Cycle - Brayton Cycle - Regenerative Brayton Cycle - Combined Cycle - Gas Refrigeration Cycle

MODULE V CONDUCTION, CONVECTION AND RADIATION 6+2

Modes of heat transfer, Heat conduction in parallel, radial and composite wall - Basics of Convective heat transfer. Fundamentals of Radioactive heat transfer

MODULE VI HEAT EXCHANGERS 7+3

Nusselt's theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient - Fouling Factors - Analysis - LMTD method - NTU method.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Nag.P.K., "Engineering Thermodynamics",5th ed, Tata McGraw-Hill(2013). 1998.
2. Cengel, "Thermodynamics An Engineering Approach", 8th Edition – 2015, Tata McGraw Hill, New Delhi.

REFERENCES:

1. Holman.J.P., "Thermodynamics", 3rd Edition McGraw-Hill, 1995.
2. Natarajan. E., "Engineering Thermodynamics" Anuragam Publications, Chennai, 2012.
3. Arora C.P, " Thermodynamics", Tata McGraw-Hill, New Delhi.
4. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi.
5. Sri Vastava R.C, Saha S. K, Jan A. K, "Thermodynamics" Prentice Hall of India, New Delhi.

OUTCOMES:

The Student Should Be Able To

- Conceptualize and apply the first of thermodynamics to any real life situation
- Conceptualize and apply the second of thermodynamics to any real life situation
- Apply the knowledge for design of air conditioning system
- Design and analyze gas power cycles
- Synthesize and utilize thermodynamic relations for practical problems solving
- Design and analyze heat exchanger

AUC 2102	VEHICLE BODY ENGINEERING	L	T	P	C
		2	0	0	2

OBJECTIVES:

- The students can impart knowledge in construction of car body, design criteria, types of car and safety aspects of car.
- The students able to know the construction of bus body and dimensions of bus body and safety aspects.
- The students can impart knowledge in types of commercial vehicles; design of cab and in aerodynamic testing, forces and moments.
- The student will be well versed in the design and construction of external body of the vehicles and materials used in vehicles.

MODULE I CAR BODY DETAILS 7

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car – Visibility regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car body construction-Various panels in car bodies. Car body construction; design criteria. Crash tests on full scale model, Dummies and Instrumentation. Safety aspect of car body.

MODULE II BUS BODY DETAILS 8

Types of bus body: based on capacity, distance traveled and based on construction. Bus body lay out for various types, floor height, engine location, entrance and exit location, seating dimensions. Types of metal sections used – Regulations – Constructional details: Conventional and integral.

MODULE III COMMERCIAL VEHICLE DETAILS 7

Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of commercial vehicle body - Flat platform body, Trailer, Tipper body and Tanker body, Drivers cab design - Regulations.

MODULE IV BODY MATERIALS AND BODY REPAIR 8

Types of materials used in body construction-Steel sheet, timber, plastics, GRP, properties of materials. Hand tools-power tools-panel repair-repairing sheet metal-repairing plastics-body fillers-passenger compartment service- corrosion and Anticorrosion methods. Modern painting process procedure-paint problems and Body trim items-body mechanisms.

Total Hours – 30

TEXT BOOKS:

1. Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 1998.

2. James E Duffy, "Body Repair Technology for 4-Wheelers", Cengage Learning, 2009.

REFERENCES:

1. Giles, G.J., "Body construction and design", Illiffe Books Butterworth & Co., 1991.
2. John Fenton, "Vehicle Body layout and analysis", Mechanical Engg. Publication Ltd., London, 1992.
3. Braithwaite, J.B., "Vehicle Body building and drawing", Heinemann Educational Books Ltd., London.
4. Dieler Anselm., The passenger car body, SAE International, 200

OUTCOMES:

- The students will able to know design of car body and identify the car body parts in a vehicle.
- The students will able to evaluate about different aspects of car body and bus body, types, commercial vehicle.
- The students will able to analyze the Role of various aerodynamic forces and moments, measuring instruments.
- The students will able to evaluate about different aspects of car body and bus body, types, commercial vehicle.
- The students able to find the material which can be used in car body, bus body of an automobile vehicle.
- The students will able to know painting process for a commercial vehicle and tools used for body repairs.

AUC 2103 BASIC MANUFACTURING PROCESS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To know about the functions of lathe machine and casting process
- To study about the types of welding process and sheet metal forming process
- To know about forging, Rolling and Extrusion process with its applications
- To understand the methods shaping of plastics and powder metallurgy components.

MODULE I LATHE MACHINE AND CASTING PROCESS 8

Lathe Machine: Function of lathe, parts of lathe and Operations performed on lathe machine. Casting Process, Sand casting process, pattern types, pattern allowance, properties of Moulding sand, Cupola furnace, Shell casting and die casting process.

MODULE II WELDING AND SHEET METAL FORMING PROCESS 7

Welding Process: Types of welding- Gas welding, Arc Welding, Resistance welding, MIG and TIG welding . Sheet metal forming Process: Sheet metal forming operations, Hydro forming, Super plastic forming and Explosive forming.

MODULE III FORGING, ROLLING AND EXTRUSION PROCESS 8

Forging process: Open and closed die forging, Types of forging operations Rolling process; Types of rolling mills , Extrusion process: Forward and Backward Extrusion, Principle of rod and wire drawing

MODULE IV SHAPING OF PLASTICS AND POWDER METALLURGY 7

Thermosetting and Thermoplastics, Blow moulding , Injection moulding . Compression and transfer moulding. Powder metallurgy: Steps followed in powder metallurgy, applications.

LAB EXPERIMENTS: **30**

- Turning
    - Turning , Step turning and taper turning operations
    - Single start V thread and knurling operations

- Sand casting
    - Dumble mould
    - Flange mould
- Welding-
    - Lap / Butt Joint
    - T Joint
- Sheet metal
    - Tray shape
    - Funnel shape
- Forging
    - Round to hexagon shape/ hexagon shape to chisel
    - Fan Hook (Demo)
- Shaping of plastics
    - Plastic Bottle by blow moulding machine
    - Chair Bushes by injection moulding machine (Demo)

Total Hours – 60 Hours

TEXT BOOKS:

1. Hajra Choudhury, Elements of Workshop Technology, Vol. I and II, Media Promotors Pvt Ltd., Mumbai, 2007
2. Serope Kalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 2006

REFERENCES:

1. B.S.MegendranParashar & R.K..Mittal, Elements of Manufacturing Processes, Prentice Hall of India, 2003.
2. P.N. Rao, Manufacturing Technology,Tata McGraw-Hill Publishing Limited, IInd Edition, 2009

3. P.C. Sharma, S. Chand and Company, A Text Book of production technology, X^{th} Edition, 2008
4. Begman, John Wilely & Sons, Manufacturing Process, $VIII^{th}$ Edition, 1999.

OUTCOMES:

- Able to do various operations using lathe machine and make mould cavity by sand casting process
- Able to make various types of welded joints and sheet metal process
- Able to do component by forging process
- Able to understand the principle of blow and injection moulding process and able to produce plastic components.

AUC 2104	STRENGTH OF MATERIALS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To gain knowledge of simple stresses, strains and deformation in components.
- To assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- Effect of component dimensions and shape on stresses and deformations are to be understood.
- To gain knowledge in the torsion of circular bars.
- To analyze the two dimensional stresses.
- The study would provide knowledge for use in the design courses.

MODULE I STRESS, STRAIN AND DEFORMATION OF SOLIDS 7+2

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress.

MODULE II LOADS AND STRESSES IN BEAMS 9+2

Types of beams: Supports and loads – Shear force and Bending Moment in beams – Cantilever and simply supported – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section.

MODULE III DEFLECTION OF BEAMS 7+3

Evaluation of beam deflection and slope: Double integration method, Macaulay ethod and Moment-area method.

MODULE IV TORSION 7+2

Analysis of torsion of circular bars – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness.

MODULE V APPLICATION OF TORSION AND BEAM DEFLECTION 8+3

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

MODULE VI TWO DIMENSIONAL STRESSES 7+3

Thin cylindrical and spherical shells – Volumetric strains – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses

L – 45; T – 15 – 60 Hours

TEXT BOOKS:

1. Beer F. P. and Johnston R, Mechanics of Materials, McGraw-Hill Book Co, Third Edition, 2002.

REFERENCES:

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

OUTCOMES:

On completion of the course students should be able to

- Gain knowledge of simple stresses, strains and deformation in components.
- Understood the effect of stresses and deformations on component dimensions and shape.
- To determine and analyse the stresses in two dimensions.
- To determine and analyse the shear forces, bending moments and principal stresses.
- Gain knowledge in columns and springs.
- Use basic knowledge in the design courses.

AUC 2105 AUTOMOTIVE ENGINES

	L	T	P	C
	2	0	2	3

OBJECTIVES:

- To understand the basic concepts, construction, types and working of internal combustion engines used for automotive applications
- To have a clear understanding of the combustion processes of SI and CI engines.
- To have a clear understanding of the testing procedures and performance parameters of automotive engines.
- To understand the developments taking place in automotive engines.

MODULE I ENGINE COMPONENTS AND SYSTEMS 9

Construction and working of Four stroke SI and CI engines, Construction and working of Two stroke SI and CI engines, Engine classification, firing order, Engine specifications, Intake and Exhaust systems, Ignition system, Carburetor, TBI, MPFI, GDI and DI, CRDI systems, Injectors and Types, Exhaust system components, Cooling and Lubrication systems.

MODULE II COMBUSTION IN SI AND CI ENGINES 7

Introduction to combustion in SI and diesel engines and stages of combustion. Combustion chambers for SI and CI engines. Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design. Knocking combustion.

MODULE III ENGINE TESTING AND PERFORMANCE 7

Dynamometers, Indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, Cylinder pressure measurement. Engine performance maps, Engine testing standards.

MODULE IV DEVELOPMENTS IN AUTOMOTIVE ENGINES 7

Bi fuel and Flexi fuel engines, Adiabatic engines, HCCI engines, Lean burn engines, Stratified charge ignition engines, LPG and Bio gas fuelled engines. Use of hydrogen in automotive engines, Electric and Hybrid vehicles.

List of Experiments cylinder

1. **Dismantling study and assembling of 4 cylinder SI engine**

Measure the bore stroke, cubic capacity and compression ratio of a given 4 cylinder petrol engine. Compare the significance of cubic capacity with power. Identify the name, function and material of the components.

2. **Dismantling study and assembling of 4 cylinder CI engine**

To calculate the clearance volume and compression ratio of a 4 cylinder diesel engine. Measure the pressure in the cylinder at the end of compression stroke. Draw the motoring curve. Identify the name, function and material of the components.

3. **Dismantling study and assembling of 2 stroke SI engine**

Measurement of 2 stroke SI engine specifications Identification of Name function and material of of the components. Understanding of the following scavenging and short circuiting process, air cooling system.

4. **Study of intake systems**

Carburettor, TBI, MPFI and GDI for SI engine and DI, IDI and CRDI systems for CI engine . Identify the Name of components function material etc. Measurement of injector performance, Measurement of runner length of manifold and its significance.

5. **Study of Exhaust systems**

Exhaust system components like catalytic combater muffler, Identification of name of components function and material. Measurement of runner length of exhaust manifold and its significance.

6. **Study of Ignition systems**

Battery coil, magneto and Electronic Ignition systems. Identification of name and function material. Measurement of density of Electrolyte .

7. **Study of cooling systems**

Identification of name, function and material of the components. Measurement of discharge of water pump at various speed.

8. **Study of lubrication systems**

Identification of Name, function and material of the components. Measurement of discharge of oil pump at such pressure for difference speeds.

9. **Measurement of dimensional variation of cylinder block and gudgeon pin**

   Measurement on cylinder block – cylinder bore, crankshaft bore and camshaft bore for taper and ovality. Measurement of gudgeon pin, diameter and taper Analysis of the impact of dimensional variation on engine performance

10. Measurement of dimensional variation of Crankshaft, camshaft, connecting rod

Measurement of crankshaft journal and pin for taper and ovality

Measurement of camshaft journal taper and ovality and cam lift.

Measurement of connecting rod big end and small end bores for taper and ovality.

11. Measurement of valve and port timing of Engines.

Analysis of the impact of dimensional variation on engine performance

PROJECT TITLES:

1. Selection and coupling of suitable I.C. Engine to run a system
2. Measurement of Air intake and calculation of volumetric efficiency
3. Measurement of fuel intake and calculation of energy of the fuel metered
4. Making a working model of CDI system
5. Measurement of Exhaust pressure and calculation of exhaust quantity
6. Working model of Electronic ignition system
7. Working model of lubrication system
8. Working model of cooling system
9. Working model of Rocker arm mechanism
10. Working model of a CRDI system
11. Working model of a MPFI system
12. Working model of variable valve timing.
13. Energy recovery from exhaust system
14. Turbo charger model.

Total Hours – 60 Hours

TEXT BOOKS:

1. Ganesan.V., “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co.,New Delhi, 2003.
2. M.L.Mathur and R.P.Sharma, “A course in Internal combustion engines”,Dhanpat Rai & Sons Publications, New Delhi, 2001.
3. K.K.Ramalingam, “Internal Combustion Engines”, Scitech Publications,Chennai, 2000.
4. William H.Crouse, “Automotive Engines”, McGraw-Hill Publishers, 1985.
5. Pulkrabek “Engineering Fundamentals of the Internal Combustion Engines”,Practice Hall of India, 2003.

REFERENCES:

1. Heldt P.M., “High Speed Combustion Engines”, Oxford IBH PublishingCo., Calcutta,1975.
2. Obert E.F., “Internal Combustion Engines Analysis and Practice”, International Text Books Co., Scrantron, Pennsylvania - 1988.
3. Ellinger H.E., “Automotive Engines”, Prentice Hall Publishers, 1992.
4. John B.Heywood, “Internal Combustion Engine Fundamental”, McGraw-Hill, 1988.
5. Richard Stone.," Introduction to Internal Combustion Engines”, Third Edition-1999, Society of Automotive Engineers Inc.

OUTCOMES:

- Should be able to analyse and select a suitable power plant for particular application and justify the selection.
- Should critically examine the combustion parameters of engines.
- Should be able to apply the knowledge gained in engine testing laboratory and evaluate the performance parameters of engines.
- Should be able deliberate the developments and suggest improvements for automotive power system.

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)

P – 30; 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.

AUC 2106 APPLIED FLUID MECHANICS LABORATORY

	L	T	P	C
	0	**0**	**3**	**1**

OBJECTIVES:

- To learn about the various measurements of fluid parameters
- 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 Rota meter.
3. Determination of friction factor 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
13. Flow visualization and pressure measurement on aerofoil

Total Hours – 45

OUTCOMES:

- Students will learn the parameters important for measuring the fluid flows.
- They will be able to run and calculate the performance of the pumps and turbines

SEMESTER - IV

AUC 2211	AUTOMOTIVE CHASSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Study the constructional details and Structures of different types of frames used in vehicle
- To Study mechanism of different types of steering system
- To Study mechanism of different types of drive line and final drive.
- To study use age of wheels and tyres.
- To Study the fundamental and working of different types of Suspension Systems of Automobiles
- To Study the fundamental and working of different types of Braking Systems of Automobiles

MODULE I INTRODUCTION AND FRAME, STEERING SYSTEM 6

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames

MODULE II FRONT AXLE AND STEERING SYSTEMS 7

Types of Front Axles and Stub Axles, Front Wheel Geometry, namely, Castor, Camber, King Pin Inclination and Toe–in, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power–Assisted Steering.

MODULE III PROPELLER SHAFT AND FINAL DRIVE 8

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Final drive, different types, Double reduction and twin speed final drives, Multi–axled vehicles, Differential principle and types, Differential housings, Non–Slip differential, Differential locks, Final drive of Crawler Tractors.

MODULE IV AXLES AND TYRES 8

Construction and Design of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings and Types, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tyres and their constructional details

MODULE V SUSPENSION SYSTEM **8**

Need for Suspension System, Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi–Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Independent Suspension System, Shock Absorbers, Types and Constructional details, Design of Leaf and Coil Springs.

MODULE VI BRAKING SYSTEM **8**

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Loading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Actuators, Disc Brake Theory, Types and Construction, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Servo Brakes, Retarders, Types and Construction, Anti–Lock Braking System, Constructional Details. Traction control, Hill assist, Engine brakes (alias Jake brake)

Total Hours - 45

TEXT BOOKS:

1. Kripal Singh, Automobile Engineering, Standard Publisher, New Delhi, 2006
2. R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited, 2007
3. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007

REFERENCES:

1. Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990
2. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
3. Heinz Hazler, Modern Vehicle Technology, Butterworth, London, 2005.

OUTCOMES

On completion of the course student should be able to

- Select suitable frame for different vehicle with justification
- Select suitable steering system for different vehicles with justification.
- Analyze various drive line systems for automobiles.
- Select suitable wheels and tires with justification
- Evaluate the different types of suspension system for vehicle.
- Select and analyze different types of vehicle layouts.

AUC 2212 MECHANICS OF MACHINERY

L	T	P	C
3	1	0	4

OBJECTIVES:

- To study about the kinematic links, different types of pairs, mechanisms and principles involved in assessing the displacement, velocity and acceleration at any point in a link of a mechanism
- To understand the kinematic aspects of friction involved in machineries such as belts, clutches and brakes
- To understand the basic concepts of toothed gearing and kinematics of gear trains
- To understand the motion resulting from a specified set of linkages and cam mechanisms for specified output motions
- To understand the undesirable effects of unbalancing resulting from prescribed motions in mechanism
- To study about the fundamentals of vibration and dynamics of mechanisms

MODULE I MECHANISMS 8+3

Machine Structure – Kinematic link, pair and chain – Gruebler's criteria – Constrained motion – Degrees of freedom – Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

MODULE II FRICTION 7+3

Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

MODULE III GEARS 7+3

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains – Determination of speed and torque

MODULE IV CAMS 7+2

Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

MODULE V BALANCING 8+2

Static and dynamic balancing – Single and several masses in different planes –

Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method.

MODULE VI VIBRATION 8+2

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi rotor systems – Geared shafts – Critical speed of shaft.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Rattan.S.S, "Theory of Machines", Tata McGraw–Hill Publishing Co., New Delhi, 2004.
2. Ballaney.P.L, "Theory of Machines", Khanna Publishers, New Delhi, 2002.

REFERENCES:

1. Rao,J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition, Wiley Eastern Ltd., 1992.
2. Malhotra, D.R and Gupta, H.C., "The Theory of Machines", Satya Prakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press, 1989.
4. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill, 1980.
5. Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall, 1979.

OUTCOMES:

On completion of the course the students should be able to

- Demonstrate the fundamentals of mechanisms and their applications and able to analyse the kinematic properties of mechanism such as displacement , velocity and acceleration
- Analyze the effect of friction in machines such as belt drives, clutches and brakes
- Understand the basic nomenclature of gears and analyze gear kinematics.
- Perform the kinematic analysis of cam
- Demonstrate the balancing of any kinematic system
- Analyze different types of Vibrations

AUC 2213 AUTOMOTIVE ELECTRICAL &ELECTRONICS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To learn about working principle and different types battery used in automobile.
- To impart knowledge to the students in the principles of operation and construction details of various Automotive of starting system and charging systems.
- To provide fundamental knowledge about various types of ignition systems.
- To impart knowledge to students about lighting system, wiring system and accessories.

MODULE I BATTERIES AND STARTING SYSTEM 8

Vehicle Batteries –Lead acid battery Construction, Working Principle, Battery Rating Lead Acid battery Charging methods and Testing Methods and Fault Diagnosis Requirement of a starting System, Starter motor-Construction and Working. Starter Drive Mechanism –Bendix drive and Folo-thru drive Starter Drive Mechanism – Over Running Clutch and Solenoid Mechanism. Starter Motor Fault Diagnosis New Developments in Battery Technologies and Starting System

MODULE II CHARGING SYSTEM AND LIGHTING SYSTEM 8

Components of DC and AC Charging System for Automobile, construction, operating principle, characteristics, charging circuit controls – cut out, relays, voltage and current regulators, troubleshooting. Mechanical and Electronic Voltage regulator – Principle and Working - Lighting Fundamentals and Lighting Circuit Conventional Headlamps and LED Lighting System- Wiper system and Signaling and Warning system

MODULE III SENSORS, ACTUATORS AND CONTROLS 7

Sensors for throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure , actuators, various types of actuators.

MODULE IV FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 6

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines.

MODULE V ELECTRONIC ENGINE MANAGEMENT SYSTEM 8

Gasoline Engine Fuel Injectors-Single point, Multi Point Fuel Injections, Testing of Fuel Injectors-Conventional Ignition System -Electronic Ignition System – Programmed ignition system, Distributor less Ignition System- Digital Engine Control Modes - EGR Control and variable valve timing Ignition Controlling –Closed loop ignition timing, Spark Advance Correction Scheme.

MODULE VI VEHICLE CONTROL SYSTEMS 8

Cruise Control System and Adaptive Cruise Control System Working –Throttle Actuator Stepper Motor Based Control Antilock Braking Mechanism –Tire Slip Controller Electric Power Assisted Steering Mechanism, Four Wheel Steering and Steer-by-Wire - Electronic Suspension System -Parking assist, Electronic brakes, Power window,

Total Hours –45

TEXT BOOKS:

1. Tom Denton "Automobile Electrical and Electronic Systems" 3rd edition,Elsiever Butterworth-Heinemann 2004..
2. Judge,A.W., Modern Electrical Equipment of Automobiles, Chapman & HallLondon.
3. William B.Ribbens Butterworth, Heinemann,"Understanding Automotive Electronics", 5th Edition, 1998.
4. Tom Weather Jr and Cland C.Hunter, "Automotive Computers and Control System", Prentice Hall Inc., New Jersey, 1984.

REFERENCES:

1. Young,A.P. & Griffiths,L., Automobile Electrical Equipment, English Language Book Society & New Press.
2. Kholi,P.L., Automotive Electrical Equipment, Tata McGraw-Hill Co. Ltd., New Delhi.
3. Robert Bosch ,"Diesel Engine Management", Wiley Publications, 2006
4. Robert Bosch , "Gasoline Engine Management", Wiley Publications, 2006

OUTCOMES:

On completion of the course the students should be able to

- Enumerate the working principle of various batteries and starting systems.
- Demonstrate the construction and working of charging and lighting system.
- Identify various sensors in EMS and link the actuators.
- Understand the fundamentals of electronics control system
- Understand the principle behind SI and CI engine management system
- Demonstrate various control systems in automobiles

AUC 2214 AUTOMOTIVE MATERIAL & METALLURGY

L	T	P	C
2	0	2	3

OBJECTIVES:

- Expose the students with various constitutions of alloys and its effects on adding with steel and also modifying the mechanical behavior of materials.
- To impart knowledge on the structure, properties, phase diagrams and applications of materials so as to identify and select suitable materials for various engineering applications.
- Impart to the students the ability to investigate, analyze and provide solutions to problems arising from metallurgical and materials engineering processes.
- To develop an overall sound knowledge of metallurgical and materials engineering .

MODULE I METALLURGICAL FUNDAMENTALS AND CONSITITUTION OF ALLOYS AND PHASE DIAGRAMS 8

Crystal structure –crystal imperfections– Grain size, Constitution of alloys – Solid solutions, substitutional and interstitial. Phase diagrams- Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Lever Rule, Iron – Iron carbide equilibrium diagram- Development of Microstructure in Iron–Carbon Alloys

MODULE II FERROUS AND NON FERROUS METALS 7

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – HSLA - maraging steels – cast Irons- Gray, White malleable, Spheroidal Graphite. Copper and its alloys– Aluminium and its alloys – Magnesium and its alloys – Titanium and its alloys - microstructure, properties and applications.

MODULE III HEAT TREATMENT AND STRENGTHENING MECHANISMS 8

Full annealing, normalising, hardening and tempering of steel, Isothermal transformation diagrams, Continuous Cooling Transformation Diagrams, case hardening- carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening. Hardenability-Jominy end quench test. Grain size strengthening, Solid solution strengthening, Strain hardening, Yield point phenomenon, dispersion strengthening, fibre strengthening, precipitation strengthening.

MODULE IV POWDER METALLURGY 6

Pressure compaction- Isostatic pressing, powder rolling, forging and extrusion, explosive compaction. Sintering, Hot pressing and Hot Isostatic Pressing , vacuum sintering, finishing operations – sizing, coining, repressing and heat treatment, Processing of nano materials

List of Experiments

1. Metallographic Examination-Demonstration and Practice
   a. Study of metallurgical microscope.
   b. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
   c. Selections of etchants for various metals and alloys.
2. Identification of microstructures of Plain Carbon Steel, Tool Steel, Gray C.I, SG Iron,
3. Heat treatment: Annealing, normalizing, hardening and tempering of steel-Hardness and its microstructure.
4. Study of microstructure of welded (HAZ) and cast component.
5. Hardenability test - Jominy End quench test.
6. Tension test
7. Compression test
8. Torsion test.
9. Deflection test
10. Impact test
11. Double shear test

T- 30, P- 30,Total Hours –60

TEXT BOOKS:

1. Syndney H Avner, “Introduction to Physical Metallurgy”, 2/E Tata McGraw Hill Book Company, 2007.

REFERENCES:

1. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian Edition 2007.
2. Raghavan. V. Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd, 5th Edition 2007.
3. Kenneth G. Budinski and Michael K. Budinski “Engineering Materials”, PHI / Pearson Education, 8th Edition, 2007.
4. George E. Dieter, Mechanical Metallurgy, McGraw Hill, 2007.

OUTCOMES:

On completion of the course the students should be able to:

- Describe the structure of materials, classify defects and explore the constitutional of alloys for different industrial components.
- Interpret and demonstrate phase diagrams.
- Classify and analyze ferrous and non-ferrous materials with properties and applications.
- Select and apply appropriate heat treatment practices to modify the mechanical behaviour of various materials
- Select and apply appropriate strengthening mechanism to modify the mechanical behavior of materials
- Analyze the various operations involved in the powder metallurgy technique.

AUC 2215	PRODUCTION PROCESS OF AUTOMOTIVE COMPONENTS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To study about the components produced by powder metallurgy
- To understand the concepts of forming process and know the components produced by forging , Extrusion and hydro forming processes
- To know about the principle and methods of gear manufacturing process
- To know about the recent trends for production of automobile components

MODULE I POWDER METALLURGY PROCESS 6

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

MODULE II FORMING PROCESS 9

.Forging – 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.

Hydro forming: Process, hydro forming of manifold and tail lamp housing. Stretch forming – Process, stretch forming of auto body panels – Super plastic alloys for auto body panels.

MODULE III GEAR MANUFACTURING 6

Different methods of Gear manufacture – Gear hobbing and gear shaping machines specifications – gear generation – different methods – gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching

MODULE IV RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS 9

Powder injection moulding – Shotpeen hardening of gears – Production of aluminium MMC liners for engine blocks – Plasma spray coated engine blocks and valves – Recent developments in auto body panel forming – Squeeze casting of pistons – aluminium composite brake rotors.

Total – 30 Hours

TEXT BOOKS:

Heldt,P.M., High Speed Combustion Engines, Oxford Publishing Co., New York, 199

REFERENCES:

1. Haslehurst,S.E., Manufacturing Technology, ELBS, London, 1990

2. Rusinoff, Forging and Forming of metals, D.B. Taraporevala Son & Co. Pvt.Ltd., Mumbai, 1995.

3. Subroff, A.M. & Others, Forging Materials & Processes, Reinhold Book Corporation, New York, 1988. 4. High Velocity Forming of Metals, ASTME, Prentice Hall of India (P) Ltd., New Delhi, 1990.

4. High Velocity Forming of Metals, ASTME, Prentice Hall of India (P) Ltd., New Delhi, 1990.

5. Groover. M.P., Automatic production systems and computer integrated manufacturing, Prentice-Hall, 1990.

6. GE Thyer, Computer Numerical Control of Machine Tools, BH.Newners, 1991.

OUTCOMES:

Students will able to

- Design and write the procedures to make automobile parts by powder metallurgy process
- Design and write the procedures to produce automobile parts by forming processes
- Apply the various gear manufacturing methods needed for automotive applications.
- Use the recent trend in manufacturing for making auto components

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.

P- 30; 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.

AUC 2216 **AUTOMOTIVE CHASSIS LABORATORY**

L	T	P	C
0	0	3	1

OBJECTIVES:

- To Study the constructional details and Structures of different types of frames used in vehicle
- To Study mechanism of different types of steering system
- To Study mechanism of different types of drive line and final drive.
- To study use age of wheels and tyres.
- To Study the fundamental and working of different types of Suspension Systems of Automobiles
- To Study the fundamental and working of different types of Braking Systems of Automobiles.

LIST OF EXPERIMENTS

1. Measurement of Automotive Chassis and Identification of various parts & types of frame and its Cross Section.
2. Evaluate the steering geometry practically by eye vision also find steering value angle of out side lock of front wheel and true turning circle radius.
3. Evaluate the function of different types of clutches and torque converter .
4. Evaluate the function of transmission system (gear box, propeller shaft, universal joint) also determine the gear ratios for each speed & speed of propeller shaft.
5. Evaluate the function of the final drive differential also find the final reduction and wheel reduction.
6. Evaluate the function of different types of wheel & tires also measure the various parameters of wheels and tyre.
7. Identification and function of each components of front and rears suspension system also find the deflection of springs.
8. Study the power steering and manual steering mechanism also find steering gear ratio.
9. Study the function of disc & drum braking system and also find the different hydraulic pressure value of drum &disc brake.
10. Project work.

Total Hours –45 Hours

OUTCOMES:

On completion of the course student should be able to

- Select suitable frame for different vehicle with justification
- Select suitable steering system for different vehicles with justification.
- Analyze various drive line systems for automobiles.
- Select suitable wheels and tires with justification
- Evaluate the different types of suspension system for vehicle.
- Select and analyze different types of vehicle layouts.

AUC 2217	AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To study the working principle of the various electrical and electronic control devices used in automobile.

STUDY EXPERIMENTS:

- Study of revolution counter circuit
- Study of control of DC motors
- Study of IC 555 timer for motor control

LIST OF EXPERIMENTS:

1. Verify logic gates (AND,OR, NAND, NOR, EX-OR)
2. Lab VIEW basic programming (tank level control)
3. Implementation of half adder and full adder
4. Characteristics of Silicon controlled rectifier (SCR)
5. Addition and Multiplication of 8 bit numbers using 8085
6. Stepper motor control using 8051.
7. Temperature monitoring using Lab VIEW
8. Heating and ventilation control using Lab VIEW.

Total Hours – 45

OUTCOMES:

On completion of the course students should be able to

- Able to know the working principle of various electrical systems used in automobile.
- Identify and Analyze Faults in a Vehicle.
- Able to design and analyze the simple electronic circuits for automotive applications.

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** **08**

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** **08**

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 09

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 08

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 Hours

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

AUC 3101 DESIGN OF AUTOMOTIVE COMPONENTS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To familiarize various forces, stresses and strains on several engine components.
- To design different automotive components in accordance with standard design procedure and design criteria.
- To know the basic design procedure of automotive components

MODULE I INTRODUCTION TO DESIGN 5+2

Classification of design - Engineering materials and their physical properties as applied to

design -Selection of materials – Theories of failure - Factors of safety in design - Design for variable loading – Soderberg, Goodman and Gerber relations.

MODULE II DESIGN OF SHAFT 7+4

Introduction - Material and design stresses - Design of shafts on the basis of strength -Design of shaft on the basis of rigidity - Design of hollow shafts.

MODULE III SPRING DESIGN 8+2

Design of close coiled helical spring subjected to axial loading- Torsion of helical springs - Design of leaf springs - Laminated leaf springs – semi-elliptical leaf spring.

MODULE IV DESIGN OF BEARINGS 8+2

Design of bearings - Journal and ball bearings - Bearing life - Static load capacity – Dynamic load capacity - Bearing material- Oil flow and temperature rise.

9+3

MODULE V **DESIGN OF GEARS**

Design considerations - Strength of gear teeth - Terminology of gears - Design of spur gears - Helical gears - Bevel gears.

MODULE VI **DESIGN OF FLYWHEEL** **8+2**

Determination of the mass of a flywheel for a given co-efficient of speed fluctuation, Engine flywheels stresses of rim of flywheels, Stresses in the arm (at the hub end).

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Kulkarni S. G, "Machine Design", Tata McGraw-Hill Education, 2008.
2. Bhandari V, "Design of Machine Elements",Tata McGraw-Hill Education, 2010
3. R.S. Khurmi, J.K. Gupta "Machine Design", S Chand & Co Ltd, 2005. 25th Revised edition.
4. Engine Design – Giles J. G., Lliffe Book Ltd.
5. Jain,R.K., "Machine Design", Khanna Publishers, 1992.
6. Engine Design – Crouse, Tata McGraw Publication, Delhi
7. Design of Automotive Engine – A. Kolchin and V. Demidov

REFERENCES:

Hall Allen,S. & other, "Machine Design", Schaum publisher Co., 1982.

2. Sigley, "Machine Design", McGraw Hill,1981.

"Design Data Book", PSG College of Technology, Coimbatore.

OUTCOMES:

On completion of the course students should be able to

- Illustrate various design aspects and design procedures.
- Design shafts in automotive.
- Design helical and leaf springs in automotive.
- Design journal and ball bearings used in automotive.

- Design various gears used in automotive.
- Understand the flywheel design.

AUC 3102	AUTOMOTIVE TRANSMISSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the various components in transmission system and drive line units of automobiles.
- To know about the working principle of transmission system and hydrodynamic transmission.
- The students able to know about the various automatic transmission systems in a vehicle.
- The students able to know the applications of automatic transmission in a vehicle.
- To know about the hydrostatic drive principle and working of electric drive in a vehicle.

MODULE I CLUTCH AND GEAR BOX 9

Requirement of transmission system, Different types of clutches, principle & Construction of Single plate and multiplate clutch, centrifugal clutch. Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchromesh gearboxes – Determination of gear ratios for vehicles.

MODULE II HYDRODYNAMIC TRANSMISSION 7

Fluid coupling-working principle and Constructional details, Torque capacity and Performance characteristics. Reduction of drag torque in fluid coupling. Torque converter-working principle and constructional details, performance characteristics.

MODULE III EPICYCLIC GEARBOXES 8

Requirements of Epicycle gear system, Epicycle gearbox working and operation and Constructional details. Principle of Planetary gear trains - Wilson Gear box, Hydraulic Control system for Automatic Transmission.

MODULE IV AUTOMATIC TRANSMISSIONS APPLICATION 7

Need for automatic transmission, Chevrolet “Turboglide” Transmission, Continuously Variable Transmission (CVT) – Types and Operations of a typical CVT and applications.

MODULE V **HYDROSTATIC TRANSMISSION** **7**

Hydrostatic drive- various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive.

MODULE VI **ELECTRIC DRIVE** **7**

Electric drive, layout of electric drive, types- Principle of early and modified Ward Leonard Control system-Advantages & limitations. Comparison of early and modified ward Leonard control system. Hybrid vehicle, fuel cell powered vehicle and solar powered vehicle.

Total Hours –45

TEXT BOOKS:

- Heldt, P.M., "Torque converters", Chilton Book Co., 1962.
- Newton and Steeds, "Motor vehicles", Illiffe Publishers, 1985.
- Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.
- A Text book of Auto Transmission and Electrical systems by K.S Raghu Ram.
- Automotive Transmissions Fundamentals, Selection, Design and Application 2011. Naunheimer, H., Bertsche, B., Ryborz, J., Novak, W.

REFERENCES:

- SAE Transactions 900550 & 930910.
- Hydrostatic transmissions for vehicle applications, I Mech E Conference, 1981
- Crouse,W.H., Anglin,D.L.," Automotive Transmission and Power Trains construction", McGraw-Hill, 1976.
- Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2002

OUTCOMES:

- The students able to know the constructional and working principle of various types of clutch and gearbox.
- The students able to evaluate the various types of automatic transmission used in automobile vehicle.
- The students can analyze the design ratio of gear box used in a automobile vehicle.
- The students able to know about the various types of transmission used in automobile vehicle.
- The students able to know the constructional and working principle of hydrostatic, hydrodynamic transmission.

  The students able to analyze the merits of electric drive used in a vehicle.

AUC 3103 MEASUREMENTS AND INSTRUMENTATION

L	T	P	C
1	0	2	2

OBJECTIVES:

- To learn about the various linear and angular measuring instruments of vari accuracies and ranges.
- To learn about measuring systems for parameters like force, torque temperature.

MODULE I MEASUREMENTS 7

Metrology, Units and standards-measuring instruments, linear and angular measurements, Range, Variance and Standard deviation, slip gauges, Taper and roundness measurements, form measurement, Flatness and surface finish measurements.

MODULE II INSTRUMENTATION 8

Instruments for gears and threads measurement, laser instrumentation, CMM, machine vision systems, Instrumentation for force and torque measurements, Instrumentation for temperature, flow and acoustic measurements. Instrumentation for engine testing.

Laboratory Experiments.

1. Calibration and Error analysis of measuring Instruments.
2. Measuring Instrument Fabrication:

   Fabrication of 0.2 mm accurate simple Vernier caliper.

   Fabrication of 0.2 mm accurate simple Micrometer.

   Fabrication of simple strain gauge load cell etc.

   Fabrication of simple strain gauge, load cell etc.
3. Complete all measurements including intricate internal details of the given component using standard equipment and by other measuring procedures (Quick setting compounds, moulds etc.).
4. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical).
5. Measurement of angle using Sine bar / Sine Center /Toolmakers microscope /Slip gauge.
6. Measurement of taper using standard balls / rollers.
7. Measurement of straightness and flatness.
8. Measurement of thread parameters.

9. Measurement of gear parameters.
10. Measurement of radius and surface roughness.
11. Measurement of Temperature.
12. Measurement of Displacement, Force and Torque.
13. Measurement of Acoustic Emission.
14. Scanning the surface using Coordinate Measuring Machine (CMM).
15. Measurement using vision system.

L – 15; P – 30; Total Hours -45

TEXT BOOKS:

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

REFERENCES:

1. Gupta S. C," Engineering Metrology", Dhanpat rai Publications, 1984.
2. Beckwith T.G, and R. D. Marangoni, "Mechanical Measurement", Addis Wesley 1999.
3. Donald D Eckma, "Industrial Instrumentation", Wiley Eastern, 1985.
4. ASTME," Hand book of industrial metrology" Prentice hall of India, 1988.
5. ASNT," Nondestructive testing handbook Emission" volume5 – acou emission testing, 1994.

OUTCOMES:

Students should be able to

- Measure various engineering specifications with linear, angular, flatness, form and roughness instruments (PO1 & PO2)
- Set up Instrumentation and measurement of threads, gears, force, torque, flow and temperature. (PO1 & PO2)

ENC 3181	COMMUNICATION AND SOFT SKILLS - I CONFIDENCE BUILDING	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop professional skills like work ethics, analytical skills, presentation skills etc.
- To train them in problem solving skills and leadership skills pertaining to industries.
- To train them in team building skills.
- To train in setting up career goals

MODULE I **6**

Brief about Multinational companies- Analysing 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 specific 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-- presenting career goals. -- preparing for interviews- interpersonal skills

Total Hours – 30

REFERENCES:

1. Covey,S.R. (2004). The 7Habits 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. Amazon.com
4. Wentz,F.H.(2012). Soft skills training: A Workbook to Develop Skills for Employment. Amazon.com

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.

AUC 3104 **HEAT TRANSFER LABORATORY**

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.

AUC 3105	AUTOMOTIVE COMPONENT MODELLING LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To learn to generate part models assembly of various machine components and systems using modeling packages
- To generate part and assembly models of actual Mechanical Products.

INTRODUCTION TO AUTO CAD **9**

Getting into Auto CAD. Drawing Editor, Menus, Co-ordinator systems, Creating adrawing. Line input methods, Angle measures, Circle-5 methods, Unity commands.Organising a Drawing Area: Limits, Zoom all, Drawing Aids, Grid, Shape, Ortho,Function keys, Entity creation, Arc, Point, Polygon, Donut, Trace, Ellipse. EditingCommands: Erase, Object selection methods, U, Oops, Redo, Move, Copy, Mirror,Rotate, Scale, Array.Two-Dimensional geometrical construction curves – Projection of points – Projection of solids – Three dimensional views of simple solids.

MODELING SOFTWARE APPLICATION **36**

Introduction of Modelling Software, Formatting of 2D and 3D objects.3D Part Modeling – Protrusion, cut, sweep, draft, loft, blend, rib, round, chamferEditing-Move, Pattern, Mirror Assembly- Creating assembly from parts-assembly constrains Conversions of 3D solid model to 2D drawing – different views, sections, isometric view and dimensioning Introduction to Surface Modeling Introduction to File import, Export – DXF, IGES, STL, STEP 3D Modeling of machine elements like Flanged coupling, screw, jack etc.,

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

LIST OF EXPERIMENTS:

1. 2D – Drawing
2. 3D – Drawing
3. Simple drawing using c- language
4. Piston development CATIA –C
5. Radiator Fan
6. Helical spring design
7. Tension Spring design
8. Leaf Spring design
9. Connecting ROD assembly design

10. Tyre design
11. Wheel – Spoke , Alloy

Total Hours - 45

REFERENCES:

1. Bhatt .N.D. and PANCHAL.V.M. "Machine Drawing", Charotar Publishing House, 388001, 38th Edition, 2003.
2. K.R. Gopalakrishnan., "Machine Drawing", 18th Edition, 2004.
3. P.S.G. Design Data Book
4. Ellen Finkelstein, "AutoCAD 2004 Bible", Wiley Publishing Inc, 2003.
5. Sham Tikoo, "AutoCAD 2002 with Applications", Tata McGraw-Hili Publishing Company, New Delhi, 2002.

OUTCOMES:

On completion of the course the students should be able to

- Generate solid models and 2-D drawings of products adhering to standards
- Generate part models assembly of various machine components and systems using modeling packages.
- Evaluate various codes and specifications of BIS concerned with engineering Drawings.
- Generate solid models and 3-D drawing for simple components

SEMESTER - VI

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.

AUC 3211 **VEHICLE DYNAMICS**

L	T	P	C
3	1	0	4

OBJECTIVES:

- Understand the concept of sources of vibrations and methods to reduce these vibrations
- Gain knowledge about the suspension related vibrations for improving passenger comfort.
- Understand about the stability of vehicle in various terrains.
- Understand characteristics of tyres in different surfaces.

MODULE I **VIBRATION BASICS** **8+3**

Fundamentals of vibration, Classification of vibration, definitions, Mechanical vibration and human comfort. Single degree of freedom, two degree of freedom, multi-degree freedom systems, free, forced and damped vibrations, sources of vibration in automobile, magnification factor, transmissibility, Vibration absorber. Vibration measuring instruments

MODULE II **VERTICAL DYNAMICS** **7+3**

Vertical forces, Fundamental and types of suspension system, Single, Half and full car wheel models, passive, semi active and active suspension, Influence of suspension stiffness, suspension damping, and tyre stiffness. Pneumatic suspension system.

MODULE III **LONGITUDINAL DYNAMICS** **7+2**

Forces acting in longitudinal direction, load distribution, calculation of acceleration, tractive effort and reactions for different drives, stability of a vehicle on a curved track, slope and a banked road.

MODULE IV **LATERAL DYNAMICS** **7+2**

Forces acting in lateral direction, steady state handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle under side forces. Effect of suspension on cornering.

MODULE V **WHEELS AND TYRES** **7+2**

Types of wheel, wheel wobble, wheel shimmy, wheel balancing - recent, statics, dynamic - tyre - requirements, types, testing dynamics, characteristics, power consumed by a tyre, rolling resistance.

MODULE VI **DYNAMIC VEHICLE CONTROL TECHNIQUES** **9+3**

Suspension Control techniques. Anti lock braking control, stability control, Traction control, Bicycle Model, cruise control.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Singiresu S. Rao, Mechanical Vibrations (5th Edition), Prentice Hall, 2010
2. Giri N.K – Automotive Mechanics, Khanna Publishers, 2002.
3. Rao J.S and Gupta. K "Theory and Practice of Mechanical Vibrations", Wiley
4. J. Y. Wong, Theory of Ground Vehicles, 3rd Edition, Wiley-Interscience, 2001

   Gillespie T.D, "Fundamentals of Vehicle Dynamics", SAE USA 1992.

REFERENCES:

1. Heldt.P.M -"Automotive Chassis"- Chilton Co., New York- 1992
2. Ellis.J.R - "Vehicle Dynamics"- Business Books Ltd., London- 1991
3. Giles.J.G.Steering - "Suspension and Tyres", Illiffe Books Ltd., London- 1998
4. Ham B, Pacejka - Tyre and Vehicle Dynamics - SAE Publication - 2002.

OUTCOMES:

- Develop the fundament concepts to analyses the vehicle system performance in dynamic condition
- Generate mathematical model and analyze the performance characteristics of Suspension
- Analyse the performance at different surfaces like curved track, slope and a banked road.
- Discuss the handling characteristics and Transient response characteristic associate with the effect of suspension on cornering.
- Demonstrate characteristics wheels and tyre dynamics control systems.
- Apply the knowledge of modern control methods to develop vehicles for modern scenario.

AUC 3212 VEHICLE DESIGN DATA CHARACTERISTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- The Students able to collect important technical specifications of an automobile from Technical notes, research publications.

MODULE I INTRODUCTION 8

Fundamentals of vehicle design, Gross Vehicle, Weight, laden and un-laden weights , Front and rear axle weights, Frontal Area, maximum speed, maximum acceleration, gradability in different gears.

MODULE II POWER ESTIMATION 7

Analysis of air and rolling resistances at various vehicle speeds - Calculation, Tabulation and Plotting of Curves, Estimation of Driving force, determination of power requirement for different loads and speeds, Maximum Power calculation.

MODULE III PERFORMANCE CURVES 7

Calculation, Tabulation and Plotting of Torque and Mechanical Efficiency for different vehicle speeds, Interpolation of Pressure – Volume diagram, Calculation of frictional Mean Effective Pressure, Calculation of Engine Cubic Capacity, Bore and Stroke Length.

MODULE IV VELOCITY , ACCERELATION AND TURNING MOMENT 7

Connecting rod length to Crank Radius Ratio, Plotting of Piston Velocity and Acceleration against Crank Angle, Plotting Gas force, inertia force and Resultant force against Crank Angle, Turning Moment and Side Thrust against Crank Angle.

MODULE V POWER TRAIN 8

Determination of Gear Ratios, Acceleration and Gradability, Typical Problems on Vehicle performance.

MODULE VI **OVERALL VEHICLE PERFORMANCE** **8**

Over all vehicle performance, Characteristics of different vehicle sub systems.

Total Hours – 45

TEXT BOOKS:

1. Heinz Heisler Advanced Vehicle Technology, 2nd edition, Publisher Elsevier - 2002.
2. Hilliers Fundamentals of Motor Vehicle Technology 6th Edition, Publisher Oxford - 2014

REFERENCES:

- N. K. Giri, Automotive Mechanics, Khanna Publishers, New Delhi, 2005.
- Heldt, P.M., High Speed Combustion Engines, Oxford and I.B.H. Publishing Co.,Kolkata, 2002.

OUTCOMES:

The students should be able to

- Understand the basic vehicle design
- Analyse the power estimation of vehicle
- Determine the performance of engine
- Calculate and plot the velocity, acceleration and turning movement of piston
- Determine the performance of power train.
- Calculate and tabulate various vehicle performance parameters and design parameters **.**

ENC 3281	COMMUNICATION AND SOFT SKILLS - II	L	T	P	C
	CAREER CHOICE	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

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.

AUC 3213 VEHICLE DYNAMICS LABORATORY

	L	T	P	C
	0	**0**	**3**	**1**

OBJECTIVES:

- Measure forces due to dynamic imbalance of a rotating shaft.
- Compute magnitudes and locations of balancing masses in two given planes.
- Implement balancing masses.
- Measure forces after balancing and assess the effectiveness of the balancing design

LIST OF EXPERIMENTS:

1. Governors - Determination of sensitivity, effort, etc.
2. Cam - Study of jump phenomenon and drawing profile of the cam.
3. Gyroscope-Verification of law's -Determination of gyroscopic couple.
4. Determination of critical speed of shaft with concentrated loads.(Whirling of shaft)
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Determination of moment of inertia 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 multidegree freedom suspension system.
10. Determination of transmissibility ratio - Vibrating plateform.
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.
13. Estimation spring rate of leaf spring
14. Design and determination of spring rate of coil spring
15. Testing of damper – determination of damping rate

Total Hours –30

OUTCOMES:

- Ability to analyze kinematics of the three-dimensional particle motion in various coordinate systems: cartesian, natural and cylindrical.
- Understanding of the concepts of displacement, velocity and acceleration as vectors and how to determine them.
- Understanding of the notion of a force as a vector.
- Ability to understand concepts of kinetic, potential and mechanical energies and the concept of a conservative force.
- Understanding of the concepts of power and mechanical efficiency.
- Ability to analyze particle dynamics
- Ability to make a right decision related to a choice of the system of particles whose motion is to be studied.
- Ability to correctly draw the free-body diagram (FBD) for the system.
- Ability to write and solve Newton equations of motion for the system.
- Ability to use concepts of angular displacement, angular velocity and angular acceleration.
- Ability to draw a FBD for a system of rigid bodies.
- Ability to determine mass moment of inertia for some simple body geometries.
- Ability to use principles derived from Newton's second law, including Work & Energy.

AUC 3214	VEHICLE COMPONENTS ANALYSIS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To analyze stress distribution and stress concentration of various components under structural and thermal loads

STATIC STRUCTURAL ANALYSIS

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

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

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

TRANSIENT STRUCTURAL ANALYSIS

4. Analysis of truss structure [2D,3D]

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

6. Analysis of cylindrical pressure vessel under internal pressure [Plane Strain] 7.

Analysis of an thick cylinder [Axisymmetric approach]

MODAL AND HARMONIC ANALYSIS

8. Natural frequencies of a beam with different boundary conditions.

9. Harmonic analysis of a beam. THERMAL ANALYSIS

10. Analysis of cooling fin [conduction and convection]

11. Thermal stress in a composite pipe.

CONTACT ANALYSIS

12. Contact analysis of pin on disk

Total Hours – 45

OUTCOMES:

Student should be able to

- Model and analyze stress distribution and stress concentration of various components under structural and thermal loads

- Calculate and tabulate various vehicle performance parameters and design parameters
- Draw curves using these data for the system .engineering Drawings.

AUC 3215 VEHICLE MAINTENANCE LABORATORY

L	T	P	C
0	**0**	**3**	**1**

OBJECTIVES:

- To study the various maintenance the reconditioning of vehicle parts.
- To train the structures in identifying the fault and rectification.
- To impart the fundamental knowledge in evaluation and maintenance.
- To know about the various methods of maintaining vehicles and their subsystems.

STUDY EXPERIMENTS:

- Study and layout of an automobile repair, service and maintenance shop.
- Safety aspects with respect to man, machine and tools.
- General procedures for servicing and maintenance schedule.
- Fault diagnosis and service of transmission system
- Fault diagnosis and service of Electrical system like battery, starting system,
- charging system, lighting system etc.
- Fault diagnosis and service of vehicle air conditioning system

LIST OF EXPERIMENTS

1. Minor and major tune up of gasoline and diesel engines.
2. Calibration of Fuel injection pump.
3. Cylinder reboring - checking the cylinder bore, Setting the tool and reboring.
4. Calibration of fuel injection nozzle and tester
5. Removal and fitting of tire and tube.
6. Fault diagnosis of ignition system and spark plug cleaner & tester
7. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel play.
8. Wheel alignment procedure for servicing and maintenance.
9. Fault diagnosis of brake/clutch
10. Calibration of head lamp aligner
11. Calibration of Refacer of valve.

Total Hours –45

TEXT BOOKS:

- Vehicle maintenance and garage practice by Jigar A.Doshi Dhru U.Panchal, Jayesh P.Maniar. 2014
- A Practical Approach to Motor Vehicle Engineering and Maintenance 3rd Edition by Allan Bonnick.

REFERENCES:

- Vehicle Service Manuals of reputed manufacturers
- Advanced Automotive Fault Diagnosis by Tom Denton 2011.
- Nissan Patrol Automotive Repair Manual: 1998-2014 by Haynes Manuals Inc.
- Automobile electrical manual a comprehensive guide by Haynes manual car repair.

OUTCOMES:

On completion of the course the students should be able to

- Identify the analyze faults in a vehicle.
- Demonstrate the procedure for reconditioning and repairing of various component and subsystems of vehicles.
- Illustrate the complete methodology of evaluation and maintenance of automobile.
- Perform dismantling & assembling of automobile components using tools.
- Enumerate the importance of maintenance and also the step by step procedure for maintaining the various automotive subsystems.

SEMESTER – VII

AUC 4101	FINITE ELEMENT ANALYSIS OF AUTOMOTIVE COMPONENTS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand about the concept of Continuum Mechanics
- To Study about the 2D and 3D parametric elements
- To know the static and dynamic problems in FEA

MODULE I INTRODUCTION 10

Basic concepts of finite element method. Review of various approximate methods in structural analysis, Stiffness and flexibility matrices for simple cases. Direct stiffness method- plane truss idealization, joint forces and displacements. Formulation of governing equations and convergence criteria.

MODULE II DISCRETE ELEMENTS 10

Use of bar and beam elements in structural analysis. Computer implementation of procedure for these elements. 1D problems with second order equations, weak formulations-Examples from solid mechanics and heat transfer.

MODULE III CONTINUM ELEMENTS 10

Classification of C0 C1 continuous problems, parameter functions and its properties – completeness and compatibility condition. Different forms of 2D elements and their applications for plane stress, plane strain and axi-symmetric problems. Consistent and lumped formulation. Use of local coordinates. Numerical integration.

MODULE IV ELEMENTS 10

Isoparametric quadrilateral elements-Shape functions for rectangular elements, Isoparametric mapping for quadrilateral elements, Numerical integration for quadrilateral elements, Four node quadrilateral element for 2DBVP,Eight node serendipity element for 2D BVP

MODULE V FEA IN THERMAL ANALYSIS 10

Finite element analysis of 2D steady state thermal analysis-Galerkin approach-General two dimensional heat conduction-Axisymmetric heat conduction-Triangular, Quadrilateral elements-Simple problems using three noded triangular only.

MODULE VI FEA IN STRUCTURAL ANALYSIS 10

Finite element analysis of plane elasticity 2D problems-Introduction to theory of elasticity-plane stress-plane strain and Axisymmetric formulation-Element matrices using energy approach-Simple problems using three noded triangular element only.

Total Hours –60

TEXT BOOKS:

1. Segerlind.L.J., " Applied Finite Element Analysis ", Second Edition, John Wiley and Sons Inc., New York, 1984.

REFERENCES:

1. Bathe.K.J. and Wilson.E.L., " Numerical methods in finite elements analysis ", Prentice Hall of India Ltd, 1983.
2. Cook.R.D., "Concepts and Applications of Finite Element analysis ", 3rd Edition, John Wiley & Sons, 1989.
3. Krishnamurthy.C.S., " Finite Elements analysis ", Tata McGraw Hill, 1987.
4. Ramamurthi.V., " Computer Aided Design in Mechanical Engg. ", Tata McGraw-Hill, 1987.

OUTCOMES:

- Apply the numerical methods involved in Finite Element basics of truss, beam, membrane, plate, and continuum elements
- Create of planar one-dimensional (truss and beam) elements having linear, quadratic, and cubic shape functions
- Develop the Global, local, and natural coordinates for analysis.
- Generation of planar, plane stress two-dimensional elements (rectangular and quadratic quadrilateral elements)
- Devise of 3-dimensional elements (four-node tetrahedral and eight-node brick elements)
- Compile the formulation and basic energy and weighted residual formulation of finite elements.

AUC 4102	TWO AND THREE WHEELERS TECHNOLOGY	L	T	P	C
		2	0	2	3

OBJECTIVES:

- Gain the knowledge about the constructional and design aspects of two wheelers and three wheelers.
- Develop the ability to know the operating characteristics two and three wheelers
- To create an experience to know the working principle and different types engine, transmission system of two and three wheelers
- To impart knowledge to the learners in the principles of working and operation and of various barking systems. brakes, wheels and tyres
- Enhance ability of the learners about working principles of electrical and electronic subsystem and sensors are using in two wheeler sand three wheelers.

MODULE I INTRODUCTION AND POWER PLANT 7

Classification and layout of two wheelers (Motorcycles, scooters mopeds) and Three wheelers, (Auto rickshaws, pickup van and delivery van) applications and capacity – goods and passengers; study of technical specifications of Two and Three wheelers; Selection of engine, Design considerations of power plants requirements for lubrication, cooling, starting, Recent engine developments

MODULE II STEERING AND TRANSMISSION SYSTEM 8

Steering geometry, steering column construction; steering system for three wheelers, controls on handle bar of two wheelers. Clutch – requirements; different types -need of primary reduction, selection of transmission – gear transmission, gear shift mechanism, belt transmission, automatic transmission (Continuous Variable Transmission – CVT),final drive and differential for three wheeler;

MODULE III SUSPENSION, BRAKES, WHEELS AND TYRES 8

suspension requirements; design considerations; Front and rear suspension systems layouts. Springs and dampers. Design consideration of brake; types of brakes: disc; drum; braking mechanism: mechanical; hydraulic and servo; ABS in two wheelers, Front and rear brake link lay-outs: wheel types Spoked wheel, cast wheel and Disc wheel; Tyre requirements details

MODULE IV FRAMES, BODY AND COMFORT 7

Types of frame; construction; loads acting on frame; design consideration; materials; three wheeler layout; aerodynamic; aesthetic and ergonomics considerations regulations. Handling characteristics; driver and pillion seating arrangement;

ergonomics and comfort; road holding and vehicle stability; gyroscope effect; riding characteristics;

Total Hours – 45

TEXT BOOKS:

1. Irvind, P.E., Motor cycle Engineering , Temple Press Book, London

REFERENCES:

1. The Cycle Motor Manual, Temple Press Ltd., London.
2. Marshall Cavensih, Encyclopedia of Motor cycling,20 Volumes,New York and London.
3. Bryaut,R.V., Vespa Maintenance and Repair series.
4. Raymond Broad, Lambretta – A practical guide to maintenance and repair.

PRACTICAL SESSION: **Hours: 15**

1. Port timing diagram and Port area measurement for Two wheeler (Scooter) Engine and Three Wheeler (Auto rickshaw) Engine.
2. Dismantling and Assembling of two stroke petrol Engine (Zentap) with cubic capacity compression ratio and brake power measurements.
3. Dismantling and Assembling of four stroke petrol engine with cubic capacity compression ratio and brake power measurements.
4. Two and Three wheeler lightning and rooting system inspection and maintenance.
5. Inspection and Testing of Battery for various load condition including measurement of specific gravity.
6. Inspection service and Maintenance of Two and Three wheeler.
7. Removal refitting of wheels and tyres and measurement of aspect ratio and other dimension of the tyre.
8. Inspection and Measurement of pollution is Two and Three wheeler.
9. Actual compression ratio measurement of four stroke petrol Engine (150 cc).

OUTCOMES:

On completion of the course students should be able to

- Extrapolate the constructional details of various types of two and three wheelers.
- Analyze the requirement and performance of the two and three wheelers transmissions systems.
- Summarize the construction of different types steering and suspension system.
- Demonstrate the construction details and design consideration of Braking system, wheel and tyres.
- Apply the basic element while develop a two wheeler frames and body.
- Develop comprehensive knowledge about the functioning of two wheelers and three wheelers and analyze the vehicle performance.

AUC4103	AUTOMOTIVE EMISSIONS AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the current scenario of Automobile Emissions and standards.
- Gain knowledge about the formation of Emissions from SI Engines.
- Gain knowledge about the formation of Emissions from CI Engines.
- Understand Emission and control Techniques in SI and CI Engines.
- Understand measuring techniques of Emission and test procedure.

MODULE I **7**

Pollutants sources – formation – effects of pollution on environment –human – transient operational - affects on pollution –Regulated - Unregulated emissions - Emission Standards.

MODULE II EMISSIONS IN SI ENGINE **8**

Chemistry of SI engine combustion – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating variables on emission formation.

MODULE III EMISSIONS IN CI ENGINE **8**

Basics of diesel combustion – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines – Particulate emission in diesel engines. Odor, sulfur and Aldehyde emissions from diesel engines – effect of operating variables on emission formation.

MODULE IV CONTROL TECHNIQUES FOR REDUCTION OF EMISSION **7**

Design modifications – Optimization of operating factors – Fuel modification – Evaporative emission control - Exhaust gas recirculation –SCR – Fumigation – Secondary Air injection – PCV system – Particulate Trap – CCS – Exhaust treatment in SI engines – Thermal reactors –Catalytic converters – Catalysts – Use of unleaded petrol.

MODULE V TEST PROCEDURE, INSTRUMENTATION & EMISSION MEASUREMENT **7**

Test procedures CVS1, CVS3 – Test cycles – IDC – ECE Test cycle –FTP Test cycle – NDIR analyzer – Flame ionization detectors – Chemiluminescent analyzer – Dilution tunnel – Gas chromatograph –Smoke meters – SHED test.

MODULE VI ALTERNATIVE FUEL EMISSIONS **8**

Properties of alcohols, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, dual fuel system Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines

Total Hours : 45

TEXT BOOKS:

1. Ganesan.V., “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. M.L.Mathur and R.P.Sharma, “A course in Internal combustion engines”, Dhanpat Rai & Sons Publications, New Delhi, 2001.
3. K.K.Ramalingam, “Internal Combustion Engines”, Scitech Publications, Chennai, 2000.

REFERENCES:

1. Heldt P.M., “High Speed Combustion Engines”, Oxford IBH Publishing Co., Calcutta, 1975.
2. Obert E.F., “Internal Combustion Engines Analysis and Practice”, International Text Books Co., Scrantron, Pennsylvania - 1988.
3. William H.Crouse, “Automotive Engines”, McGraw-Hill Publishers, 1985.
4. Ellinger H.E., “Automotive Engines”, Prentice Hall Publishers, 1992.
5. John B.Heywood, “Internal Combustion Engine Fundamental”, McGraw-Hill, 1988.
6. Pulkrabek “Engineering Fundamentals of the Internal Combustion Engines”, Practice Hall of India, 2003.

OUTCOME:

Students will able to

- Describe and identify the source of pollution from automobile.
- Analysis the causes of formation of SI engine.
- Evaluate the emission formation from the CI engine.
- Design and analysis the emission control system for IC engine.
- Conducted the emission cycle for automobile vehicle.
- Analysis the effect of surrogated fuel on engine emission.

AUC 4104	ENGINE TESTING AND EMISSION LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To learn the various performance characteristics of both petrol and diesel engines
- To learn the various constituents of exhaust emission.

LIST OF EXPERIMENTS:

1. Performance study of petrol engine at full throttle and part throttle conditions.
2. Performance study of twin cylinder constant diesel engine.
3. Performance and combustion study of single cylinder constant speed CI engine.
4. Performance study on variable speed single cylinder compression ignition engine.
5. Performance study of variable speed twin cylinder compression ignition engine.
6. Morse test on petrol engines.
7. Determination of volumetric efficiency and optimum cooling water flow rate in IC engines.
8. Head balance test on a Automotive diesel engine.
9. Engine tuning for performance improvement.
10. Measurement of HC, CO, CO2, O2 using exhaust gas analyzer.
11. Diesel smoke measurement.

Total Hours - 45

REFERENCES:

1. Giles,J.G., Vehicle Operation and performance, lliffe Books Ltd., London, 1989.
2. Obert,E.F., Internal Combustion Engine analysis and Practice, International Text Book Co., Scranton, Pennsylvania, 1988. .

OUTCOMES:

After completion of this course the students should be able to

- Analyze the engine performance of given diesel and petrol engine.
- Analyze the friction loss of given IC engine.
- Measure the heat apportion of given IC engine.
- Analyze the petrol and diesel emission with suitable instruments

AUC 4105	ADVANCED AUTOMOBILE COMPONENTS MANUFACTURING LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To familiarize the various mechanisms available in the, milling ,gear hobbing and grinding machines.
- To know the various tools and work holding devices used in machining processes
- To practice the basic machining operations performed in the special purpose machines
- To have knowledge about product manufacturing phases and experience working in teams to manufacture a product.
- To know the application of various CNC machines

- Milling Machines
  1. Milling Polygon Surfaces
  2. Keyway Milling
- Grinding / Polishing
  3. Surface Grinding
  4. Cylindrical Grinding
- Machining Components for Assembly of different fits.
  5. Bush and Shaft
  6. Step turning with drilling using capstan lathe
- Gear Machining
  7. Gear Milling
  8. Machining using CNC vertical machining
  9. Machining using CNC turning tap
- Project work
  10. Combined Skill (Each team has to make one simple product)

Total Hours –45

OUTCOMES:

On completion of the course, students should be able to:

- Select suitable machining operations for automobile components.
- Equip with good practical knowledge required in the core industry.
- Write the CNC program for particular machining operations.
- Compute the various operations in the CNC machine.
- Interpret the different machining process using different techniques.
- Apply and analyze the machining operations performed in the special purpose machines

AUC 4106	INTERNSHIP	L	T	P	C
		0	0	0	1

OBJECTIVES:

- To expose the students to industrial environment
- To study the industrial process, product and services
- To study the resources used in industries

OUTCOMES:

- To analyze the present process product for improvement
- To prepare consolidated with findings and conclusion
- To present a seminar on the outcome of the internship

The students will undertake internship training in automotive and related industry for one month during the summer vacation. The student should be submit a report and make presentation about learning outcome for the industry. The credit will be awarded in the 7th semester.

AUC 4107 **AUTOMOBILE 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

SEMESTER - VIII

AUC 4211	**PROJECT WORK**	**L T P C** **0 0 24 12**

OBJECTIVES:

- To enable the students to apply their acquired knowledge during the course of study and provide solutions to real life problems

OUTCOMES:

- To identify and define the problem
- To carry out literature survey related to the problem and critically review the literature
- To device suitable methodology by adopting methods and modeling & analytical techniques
- To do research on a specified area and find a solution for the objective
- To prepare a consolidated report with all findings and conclusion
- To publish the findings in national / international conference in the form of research paper.

PROFESSIONAL ELECTIVES

AUC X01 **HOMOLOGATION AND TESTING**

L	T	P	C
1	0	0	1

OBJECTIVES:

- To provide knowledge on, vehicle certification
- To get familiarized with Vehicle testing procedures

MODULE I **HOMOLOGATION** **7**

Certification of vehicles, ARAI, NATRIP, GARC, Standards, Testing procedures, Testing conditions, Preparation of vehicles for testing.

MODULE II **TESTING** **8**

Testing of Vehicles, components, systems such as Engine, Powertrain, Passive safety, EMC (Electrical and Electronic components), NVH, Fatigue, Material, Tyres and Vehicle dynamics, Brakes, HVAC, Crash worthiness

Total Hours: 15

REFERENCES:

1. ARAI Standards and case studies
2. www.araiindia.com

OUTCOMES:

- Ability to demonstrate the procedure for vehicle certification
- Ability to explain the testing procedure of vehicle systems and components.

AUC X02	GEOMETRIC DIMENSIONING AND TOLRENCING	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To provide knowledge on, Dimensioning and Tolerancing.
- To get familiarized Engineering Drawings

MODULE I **FUNDAMENTALS** **7**

Drawing standards, Dimensions, Tolerances, Notes used in drawings, Limits, Fits and Tolerance, Key GD&T Terms, Symbols and ,Modifiers, Rules and Concepts

MODULE II **GD&T** **8**

Datum system. Targets and Features, Orientation, Runout, Concentricity, Symmetry and profile, Applications.

Total Hours –15

TEXT BOOKS:

1. Fundamentals of Geometric Dimensioning and Tolerancing, Third Edition, Alex Krulikowski
2. Geometric Dimensioning and Tolerancing: Workbook and Answerbook, ASME, James D. Meadows

REFERENCES:

1. Geometric Dimensioning and Tolerancing: Applications and Inspection, Prentice Hall, 2002 - Technology & Engineering , Gary.K.Griffith.

OUTCOMES:

- Ability to select suitable dimensions and tolerances for particular application
- Ability to prepare engineering drawings for components

AUC X03 VEHICLE ENGINEERING & INTEGRATION

L	T	P	C
1	0	0	1

OBJECTIVES:

- To provide knowledge on latest practices in the vehicle manufacture
- To get familiarized with practices on vehicle packaging and integration

MODULE I VEHICLE ENGINEERING 7

Production of components, testing of components, making of sub-systems, testing of sub-systems, prototype of vehicle

MODULE II VEHICLE INTEGRATION 8

Integration of vehicle components, subsystems and systems into vehicle, Integration of soft wares to test the design of vehicle, Vehicle packaging such as engine packaging, interior packaging, auto jewels etc for a particular model to the requirement.

Total Hours – 15

TEXT BOOKS:

1. The Fundamentals of Car Design and Packaging Paperback – Import, 1 Feb 2009 by Stacey Macey

REFERENCES:

1. The Fundamentals of Car Design Packaging Read Online.

OUTCOMES:

- Ability to select suitable components for making a particular vehicle.
- Ability to suggest packages for particular vehicle model

AUC X04	AUTOMOTIVE HVAC(Heating Ventilation Air Conditioning)	L	T	P	C
		2	0	0	2

OBJECTIVES:

Upon completion of this course, the student will be able to:

- Identify and use Heating and Air Conditioning Service specialty test equipment and basic mechanics hand tools.
- Visually inspect a heating and air conditioning system and locate obvious troubles.
- Diagnose common heating and air conditioning problems.
- Perform general repair procedures on the heating and air conditioning system including
- Charging the air conditioning system , Recovering and recycling refrigerant, Evacuating the air conditioning system, Removing and replacing heating and air conditioning system components

MODULE I — AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS — 7

Purposes of Heating, Ventilation and Air Conditioning- Environmental Concerns- Ozone layer depletion- Location of air conditioning components in a car – Schematic layout of a vehicle refrigeration system. Psychrometry – Basic terminology and Psychrometric mixtures- Psychrometric Chart- Related problem

MODULE II — AUTOMOTIVE COOLING AND HEATING SYSTEM — 8

Vehicle Refrigeration System and related problems- Fixed thermostatic and Orifice tube system- Variable displacement thermostatic and Orifice tube system- Vehicle air conditioning operation Types of compressor- Compressor Clutches- Compressor Clutch electrical circuit- Compressor lubrication- Condensers- Evaporators- Expansion devices- Evaporator temperature and pressure controls- receiver-drier- Accumulators- refrigerant hoses, Connections and other assemblies- Heating system

MODULE III — AIR-CONDITIOING CONTROLS, DELIVERY SYSTEM AND REFRIGERANTS — 7

Types of Control devices- Preventing Compressor damage- Preventing damage to other systems- Maintaining driveability- Preventing Overheating Ram air ventilation- Air delivery Components- Control devices- Vacuum Controls Containers – Handling refrigerants – Discharging, Charging & Leak detection – Refrigeration system diagnosis – Diagnostic procedure – Ambient conditions affecting system pressures.

MODULE IV **AUTOMATIC TEMPERATURE CONTROL AND A/C SERVICING** **8**

Different types of sensors and actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system. Special tools for servicing vehicle air conditioning – Diagnosing components and air conditioning systems- Diagnosing cooling system- Air delivery system Automatic temperature Control system diagnosis and service

Total Hours –30

TEXT BOOKS:

1. William H. Crouse, ‘Automotive Air Conditioning’, Tata McGraw Hill Publication.
2. ‘Automotive Air Conditioning’, Mitchell Information Service, PHI.
3. W.H. Hucho, ‘Aerodynamic of Road Vehicles, Butterworths Co.
4. Warren Farnell and James D.Halderman, “Automotive Heating, Ventilation, and Air Conditioning systems”, Classroom Manual, Pearson Prentice Hall, 2004
5. William H Crouse and Donald L Anglin, “Automotive Air conditioning”, McGraw Hill Inc., 1990.

REFERENCES:

1. Mitchell Information Services, Inc., “Mitchell Automatic Heating and Air Conditioning Systems”, Prentice Hall Inc., 1989.
2. Paul Weisler, “Automotive Air Conditioing”, Reston Publishing Co. Inc., 1990.
3. McDonald,K.L., “Automotive Air Conditioning”, Theodore Audel series, 1978.
4. Goings,L.F., “Automotive Air Conditioning”, American Technical services, 1974.

OUTCOMES:

- Upon the completion of the course, the student should understand the basic of vehicle air- conditioning system, its components, working principle, control mechanism, service etc.

AUC X05 **HYBRID AND ELECTRIC VEHICLE**

L	T	P	C
2	0	0	2

OBJECTIVES:

- To familiar with hybrid vehicles and types
- To understand the hybrid vehicle design, architecture and its specification.
- To study the powerplant specifications
- To study the electric drives and its types

MODULE I **HYBRID VEHICLES** **8**

Performance characteristics of road vehicles, calculation of road load, predicting fuel economy, Grid connected hybrids. DC motors-series wound, shunt wound. Compound wound and separately excited motors AC motors - induction, synchronous, brushless DC motor, switched reluctance motors.

MODULE II **HYBRID ARCHITECTURE** **7**

Series configuration- locomotive drives, series parallel switching, load tracking architecture. Pre transmission parallel and combined configurations-Mild hybrid, power assist, dual mode, power split, power split with shift, Continuously Variable transmission (CVT). Wheel motors.

MODULE III **HYBRID POWER PLANT SPECIFICATIONS** **7**

Grade and cruise targets. launching and boosting, braking and energy recuperation, drive cycle implications, engine fraction-engine downsizing and range and performance, usage requirements.

MODULE IV **ELECTRIC DRIVES** **8**

Early Ward Leonard control system - main features, generator, merits, reverse motion, modified WARD LEONARD control system - main features, modifications. Modern electric drives - main features, advantages of electric drives, limitations of electric drive, variations of torque and speed with armature current Generator, motor, series motor, variations of efficiency with armature current

Total Hours –30

TEXT BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi., "Modern Electric, Hybrid Electric, and Fuel Cell vehicles", Fundamentals, Theory, and Design, CRC Press 2009.

2. Ron Hodkinson and John Fenton, "Lightweight Electric/Hybrid Vehicle ", Butterworth –Heinemann, 2001.

REFERENCES:

1. James Larminie and John Loury, " Electric Vehicle Technology -Explained", John Wiley & Sons.
2. Ronald K Jurgen, "Electric and Hybrid -Electric Vehicles", SAE, 2002.
3 Sandeep Dhameja, "Electric Vehicle Battery Systems", Butterworth – Heinemann,2002.

OUTCOMES:

On completion of the course the students should be able to

- Identify different types of hybrid vehicles
- Identify different types of hybrid architectures and draw layouts
- To find out the power plant specifications.
- Identify different Electric drives for vehicles

AUC X06 **VEHICLE DIAGNOSTICS**

L	T	P	C
2	0	0	2

OBJECTIVES:

- To provide knowledge on, diagnostic procedure and instrumentation.
- To get familiarized with the world of vehicle diagnostics

MODULE I **INTRODUCTION** **8**

Diagnostic process, Mechanical techniques, Electrical techniques, Fault codes, Data sources, Basic equipments, Piecoscope oscilloscope, Scanners, Emission testing, pressure testing, Automotive pressure oscilloscope transducer.

MODULE II **ENGINE DIAGNOSTICS** **7**

Si engine management, OBD, Monitors, Misfire detection, Ignition faults, Fuel system, CI engine management, Fuel system and Injection system faults.

MODULE III **CHASSIS SYSTEMS** **7**

Fault Diagnosis of brake system, ABS, Traction control system, Steering system, Suspension system, Transmission systems, Manual and Automatic, Tires

MODULE IV **ELECTRICAL AND ELECTRONIC SYSTEMS** **8**

Diagnosis of Electronic components and circuits, Multiplexing, Diagnosis of lighting and electrical system and components, Instruments, Auxiliaries.

Total Hours – 30

TEXT BOOKS:

1. Advanced Automotive Fault Diagnosis, 4th Ed: Automotive Technology: Vehicle Maintenance and Repair, Tom Denton.
2. Road vehicles - Diagnostic communication Paperback – 2008, Peter Subke

REFERENCES:

- How To Use Automotive Diagnostic Scanners (Motor books Workshop) Paperback – Import, 1 Aug 2015 Tracy Martin

OUTCOMES:

- Ability to analyze the faults of vehicle systems and set up instrumentation for identifying the faults.
- Ability to design and develop methods for rectifying the faults in vehicle systems.

AUC X07	SPARK IGNITION ENGINE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge on construction, fuel system and ignition system.
- To understand about the cooling and lubricating system.
- To understand the principle of combustion
- To learn about the formation of emission and control technique.

MODULE I **ENGINE CONSTRUCTION AND OPERATION** **7**

Four and two stroke engine - Constructional details, working principle. Otto cycle, Actual indicator diagram, Fuel air cycle. Cylinder layout and configurations. Firing order and its significance. Engine balancing. Materials for engine components.

MODULE II **FUEL SYSTEM** **7**

Gasoline - air mixtures. Mixture requirements - Mixture formation - Carburettor, Choke, Carburettor systems for emission control- Secondary Air Injection. Electronic injection – requirement – Manifold injection – Port injection – Gasoline direct injection – Air assisted direct injection

MODULE III **IGNITION SYSTEM** **8**

Ignition fundamentals, Solid state ignition systems, High energy ignition systems, Electronic spark timing and control. Combined ignition and fuel management systems. Dwell angle calculation, Ignition timing calculation.

MODULE IV **COOLING AND LUBRICATION SYSTEM** **7**

Need for cooling. Types of cooling system – air cooling and Liquid cooled systems. Forced circulation system, pressure cooling system, Evaporative cooling system – Need for Lubrication system. Mist lubrication system, wet & dry sump lubrication, Properties of lubricants, properties of coolant – Recent Technologies.

MODULE V **COMBUSTION IN S.I. ENGINES** **8**

Stages of combustion, normal and abnormal combustion, knocking, Variables affecting Knock, Features and design consideration of combustion chambers. Flame structure and speed, Cyclic variations, Lean burn combustion, Stratified charge combustion systems. Heat release correlations.

MODULE VI **EMISSION FORMATION AND CONTROL TECHNIQUES** **8**

Formation of oxides of nitrogen, carbon monoxide, hydrocarbon, aldehydes emission. Effects of Engine Design - operating variables on Emission formation. Engine Design modifications, fuel modification, evaporative emission control, EGR, air injection,thermal reactors, catalytic convertors, catalytic converter efficiency.

Total Hours – 45

TEXT BOOKS:

1. Ganesan.V., "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., New Delhi,2012.
2. M.L.Mathur and R.P.Sharma, "A course in Internal combustion engines", Dhanpat Rai & Sons Publications, New Delhi, 2001.
3. K.K.Ramalingam, "Internal Combustion Engines", Scitech Publications, Chennai, 2000.

REFERENCES:

1. Heldt P.M., "High Speed Combustion Engines", Oxford IBH Publishing Co., Calcutta, 1975.
2. Obert E.F., "Internal Combustion Engines Analysis and Practice", International Text Books Co., Scrantron, Pennsylvania - 1988.
3. William H.Crouse, "Automotive Engines", McGraw-Hill Publishers, 2011.
4. Ellinger H.E., "Automotive Engines", Prentice Hall Publishers, 1992.
5. John B.Heywood, "Internal Combustion Engine Fundamental", McGraw-Hill, 1988.
6. Pulkrabek "Engineering Fundamentals of the Internal Combustion Engines", Practice Hall of India, 2003.

OUTCOMES:

The student should be able to

- Identify the two and four stroke engine construction.
- Design the fuel system and ignition system.
- Analyze the cooling and lubricating system.
- Determine the parameter affect the combustion phenomenon.
- Control the emission formation in SI engine

AUC X08	COMPRESSION IGNITION ENGINE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the knowledge on basic concepts on Compression Ignition Engines
- To understand various sub components along with its functions.
- To learn combustion process of diesel engine
- To understand different types of combustion chambers.
- To learn the concept of supercharging and turbo charging.
- To understand the performance testing of diesel engines.

MODULE I **DIESEL ENGINE BASIC THEORY** **8**

Diesel engine construction and operation. Two stroke and four stroke diesel engines. Diesel cycle – Fuel-air and actual cycle analysis. Diesel fuel. Ignition quality. Cetane number. Laboratory tests for diesel fuel. Standards and specifications.

MODULE II **FUEL INJECTION SYSTEM** **8**

Requirements – solid injection. Function of components –common rail direct injection - Jerk and distributor type pumps. Pressure waves, Injection lag. Unit injector. Mechanical and pneumatic governors. Fuel injector, Types of injection nozzle, Nozzle tests. Spray characteristics. Injection timing. Pump calibration. Pilot injection.

MODULE III **AIR MOTION, COMBUSTION** **7**

Importance of air motion – Swirl, squish and turbulence, Swirl ratio. Fuel air mixing. Stages of combustion. Delay period – factors affecting delay period. Knock in CI engines. Comparison of knock in CI & SI engines.

MODULE IV **COMBUSTION CHAMBERS** **7**

Direct and indirect injection combustion chambers. Air cell chamber. Combustion chamber design – objectives – Different types of combustion chamber. Combustion chamber. Combustion chambers for Homogeneous charge compression ignition systems – Dual and alternate fueled engine systems.

MODULE V **SUPERCHARGING AND TURBOCHARGING** **7**

Necessity and limitation – Charge cooling. Types of supercharging and turbocharging – Relative merits. Matching of turbocharger. Inter cooler, Inseries Twin turbo

MODULE VI **TESTING AND PERFORMANCE** **8**

Automotive and stationary engine testing and related standards – Engine power and efficiencies – performance characteristics. Variables affecting engine performance – Methods to improve engine performance – Heat balance – Performance maps. Hot testing of engines, Dynamometer type, Chassis dynamometer for emission test

Total Hours – 45

TEXT BOOKS:

1. Mathur M.L. and R.P. Sharma, Internal Combustion Engines, Dhanpat Rai Publication, Delhi, 2010.
2. Ganesan,V., Internal Combustion Engines, Tata-McGraw Hill Publishing Co., New Delhi, 1994.

REFERENCES:

1. Heldt,P.M., High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta, 1985.
2. Obert,E.F., Internal Combustion Engine analysis and Practice, International Text Book Co., Scranton, Pennsylvania, 1988.
3. Maleev,V.M., Diesel Engine Operation and Maintenance, McGraw Hill, 1974. Dicksee, C.B., Diesel Engines, Blackie & Son Ltd., London, 1964.

OUTCOMES:

On completion of course the students should be able to,

- Demonstrate the working concepts of various components of Diesel engine
- Analyze Diesel cycle efficiency.
- Analyze and prepare a layout of fuel system for various diesel engine.
- Demonstrate combustion process and design a combustion chamber in CI engine.
- Analyze the performance of supercharger and turbocharger.
- Analyze the engine performance characteristics.

AUC X09	AUTOMOTIVE AERODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The students able to study the basics of Automotive Aerodynamics in a automobile vehicle.
- The student can impart knowledge in the performance of the automobile vehicle.
- The students able to know the resistance of motion, rolling and grade resistance
- The students can impart knowledge in the aerodynamic drag and pressure occurs in an automobile vehicle.
- The students will have good exposure in automotive aerodynamic aspects.
- The students also able to know about the wind tunnel test in a vehicle and behaviour of a vehicle.

MODULE I INTRODUCTION 5

Scope - historical development trends - Fundamental of fluid mechanics - Flow phenomenon related to vehicles -External & Internal flow problem - Potential of vehicle aerodynamics.

MODULE II RESISTANCE AND PERFORMANCE OF VEHICLE 5

Deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

MODULE III AERODYNAMIC DRAG OF CARS 8

Cars as a bluff body - Flow field around car - drag force - types of drag force - analysis of aerodynamic drag - drag coefficient of cars - strategies for aerodynamic development - low drag profiles.

MODULE IV ANALYSIS OF DRAG OF CARS 7

Front end modification - front and rear wind shield angle - Boat tailing - Hatch back, fast back and square back - Dust flow patterns at the rear - Effects of gap configuration - effect of fasteners.

MODULE V VEHICLE HANDLING 10

The origin of forces and moments on vehicle - side wind problems - methods to calculate forces and moments - vehicle dynamics under side winds - the effects of forces and moments - Characteristics of forces and moments - Dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles.

MODULE VI WIND TUNNELS FOR AUTOMOTIVE AERODYNAMIC 10

Introduction - Principle of wind tunnel technology - Limitation of simulation - Stress with scale models – full scale wind tunnels - measurement techniques - Equipment and transducers - road testing methods – Numerical methods.

Total Hours – 45

TEXT BOOKS:

1. Hucho.W.H., "Aerodynamic of Road vehicles", Butterworths Co. Ltd., 1997

REFERENCES:

1. Pope. A., "Wind Tunnel Testing", John Wiley & Sons, 2nd Edition, New York, 1974.
2. Automotive Aerodynamic: Update SP-706, SAE, 1987
3. Vehicle Aerodynamic, SP-1145, SAE, 1996.

OUTCOMES:

- Demonstrate knowledge and understanding of the essential facts, concepts and principles of incompressible flows including vortices and viscous effects, boundary layers, wing and diffuser aerodynamic characteristics.
- Demonstrate understanding of how aerodynamics affects the motorsport vehicle design and operation.
- Demonstrate a critical awareness of the wind tunnel techniques used to analyse motorsport aerodynamic problems and apply these techniques and concepts to develop solution strategies for relevant wind tunnel simulations.
- Demonstrate competence in analyzing and evaluating the low speed aerodynamic characteristics of representative vehicles.
- The students able to identify the handling characteristics of a vehicle.
- The students able to know the components using acquired wind tunnel data, data sheets and fundamental principles.

AUC X10 **VEHICLE COMFORT SYSTEM AND ERGONOMICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the engineering principles that underpins the design of an automotive vehicle for the comfort of the occupants and other road users.
- Recognize the future direction of the design of comfort systems within the automotive engineering sector.
- Appreciate the role and use of comfort systems in automobile engineering.
- The students also able to know about the safety systems in a vehicle and deformation behavior of a vehicle.

MODULE I **INTRODUCTION TO AUTOMOTIVE COMFORT SYSTEMS** **9**

Introduction to automotive comfort systems for both the vehicle occupants and other road users. Driver assistance systems-Traffic jam assist, Road sign assistant, Intelligent headlight control, Remote park assist, Side view assist, Interior comfort systems-Seat and comfort actuation, Window lift and sunroof drives.

MODULE II **DESIGN,CONSTRUCTION AND OPERATION OF COMFORT SYSTEMS** **7**

Introduction to the design, construction and operation of comfort systems such as: NVH (noise, vibration and harshness) of chassis, engines and power train, ride quality and sound quality; heating, ventilation and air conditioning systems.

MODULE III **DRIVER COMFORT** **7**

Driving comfort for a passenger car and commercial vehicle – driving, seating, visibility, man-machine system, Psychological factors – stress and attention of a driver.

MODULE IV **PASSENGER COMFORTS** **7**

Passenger comforts - Ingress and egress, spaciousness, ventilation, temperature control, dust and fume prevention and vibration.

MODULE V **COMFORT AND CONVENIENCE SYSTEM** **8**

Steering and mirror adjustment, Central locking system- Garage door opening system, Tyre pressure control system, Rain sensor system, Environment information system.

MODULE VI **VEHICLE ERGNOMICS** **7**

Introduction to human body, Anthropometrics and its application to vehicle ergonomics and cockpit design. Ergonomic research methods / ergonomic audit, Practical work aimed at integrating design and ergonomics.

Total Hours – 45

REFERENCES:

1. B.Peacock, Waldemar Karwowski; Automobile ergonomics. Publisher: CRC; 1st edition, 1993
2. Bosch, “Automotive Handbook”, 5th Edition, SAE publication, 2000.
3. Ronald.K.Jurgen, “Automotive Electronics Handbook”, 2nd Edition, McGraw-Hill Inc.,1999

OUTCOMES:

- Describe the characteristics and importance of ergonomics in automotive design technology.
- Identify relevant automotive design standards with regard to ergonomics.
- Design a vehicle system based on automotive design standards with regard to ergonomics.
- Analyze vehicle design performance related to ergonomic aspect.
- The students able to analyze the various comfort system in a automobile vehicle.
- The students able to identify relevant vehicle ergonomics aspects.

AUC X12	DESIGN OF TRANSMISSION SYSTEM AND CHARACTERISTICS ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the design procedures and practices and automotive components like frame, suspension systems, axles, clutch, gear box, drive line components etc.

MODULE I **GENERAL DESIGN CONSIDERATIONS**

Theory of Failure, Selection of materials, Basic criteria of selection of material for automotive parts like piston, cylinder, connecting rod, crankshaft and camshaft, mechanical properties of those materials in brief. Study of Stress concentration, factor of safety under different loading conditions

MODULE II **INTRODUCTION ABOUT TRANSMISSION SYSTEM**

Need for Transmission system, Tractive effort and resistances to Motion of a Vehicle, Requirements of transmission system, Classification of Transmission systems, Different Wheel drive systems (Single, Two and Four), Drives (Belt, Chain, Shaft, Hydraulic and Electric drives), Multi-axle drives, Location of transmission system, Different Transmissions units in scooter, car, MUVs and different transport vehicles of Indian make.

MODULE III **CLUTCH**

Principle of operation, Constructional details, torque capacity and design aspects of different types of clutches, Operation of single plate: helical spring and diaphragm type, and multi-plate clutch, Centrifugal and Automatic Clutches, Dry and Wet type of clutch, Friction lining materials, Over-running clutches, Modes of Operating clutch – mechanical, hydraulic and electric, Dual Clutch transmission.

MODULE IV **GEAR BOX**

Gear train calculations, layout of gearboxes. Calculation of bearing loads and selection of bearings. Design of three speed and four speed gearboxes. Determination of gear ratios for vehicles, Different types of gearboxes – sliding, constant and synchromesh type, need for double declutching and working of synchronizing unit, Power and economy modes in gearbox, transfer box, Transaxles, Overdrives, Gear shifting mechanisms – mechanical link and wire types, Paddle shift.

MODULE V **HYDRODYNAMIC DRIVE**

Fluid coupling- principle of operation, constructional details, Torque capacity, Performance characteristics, Reduction of drag torque, Torque converter, converter coupling- Principle of operation, constructional details & performance characteristics.
Hydrostatic Drive: Hydrostatic drive, various types of hydrostatic systems, Principles of hydrostatic drive system, Advantages and limitations, Comparison of hydrostatic drive with hydrodynamic drive, Construction and working of typical Janny hydrostatic drive.

MODULE VI

Electric Drive: Electric drive, Principle of early and modified Ward Leonard Control system, Advantage & limitations, Performance characteristics.
Automatic Transmission & Applications: Block diagrams of- Chevrolet "Turbo-glide" Transmission, Power-glide Transmission & Clutch Hydraulic Actuation system, Introduction to Toyota "ECT-i" Automatic Transmission with Intelligent Electronic controls system.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

- Giri, N.K., “Automobile Mechanics”, Khanna publishers, New Delhi.
- Khurmi. R.S. & Gupta. J.K., “A textbook of Machine Design”, Eurasia Publishing House (Pvt) Ltd, 2001

REFERENCES:

- Newton and Steeds, ‘Motor vehicles’, Illiffe Publishers.
- A.W. Judge, ‘Modern Transmission Systems’, Chapman and Hall Ltd.
- W.H. Crouse, D.L. Anglin, ‘Automotive Transmission and Power Trains Construction’, McGraw Hill.
- R.C. Juvenal, ‘Fundamental of Machine Component Design’, John Wiley.
- ‘PSG Design Data’, PSG College of Technology.
- J.A. Charles, ‘Selection & Use of Engineering Materials’, Butterworth – Heinemann.

- V.B. Bhandari, ‘Design of Machine Elements’, McGraw Hill, ED.
- Joseph Edward, ‘Mechanical Engg. Design’, Shigley.

OUTCOMES:

- At the end of the course, the student can able to design the automotive components like frame, suspension systems, axles, clutch, gear box, drive line components etc

AUC X13	DESIGN OF HYDRAULICS PNEUMATICS SYSTEMS FOR AUTOMOTIVES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The student will able to know fluid power fundamentals
- The student will have good exposure to applied hydraulics and pneumatics.
- The students can impart knowledge basic in fundamentals of fluids, hydraulics system and components.
- The students can impart knowledge basic in design of circuits and in accumulators.
- The students can impart knowledge in properties of air, compressors and regulators.
- The students can impart knowledge in pneumatic systems and components.

MODULE I FLUID POWER SYSTEMS AND FUNDAMENTALS 8

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids - Fluid power symbols. Basics of Hydraulics-Applications of Pascal's Law- Laminar and Turbulent flow - Reynold's number - Darcy's equation - Losses in pipe, valves and fittings.

MODULE II HYDRAULIC SYSTEM & COMPONENTS 8

Sources of Hydraulic Power: Pumping theory - Pump classification - Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance - Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators - Types of hydraulic cylinders - Single acting, Double acting special cylinders like tandem, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators - Fluid motors, Gear, Vane and Piston motors. Construction of Control Components : Direction control valve - 3/2 way valve - 4/2 way valve - Shuttle valve - check valve - pressure control valve – pressure reducing valve, sequence valve, Flow control valve - Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram.

MODULE III DESIGN OF HYDRAULIC CIRCUITS 8

Reciprocation, quick return, sequencing, synchronizing circuits, simple industrial circuits- press circuits, earth movers, grinding machines. Safety and emergency modules. Accumulators and intensifiers: Types of accumulators - Accumulators circuits, sizing of accumulators, intensifier - Applications of Intensifier - Intensifier circuit.

MODULE IV PNEUMATIC SYSTEMS AND COMPONENTS 7

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

MODULE V PNEUMATIC SYSTEMS AND CIRCUIT DESIGN 7

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

MODULE VI DESIGN OF FLUIDIC SYSTEMS 7

Fluidic systems - Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluids - Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

Total Hours – 45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

On completion of the course students should be able to

- Analyze the merits and demerits the fluid power.
- Analyze different types of fluid power system, and properties of hydraulic fluids and general types of fluids
- Design hydraulic circuits.
- Compare different pneumatic systems and components
- Design pneumatic circuits
- Select suitable system for different applications.

AUC X14 **TRACTOR AND AGRICULTURAL MACHINERIES**

L	T	P	C
3	0	0	3

OBJECTIVES:

- The student will have good exposure to Tractors and form equipments

MODULE I **GENERAL DESIGN OF TRACTORS** **7**

Classification of tractors – Main components of tractor – Safety rules.

MODULE II **CONTROL OF THE TRACTOR AND FUNDAMENTALS OF ENGINE OPERATION** **8**

Tractor controls and the starting of the tractor engines – Basic notions and definition – Engine cycles – Operation of multicylinder engines – General engine design – Basic engine performance characteristics.

MODULE III **ENGINE FRAME WORK AND VALVE MECHANISM OF TRACTOR** **8**

Cylinder and pistons – Connecting rods and crankshafts – Engine balancing – Construction and operation of the valve mechanism – Valve mechanism troubles.

MODULE IV **COOLING SYSTEM OF A TRACTOR** **6**

Cooling system – Classification – Liquid cooling system – Components,

MODULE V **LUBRICATION SYSTEM AND FUEL SYSTEM OF A TRACTOR** **8**

Lubricating system servicing and troubles – Air cleaner and turbo charger – Fuel tanks and filters – Fuel pumps.

MODULE VI **FARM EQUIPMENTS** **8**

Working attachment of tractors – Farm equipment – Classification –Auxiliary equipment – Trailers and body tipping mechanism.

Total Hours –45

TEXT BOOKS:

1. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers, 1987

REFERENCES:

1. Kolchin,A., and V.Demidov, Design of Automotive Engines for Tractor
2. MIR Publishers, 1972.

OUTCOMES:

On completion of the course students should be able able to

- Demonstrate various design aspects of tractors.
- Analyze the control techniques of tractors and performance of tractor engines.
- Select suitable cooling system with justification.
- Analyze various types of lubrication and system.
- Evaluate different types of suspension system
- Select suitable layout for tractors with justification

AUC X15	VEHICLE CONTROL SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about different sensors and actuator used in the vehicle.
- To understand the methods of representation of system and their transfer function models
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To give basic knowledge in obtaining the open loop and closed loop frequency responses of systems
- To understand the concept of stability of control system and methods of stability analysis
- To study the three way of designing compensators for a control system.

MODULE I INTRODUCTION 7

Basic elements in control systems-Open loop and Closed loop system-Feedback characteristics-mechanical, Thermal, hydraulic and Pneumatic systems-

MODULE II BASICS OF CONTROL SYSTEM 7

Transfer function- Time response - Types Steady state error - Frequency response - Bode plot- Polar plot- Nichols chart- Determination of closed loop responses from open loop response.

MODULE III SAFETY SYSTEM CONTROL 8

Speed control – cylinder cut - off technology, Gear shifting control – Traction / braking control, brake by wire – Adaptive cruise control, throttle by wire. Steering - automatic parking – steer by wire.

MODULE IV COMFORT SYSTEM CONTROL 8

Active suspension systems, requirement and characteristics, different types, Vehicle Handling and Ride characteristics of road vehicle, pitch, yaw, bounce control, power windows, thermal management system, adaptive noise control.

MODULE V CHASSIS CONTROL SYSTEM 8

Components of chassis management system – role of various sensors and actuators pertaining to chassis system – construction – working of chassis management system .

MODULE VI ROUTING AND TRAFFIC CONTROLS 7

Traffic routing system - Automated highway - Lane departure warning system, Data communication within the car, Future Cars – Case studies.

Total Hours –45

TEXT BOOKS:

1. U. Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer-Verlag, 2000.
2. Ljubo Vlacic, Michel Parent, Fumio Harashima, “Intelligent Vehicle Technologies”, Butterworth Heinemann publications, Oxford, 2001.

REFERENCES:

1. Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9thedition, TMH, New Delhi, 2002.
2. William B.Ribbens -Understanding Automotive Electronics, 5th edition, Butter worth Heinemann Woburn,1998.
3. Bosch, “Automotive Hand Book”, 6^{th} edition, SAE, 2004

OUTCOMES:

- Apply the fundamentals of chassis management system and its control
- Apply the knowledge to evaluate open loop and closed loop frequency responses of systems
- Analysis of different sensors and actuators for automotive applications.
- Apply the knowledge in the time response of systems and steady state error analysis
- Apply the knowledge in stability of control system development and analysis
- Discuss case studies on Research focused areas

AUC X16	MODERN AND INTELLIGENT VEHICLE SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge about the principle of modern vehicle systems.
- To learn about different sensors and actuator used in the vehicle.
- To gather knowledge about the modern techniques in the vehicle
- To learn control systems like steering, suspension, and braking system.
- To gain knowledge of the different controls system in vehicle navigation systems.

MODULE I **INTRODUCTION** **8**

Fundamental of modern and intelligent vehicle systems, different types, functions, Unmaned vehicle technologies

MODULE II **SENSOR AND ACTUATORS** **7**

Working principle of wheel speed sensor, steering position, oxygen sensor, tyre pressure, brake pressure, steering torque, exhaust temperature sensor, fuel level sensors.

MODULE III **SAFETY AND SECURITY SYSTEM** **7**

Airbags, seat belt tightening system, collision warning systems, child Lock, anti lock braking systems, Vision enhancement, road recognition system, Anti theft technologies, smart card system, number plate coding, central locking system.

MODULE IV **DRIVER INFORMATION SYSTEMS** **7**

Traffic routing system - Automated highway systems - Lane warning system – Driver Information system, side blind zone warning system, automatic parking system, driver assistance systems

MODULE V **INTELLIGENT TRANSPORTATION SYSTEM** **8**

Radar guide brakes, radar guided lane assist, Global positioning system. Data communication within the car, Driver conditioning warning -Route Guidance and Navigation Systems – vision enhancement system.

MODULE VI **MODERN VEHICLE SYSTEMS** **8**

Integrator starter, Alternator, Starts stop operation, Un man vehicle technology, Regenerative energy recovery, advanced lead acid batteries, alkaline batteries, Lithium batteries, Development of new energy storage systems,Deep discharge and rapid charging, ultra-capacitors. - In-Vehicle Computing –Vehicle Diagnostics system – Hybrid / Electric and Future Cars – Case studies.

Total Hours – 45

TEXT BOOKS:

1. U. Kiencke, and L. Nielsen, Automotive Control Systems,SAE and Springer-Verlag, 2000.
2. LjuboVlacic, Michel Parent, Fumio Harashima, “Intelligent Vehicle Technologies” ButterworthHeinemann publications, Oxford, 2001.

REFERENCES:

1. Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9thedition, TMH, New Delhi, 2002.
2. William B.Ribbens -Understanding Automotive Electronics, 5th edition, Butter worth Heinemann Woburn,1998.
3. Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.

TERM WORK

- Modern storage devices
- Future Cars in Hybrid and Electric
- Intelligent transportation systems
- Safety and security systems
- Energy control and regenerative technologies

OUTCOMES:

- Apply the fundamentals of chassis management system and its control
- Analysis of different sensors and actuators for automotive applications.
- Discuss case studies on research focused areas
- Learner can able to apply the knowledge to develop future technology cars
- Apply The knowledge to develop different controls system in vehicle navigation systems
- Analysis the different vehicle system to develop intelligent transportation system

AUC X17	ALTERNATIVE FUELS AND ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge of alternate fuels
- To understand the changes in the engine design for alternative fuels handling.
- To understand various type of energy systems for use in the automobiles.

MODULE I **INTRODUCTION** **6**

Estimation of petroleum reserve "World Energy Scenerio, Energy Survey of India" – Need for alternate fuel – Availability of alternate fuels.

MODULE II **ALCOHOLS** **8**

Properties of alcohols, engine modifications required to use alcohols in SI engines, performance, combustion and emission characteristics in SI engines, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, use of alcohols in CI engines-emulsions, dual fuel system, spark assisted diesel engine, surfaceS ignition engine, ignition accelerators, performance, combustion and emission characteristics in CI engines.

MODULE III **GASEOUS FUELS** **8**

Properties of hydrogen, production and storage methods, safety precautions , use in SI and CI engines, biogas production and its properties, use in SI and CI engines, properties of LPG and CNG, use in SI and CI engines. Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines.

MODULE IV **VEGETABLE OIL** **8**

Various vegetable oils for diesel engines, structure and properties, problems in using vegetable oils in diesel engines, methods to improve the engine performance using vegetable oils-preheating, Esterification (biodiesel, blending with good secondary fuels, semi-adiabatic engine, surface ignition engine, ignition accelerators dual fuelling with gaseous and liquid fuels, performance, combustion and emission characteristics of vegetable oil fuelled diesel engines.

MODULE V **ELECTRIC POWERED VEHICLES** **8**

Layout of an electric vehicle – advantage and limitations – Specifications – System component, Electronic control system – High energy and power density batteries – Hybrid vehicle – Fuel cell vehicles- Solar energy power vehicle.

MODULE VI **GAS TURBILE VEHICLES** **7**

Construction and working of gas turbine – Gas turbine cycle – Fuel used in gas turbine – Flame stability – Layout of gas turbine vehicle – power transmitted to wheel - advantage and limitation -

Total Hours –45

TEXT BOOKS:

1. Ramalingam. K.K., Internal combustion engine, scitech publications, Chennai, 2003.

2. Bechtold, R.L., Alternative Fuels Guide Book, SAE, 1997.

REFERENCES:

1. Nagpal, Power Plant Engineering, Khanna Publishers, 1991.
2. Alcohols and motor fuels progress in technology, Series No.19, SAE Publication USA 1980.
3. SAE Paper Nos.840367, 841156, 841333, 841334.
4. The properties and performance of modern alternate fuels – SAE Paper No.841210.

OUTCOMES:

The student should be able to

- Analyze various needs of alternative fuels.
- Select suitable fuels for existing engines.
- Analyze various types of natural fuels.
- Select suitable various vegetable oils for engines with justification.
- Evaluate different layouts for an electric vehicle.
- Select suitable layout for solar vehicle with justification.

AUC X18	VEHICLE NETWORKING AND INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide with a working knowledge of vehicle systems networks and exposure to aspects of design, development, application and performance issues associated with those systems.
- To provide Knowledge in concepts of capture of sensor data, storage and exchange of data to obtain remote services.

MODULE I FUNDAMENTALS OF VEHICLE NETWORKING 7

Need of Networking - Overview of data communication and networking - need of vehicle networking - layers of communication (Link Layer, Network layer , transport layer, Application layer) multiplexing and de-multiplexing concepts - vehicle buses and types.

MODULE II PROTOCOLS AND NETWORK 8

Multiple access protocols - Ethernet, TCP, UDP, IP, ICMP, ARP, RARP - Hubs, Bridges, and switches - PPP - Overview of CAN - fundamentals - selecting CAN Controllers - CAN development tools - CAN application areas.

CAN Protocol : Principles of data exchange - real time data transmission - message frame formats, bit encoding - bit timing and synchronization - data rate and bus length - network topology - bus access - physical layer standards.

MODULE III LOCAL INTERCONNECT NETWORK (LIN) PROTOCOL 7

Introduction to LIN Protocol - Standard overview - applications - LIN communications real time data transmission - message frame formats, bit encoding - bit timing and synchronization - data rate and bus length - network topology - bus access - physical layer standards.

MODULE IV ADVANCED PROTOCOLS 8

MOST and FlexRay: MOST review - data rates - data types - topology - application areas - FlexRay Introduction - network topology - ECUs and Bus interfaces - Controller host interface and protocol operation controls - media access control and frame and symbol processing - coding/decoding unit - FlexRay scheduling - message processing - Wakeup/startup -applications.

MODULE V WAN AND SATELLITE NETWORKS 7

Introduction to WAN Networks - GPS - setting receivers - Positioning - activating the navigation function -Concept of latitude and longitude grid system - Mapping and location technologies - application.

MODULE VI SENSORS AND ACTUATORS 8

Electronics and Embedded computing fundamentals - Sensors - Actuators - Microcontrollers - simple microcontroller coding introduction - system on chips - platform considerations - power supply and ranges.

Total Hours – 45

REFERENCES:

1. B.Hoffman - Wellenhof, H.Lichtenegger and J.collins, " GPS Theory and Practice" 4 th revised edition ,Springer, wein new york, 1997.

2. Wireless systems, W.C.Y.lee, prentice hall publ.(LBS) - mobile and wireless design essentials - Martyn Mallick - Wiley publishing, inc. - first edition.

3. Indira Widjaja, Alberto Leon-Garcia, communication networks: Fundamental concepts and Key Architectures, Mcgraw- Hill college, 1st edition, January, 15,2000.

4. Konrad Etschberger, Controller Area Network, IXXAT Automation August 22, 2001.

5. Olaf Pfeiffer, Andrew Ayre, Christian Keydal, Embedded Networking With CAN and CANopen, Annbooks/Rtc Books, November 1, 2003.

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

OUTCOMES:

- Ability to analyze information for intensive applications that are being enabled for vehicles by a combination of telecommunications and computing technology.

- Ability to develop communications, and navigation/routing, in automotive telematics.

AUC X19	AUTOMOTIVE INSTRUMENTATION & EMBEDDED SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide with a working knowledge of measurements and instrumentation for Automotive applications
- To provide Knowledge in concepts of embedded systems and real time operating systems

MODULE I BASICS OF MEASUREMENT 7

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

MODULE II AUTOMOTIVE INSTRUMENTATION 8

Modern automotive instrumentation – computerized instrumentation system, multiplexing, sampling and advantages – Measurements – fuel quality, coolant temperature, oil pressure vehicles speed, Display devices – LED, LCD, VFD, CRT and types, CAN network, the glass cockpit and information system

MODULE III DIAGNOSTICS 7

Onboard diagnostics – fault code displays. Off board diagnostics – engine data display , expert system occupant protection system – Airbag deployment system security and warning systems.

MODULE IV MEASUREMENT ANALYSIS 7

Chemical, thermal, magnetic and optical gas analyzers, measurement of smoke, dust and moisture, gas chromatography, spectrometry, measurement of pH, Review of basic measurement techniques.

MODULE V INTRODUCTION TO EMBEDDED SYSTEMS 8

Introduction to functional building blocks of embedded systems – Register, memory devices, ports, timer, interrupt controllers using circuit block diagram representation for each categories – Devices & buses for devices network - serial communication using I2C, CAN, USB buses - parallel communication using ISA, PCI - device drivers in a system – Serial port & parallel port.

MODULE VI REAL TIME OPERATING SYSTEMS 8

Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems, RTOS – Interrupt handling, task scheduling; embedded system design issues in system development process – Action plan, use of target system, emulator, use of software tools.

Total Hours – 45

TEXT BOOKS:

1.William B.Riddens - Understanding Automotive Electronics, 5th edition- Butter worth Heinemann, Woburn- 1998
2. Rajkamal, 'Embedded System – Architecture, Programming, Design', Tata McGraw Hill, 2003.
3. Daniel W. Lewis 'Fundamentals of Embedded Software', Prentice Hall of India, 2004.
4. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 1988
5. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw Hill, New Delhi, 1983.

REFERENCES:

1. Bechhold- Understanding Automotive Electronics- SAE- 1998.
2. David E. Simon, 'An Embedded Software Primer', Pearson Education, 2004.
3. Frank Vahid, 'Embedded System Design – A Unified hardware & Software Introduction', John Wiley, 2002

OUTCOMES:

- Ability to analyze the data for measurement of parameters and set up instrumentation systems for automotive applications.

- Ability to design and develop embedded circuits for automotive applications.

AUC X20	ADVANCED MATERIAL TESTING AND FAILURE ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To have knowledge about importance and significances of material quality in service.
- To understand the impact on component life, customers satisfaction in performance.
- To know the procedure of Material Testing characterization and failure analysis.

MODULE I MATERIAL PROPERITES 7

Mechanical Characterization: Mechanical Property characterization- Principles & characterization techniques related to tensile, compressive, hardness, fatigue, and fracture toughness properties. Deformation, Super plasticity Stress-strain diagram, Determination of YS, UTS, MoE, %E, %RA, Hardness testing, true stress-strain diagram, stretcher strain characteristics, effects of cold working, & n values, poisons ratio

MODULE II MECHANICAL TESTS 7

Deep drawn quality of sheets, Impact test, bend test, shear test, Significances of property evaluation, SN curves and fatigue life, non-destructive testing, residual stress measurements, microscopy and scanning electron microscopy, EDAX / WDS analysis, corrosion testing, wear & tear characteristics, slow strain rate characteristics, thermal behaviors. Thermal Analysis: Principles and applications of thermal analysis.

MODULE III PROPERTIES OF PLASTICS, ELASTOMERS AND COMPOSITES 8

Molecular weight distribution, MFI, HDT & VICAT softening point, cold temperature behaviors, Rheological behaviors, hardness and impact properties, identification of polymers, weathering characteristics, cyclic temperature test, flammability, VOC and odor test, scratch resistance test, metal composition analysis, RoHS analysis.

MODULE IV MATERIAL BEHAVIOURS – ELECTRICAL EFFECTS 7

Electrical properties of Materials – Dielectric constant, electrical resistivity, wire harness test Mechanical behaviors, Electrical-Magnetic-Optical properties of ploymer nano-composites.

MODULE V **MATERIAL BEHAVIOURS – EFFECTS** **8**

THermal properties of Materials – coeffic ent of thermal expansion & contraction, Thermal response, Fire retardancy, Chemical resistance.

MODULE VI **INSTRUMENTAL TECHNIQUES** **8**

FTIR spectrometer, Thermal analyzer, X-ray analyzer, Optical emission spectroscopy, Ion Chromatography, Gas and Liquid Chromatography, High strain rate tester, Non-destructive instruments, etc. New innovations in testing and characterization, X-ray Diffraction, Electron microscope (SEM, TEM), Scanning probe microscopy (SPM, AFM), Spectroscopic methods (EDS, FTIR); Mechanical behaviors, Thermal response, Fire retardancy, Chemical resistance and Electrical-Magnetic-Optical properties of ploymer nano-composites.

Total Hours – 45

TEXT BOOK:

1. Dictionary of Materials and Testing, Second Edition by Joan Tomsic
2. "Metallurgy of Failure Analysis" by A K. Das; by McGraw- Hill Professional Publication.

REFERENCES:

1. Material Characterization: Introduction to Microscopic & Spectroscopic Methods by Yang Leng John Wiley & Sons (Asia) Pte Ltd.
2. ASM Handbook on Metals Handbook: Vol. 8 Mechanical Testing – 1978.
3. ASM Handbook Vol.11 - Failure Analysis and Prevention, ASM International Publication, 1995.
4. Automotive Component Failures by A. M. Heyes .
5. Handbook of Case Histories of Failure Analysis, Vol 1 by C.Uhietal Robert

OUTCOMES:

On completion of the course, students should be able to:

- Select the suitable material testing processes with justification
- Identify and analyze the relation between the mechanical properties.
- Evaluate the various mechanical and chemical properties of composites.
- Summarize the characteristics of electrical effects of the material.
- Analyze the material behaviour on thermal and chemical loading.
- Analyze the instrumental techniques employed in material testing.

AUC X21	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The student will have good exposure in basic of computer aided design and Manufacturing.
- The students shall understand the drafting and geometric modeling of database structure for graphics modeling.
- The students shall understand the numerical control, machining center, turning centre And CNC programming.
- The students will know the importance of computer aided production planning
- The students shall understand the CAD production group technology and production planning.
- The students will understand the principle of automation.

MODULE I **INTRODUCTION** **7**

Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices. Computer Graphics: Raster scans graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

MODULE II **GEOMETRIC MODELING** **8**

Geometric modeling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired. Drafting and Modeling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling, constraint based modeling.

MODULE III **COMPUTER AIDED MANUFACTURING** **8**

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

MODULE IV **COMPUTER AIDED PRODUCTION PLANNING** **7**

Computer Aided Processes Planning, Material requirement planning, manufacturing resources planning

MODULE V COMPUTER AIDED PRODUCTION GROUP TECHNOLOGY 8

Part family, coding and classification, production flow analysis, advantages and limitations, Retrieval type and Generative type

MODULE VI FLEXIBLE MANUFACTURING SYSTEMS 7

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

Total Hours – 45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

On completion of the course the students should be able to

- Interpret complex engineering drawings including geometric dimensioning and tolerancing.
- Perform competently in solving technical manufacturing and engineering mathematics problems.
- Exhibit competency in two-dimensional, three-dimensional and solid modeling skills as applied to complex computer-aided design technology.
- Demonstrate an understanding of the role and function of computers and effectively use the computer to solve complex technical problems.
- Able to classify part families and understand production flow analysis.
- Select the suitable manufacturing principle for particular product development with justification.

AUC X22	DESIGN OF JIGS , FIXTURES AND PRESS TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic design of jigs and fixtures
- To study about design of jigs for desired component
- To Know about fixtures design principle for various machining process
- To study about the press working tools
- To understand about press working elements of dies
- To know about the dies and their elements

MODULE I — PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES — 8

Tool design objectives –Design procedures for Jigs and Fixtures-Locating devices-Clamping devices- Production devices - Inspection devices - Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures-Mechanical actuation-pneumatic and hydraulic actuation-Analysis of clamping force-Tolerance and error analysis

MODULE II — JIGS — 8

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 III — 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 IV — PRESS WORKING TERMINOLOGIES — 5

Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements

MODULE V — PRESS WORKING ELEMENTS OD DIES AND STRIP LAYOUT — 6

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 — 9

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 Hiram E Grant, “Jigs and Fixture” Tata McGraw-Hill, New Delhi, 2003.
3. “Fundamentals of Tool Design”, CEEE Edition, ASTME, 1983.
4. Design Data Handbook PSG College of Technology, Coimbatore.

OUTCOMES:

Upon completion of the subject, students will be able to

- Apply the basic principles in designing general jigs and fixtures,
- Use the basic principles in designing general jigs for any desired component
- Use the basic principles in designing general fixtures for any desired component.
- Implement the basic principles in designing press
- Implement the basic principles in designing elements of dies
- Apply the basic principles in designing dies

AUC X23 **SIMULATION OF I.C. ENGINE PROCESSES**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about the heat of reaction and adiabatic flame temperature.
- To learn about the constant volume and constant pressure adiabatic combustion.
- To learn about the progressive combustion and multi zone combustion.
- To learn new concept engine development

MODULE I **INTRODUCTION** **8**

Introduction-Heat of reaction-Measurement of URP-Measurement of HRP-Adiabatic flame temperature, complete combustion in C/H/O/N Systems,

MODULE II **ADIABATIC PROCESS** **8**

Constant volume adiabatic combustion, constant pressure adiabatic combustion. Calculation of adiabatic flame temperature-Isentropic changes of state.

MODULE III **SI ENGINE SIMULATION WITH AIR AS WORKING MEDIUM** **7**

Deviation between actual and ideal cycle-Problems, IC engine simulation with adiabatic combustion, temperature drop due to fuel vaporization, full throttle operation-efficiency calculation, part-throttle operation, super charged operation

MODULE IV **PROGRESSIVE COMBUSTION** **8**

SI Engines simulation with progressive combustion with gas exchange process, Heat transfer process, friction calculation, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram and other engine performance.

MODULE V **SIMULATION OF CI ENGINE** **7**

Diesel Engine Simulation: Multi Zone model for combustion, different heat transfer models, equilibrium calculations, simulation of engine performance, and simulation for pollution estimation.

MODULE VI **SIMULATION OF NEW ENGINE CONCEPTS** **7**

Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine, controlled auto ignition engine.

Total Hours – 45

TEXT BOOKS:

1. Ganesan .V – 'Computer Simulation of Spark Ignition Processes' - Universities Process Ltd, Hyderabad - 1993.
2. Ganesan.V. – Computer Simulation of compression ignition engines – Orcent Longman – 2000

REFERENCES:

1. Ramoss. A.L., Modelling of Internal Combustion Engines Processes, McGraw Hill Publishing Co., 1992.
2. Ashley Campbel, Thermodynamic analysis of combustion engines, John Wiley & Sons, New York, 1986
3. Benson. R.S., Whitehouse. N.D., Internal Combustion Engines, Pergamon Press, Oxford, 1979.

OUTCOMES:

After completing the course students must be able to

- Analyze the heat reaction and combustion product.
- Analyze the adiabatic flame temperature of constant pressure and volume combustion process.
- Analyze the ideal and actual cycle
- Analyze the progressive combustion and multi zone combustion.
- Design a combustion chamber for HCCI, Dual fuel and multi-fuel engines.

AUCX24	COMBUSTION THERMODYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Acquire the fundamental knowledge of combustion.
- Understand the thermodynamics of combustion.
- Understand the kinetics of combustion.
- Understand the combustion aspects in SI and CI Engines

MODULE I COMBUSTION OF FUELS 7

Combustion equations - Theoretical air, excess air - Air fuel ratio, equivalence ratio - Exhaust gas composition - Air fuel ratio from exhaust gas composition and heating value of fuels.

MODULE II THERMODYNAMICS OF COMBUSTION 7

Thermo-chemistry, first law analysis of reacting systems - Adiabatic combustion temperature - Second law analysis of reacting systems - Criterion for chemical equilibrium - Equilibrium constant for gaseous mixtures - Evaluation of equilibrium composition - Chemical availability.

MODULE III KINETICS OF COMBUSTION 7

Rates of reaction - Reaction order and molecularity complex reactions – Chain reactions - Arrhenius rate equation, collection theory - Activated complex theory - Explosive and general oxidative characteristics of fuels.

MODULE IV FLAMES 8

Laminar and turbulent flames - Premixed and diffusion flames - Burning velocity and its determination - Factors affecting burning velocity - Quenching, flammability and ignition - Flame stabilization in open burners.

MODULE V ENGINE COMBUSTION 8

Combustion in SI and CI engines - Stages of combustion in SI and CI engines, normal combustion and abnormal combustion - Emissions from premixed combustion - Emission from non premixed combustion - Control of emissions.

MODULE VI **HEAT TRANSFER IN IC ENGINES** **8**

Basic definitions - Convective heat traanfer - Radiative heat transfer - Heat transfer, temperature distribution and thermal stresses in piston - Cylinder liner - Cylinder head - fins and values.

Total Hours – 45

TEXT BOOKS:

1. Ganesan .V - “IC Engines” – 4th edition Tata McGraw-Hill, 2012.
2. John B. Haywodd, “Internal Combustion Engine Fundamentals”, McGraw-Hill-Indian edition,2011.

REFERENCES:

1. Ganesan .V – ‘Computer Simulation of Spark Ignition Processes’ - Universities Process Ltd, Hyderabad - 1993.
2. Ganesan.V. – Computer Simulation of compression ignition engines – Orcent Longman – 2000.
3. Richard Stone – “Introduction to IC Engines” – 2nd edition – Macmilan – 1992

OUTCOMES:

The student should be able to

- Conduct analysis on combustion process of given engine
- Analyze heat apportion of given engine
- Perform photographic analysis of give automobile engines
- Analysis causes of the knocking.
- Perform calculations to evaluate the heat transfer in IC engines.
- Investigate the state variables of combustion and heat flow in IC engines

AUC X25	UNCONVENTIONAL ENERGY SOURCES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Familiarize the biomass energy conversion technologies.
- Familiarize the solar energy technologies.
- Understand the wind energy and hybrid energy systems.
- Know concepts of hydro, ocean and geothermal energy systems.
- Familiarize the operations of direct energy conversion systems.

MODULE I BIOMASS 8

Biomass, sources of biomass, thermo-chemical and bio-chemical conversion of biomass - pyrolysis, gasification, combustion and fermentation. Gasifiers - up draft, downdraft and fluidized bed gasifiers. Digesters - Fixed and floating digester biogas plants, economics of biomass power generation.

MODULE II SOLAR ENERGY 9

Solar radiation and its measurements, types of solar thermal collectors - Flat and concentrating collectors, solar thermal applications - Water heaters, dryers, stills, refrigeration, air-conditioning, solar pond, central receiver power generation, thermal energy storage systems, solar photovoltaic components and solar photovoltaic power plants.

MODULE III WIND ENERGY 8

Basic principle of wind energy conversion system, wind data and energy estimation, Site selection, components of wind energy conversion systems, design consideration of horizontal axis wind mill, aerofoil theory, analysis of aerodynamic forces acting on the blade, performance of wind machines. Introduction to solar - Wind hybrid energy systems.

MODULE IV OCEAN AND HYDRO ENERGY 6

Wave and tidal energy, ocean thermal energy conversion - Principle, types, power plants - Small, mini and micro hydro power plants.

MODULE V GEOTHREMAL ENERGY 6

Exploration of geothermal energy, geothermal power plants, challenges - Availability, geographical distribution, scope and economics.

MODULE VI **DIRECT ENERGY CONVERSION SYSTEMS** **8**

Basic principle of thermo-electric and thermo-ionic power generations, fuel cellprinciple, types, conversion efficiency, applications. Magneto hydrodynamic power generation - Principle, open cycle and closed cycles, design considerations and recent developments. Hydrogen energy - Production, storage, transportation and applications.

Total Hours – 45

TEXT BOOKS:

1. Rai.G.D, "Non-Conventional Energy Sources", Khanna Publishers, 4th edition, New Delhi, 2009.
2. Domkundwar.V.M, Domkundwar.A.V, "Solar energy and Non-conventional sources of energy", Dhanpat rai & Co. (P) Ltd, 1st edition, New Delhi, 2010.

REFERENCES:

1. Godfrey Boyle, "Renewable energy", 2nd ed, Oxford University Press, 2010.
2. Khan.B, "Non-conventional Sources of energy", 2nd edition, New Delhi, Tata McGraw Hill, 2009.
3. Tiwari.G.N, Ghosal.M.K, "Fundamentals of renewable energy sources",1st edition, UK, Alpha Science International Ltd, 2007.
4. Twidell.J.W and Weir.A.D, "Renewable Energy Resources",1st edition, UK, E.&F.N. Spon Ltd, 2006.

OUTCOMES:

The student should be able to

- Apply knowledge in production of Bio-mass.
- Design and analysis the solar heater and power plant.
- Apply the knowledge in extraction and utilization of wind, hydro and geothermal energy.

AUC X26	COMPUTATIONAL FLOW AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic governing equation and Boundary conditions of various FEA problems
- To gain knowledge about discretization and solution methods.
- To study about the heat conduction of fluids
- To know about the convection and their significances.
- To study flow modelling for fluids.
- To impart knowledge about diffusion problems.

MODULE I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 7

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

MODULE II DISCRETIZATION AND SOLUTION METHODOLOGIES 8

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

MODULE III HEAT CONDUCTION 7

Finite difference and finite volume formulation of steady/transient one dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

MODULE IV CONVECTION 8

Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes – Discretization equations for two dimensional convection and diffusion.

MODULE V CALCULATION OF 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. Turbulence models: mixing length model, Two equation (k-epsilon) models.

MODULE VI DIFFUSION 8

Finite volume formulation of steady one-dimensional Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional diffusion.

Total Hours –45

REFERENCES:

1. Construction Equipment Operation & Maintenance” by Y. Pokras and M. Tushnyakov, MIR,
2. “Truck Cranes”, by A. Astskhov, MIR, Moscow.
3. Pipenger, ‘Industrial Hydralics’, Mcgraw Hill, Tokoyo, 1979.
4. A. Astakhov, ‘Truck cranes’, MIR Publishers, Moscow, 1971.
5. Bart H Vanderveen, ‘Tanks and Transport Vehicles’, Frederic Warne and co. Ltd., London, 1974.
6. K. Abrosimov, A. Bromberg and F. Katayer, ‘Road making machineries’, MIR Publisher, Moscow,1975.

OUTCOMES:

After successfully completing this course you will be able to:

- The student will able to demonstrate the ability to simplify a real fluid-flow system into a simplified model problem.
- To develop an understanding for the major theories, approaches and methodologies used in CFD;
- To build up the skills in the actual implementation of CFD methods (e.g.boundary conditions, turbulence modeling etc.) in using commercial CFD codes;
- To gain experience in the application of CFD analysis to real engineering designs.
- The students able to convert heat transfer problems into mathematical models.
- The student will able to demonstrate the ability to analyze a flow field to determine various quantities of interest, such as flow rates, heat fluxes, pressure drops, losses, etc., using flow visualization and analysis tools.
- The student will able to demonstrate an ability to recognize the type of fluid flow that is occurring in a particular physical system and to use the appropriate model equations to investigate the flow.

AUC X27 **MOTORSPORT ENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Study the constructional details and Structures of different types of frames used in motorsports vehicle
- To Study mechanism of different types of steering system used in motorsports vehicle.
- To Study mechanism of different types of drive line and final drive used in motorsports vehicle.
- To study use age of wheels and tyres used in motorsports vehicle.
- To Study the fundamental and working of different types of Suspension Systems of motorsports vehicle.

  To Study the fundamental and working of different types of Braking Systems of motorsports vehicle

MODULE I **OVER VIEW OF MOTOR SPORT ENGINEERING** **8**

Introduction about motor sport vehicles, various types of motor sport vehicles and their requirements, competitions and requirements, Preparing for the competitions, bench marking, project planning, Case studies of completed events.

MODULE II **POWER TRAIN** **8**

Engine management systems, sensors, alternative fuels, oxidizing agents, chemical composition of fuels, ignition systems and components.Engine and transmission configurations – front/ rear/mid engine and associated driveline Transmission systems – clutches, torque converters, manual gearbox types, automatic gearbox types, electronic and hydraulic transmission control, traction control, launch control, KERS systems. Final drive systems – differentials, Tor-sen, torque biasing, LSD, Salisbury, air-locking, fluid coupling Hybrid Drive systems.

MODULE III **MATERIALS AND PROCESSES** **8**

Selection criteria: material properties, including cost drivers, mechanical, physical, chemical and process characteristics. basic properties of materials such as ceramics, metals, composites and polymers. Testing of materials, ISI standards, standard published data sources, engineering drawings Joining techniques including, brazing and welding, effect on structure and properties, use of adhesives.Processing limitations: effects of properties such as structure preventing or facilitating processing techniques. heat treatments of metals and alloys, coatings and other surface treatments, polymer processing.

MODULE IV **FAILURE MECHANISMS** **7**

Causes of failure: appreciation of failure mechanisms in materials such as metals, ceramics, polymers and composites; such as creep, fatigue, impact, overstressing, corrosion, temperature, thermal cycling, residual stresses, stress relaxation, degradation (composition change), radiation, electrical breakdown.

MODULE V **VEHICLE ELECTRONICS** **7**

Electronics – semiconductors, electronic circuitry, integrated circuits. ignition systems, Engine management systems, sensors transistorized and capacitor discharge types, fuel injection systems and sensors, ECU programming and mapping., ABS, TRS, active suspension system, Tuned manifloding

MODULE VI **MOTOR VEHICLE CHASSIS** **7**

Frame design for different vehicles, layout of components, weight distribution, weight transfer and braking requirements, suspension system, steering system, body design and fabrication, driver seat and safety requirements, Electrical systems and wiring, wheels and tires. Testing and validation.

Total Hours – 45

REFERENCES:

- Hillier, VAW (2006) Fundamentals of Motor Vehicle TechnologyStanleyThornes Davis & Davis (2001) Supercharging, Turbocharging and Nitrous Oxide performance. Motorbooks.
- Marek, J. (2003) Sensors applications: sensors for automotive technology. Wiley
- Walker, D. (2001) Engine management. Haynes
- Staniforth, A (2002)Race and rally car sourcebook Haynes
- Staniforth, A (2006)Competition car suspension Haynes
- van Valkenburg, P (2001)Race car engineering and mechanicsMotorbooks International
- Milliken & Milliken (1997) Vehicle dynamics. SAE

OUTCOMES:

On completion of the course student should be able to

- Design and select suitable frame for different vehicles.
- Select suitable layout of components, based on weight distribution, weight transfer and braking requirements.
- Design suitable transmission, suspension system and steering system.
- Design and fabricate body, driver seat and safety requirements.
- Design of electrical systems and wiring and power train tuning.
- Select suitable wheels and tires.
- Test and validate the vehicle

AUC X28	COMPOSITE MATERIALS FOR AUTOMOBILES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the composite materials and its applications in automotive industry
- To impart knowledge in several composite materials production processes.
- To have knowledge in different polymers, metals and ceramics reinforced composites.
- To gain knowledge in different matrices and reinforcements
- To have knowledge about composite structure.
- To understand the various types of composite materials

MODULE I INTRODUCTION 8

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

MODULE II POLYMER MATRIX COMPOSITES 8

Polymer Matrix Composites -Types – Processing – Thermal matrix composites – Hand layup and spray technique, filament winding, Pultrution, resin transfer moulding, autoclave molding – Thermoplastic matrix composites – Injection molding, film stacking – Diaphragm forming – Thermoplastic tape laying. Glass fibre/polymer interface. Mechanical properties – Fracture. Applications.

MODULE III METAL MATRIX COMPOSITES 6

Metal Matrix Composites Types. Important metallic matrices. Processing – Solid state, liquid state, deposition, Mechanical properties. Applications.

MODULE IV CERAMIC MATRIX COMPOSITES 6

Ceramic matrix materials – Processing – Hot pressing, liquid infiltration technique, Lanxide process, insitu chemical reaction techniques – CVD, CVI, sol gel process. Interface in CMCs. Mechanical properties – Thermal shock resistance – Applications.

MODULE V COMPOSITE STRUCTURES 9

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

Introduction to structures - selection of material, manufacturing and laminate configuration -design of joints - bonded joints - bolted joints - bonded and bolted – laminate optimization.

MODULE VI AUTOMOTIVE APPLICATIONS 8

Drive Shafts, Suspension Arms, Wheels, Valve Guides, Clutch Plates, use of MMC in disc brakes, Mufflers and other applications.

Total Hours – 45

REFERENCES:

1. Mathews F L and Rawlings R D, "Composite Materials: Engineering and Science", CRC Press and Woodhead Publishing Limited, 2002.
2. Krishnan K Chawla, "Composite Materials Science and Engineering", Springer, 2001.
3. Handbook of Composites – American Society of Metals, 1990.
4. Derek Hull, "An introduction to Composite Materials", Cambridge University Press, 1988.

OUTCOMES:

On completion of the course, students should be able to:

- Classify the characterization of different composite materials.
- Demonstrate the polymer matrix composite manufacturing processes.
- Identify different metal matrix composites and their productions with justification
- Enumerate the ceramic applications in the composite materials.
- Evaluate the effects of structural parameters on the properties of composite.
- Analyze current automotive applications of composite materials in the industry.

AUCX29 **TRAFFIC ENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the knowledge of traffic engineering includes traffic survey highway, characteristics and traffic control
- To understand the measure of traffic management and importance motor vehicle act.

MODULE I **INTRODUCTION AND TRAFFIC CHRACTERISTICS** **7**

Objectives and scope of traffic engg. Organizational set up of traffic engg department in India; Importance of traffic characteristics; Road user characteristics; Vehicular characteristics; Max dimensions and weights of vehicles allowed in India. Effects of traffic characteristics on various design elements of the road.

MODULE II **TRAFFIC SURVEYS** **7**

Methods of conducting the study and presentation of the data for traffic volume study; speed study and origin and destination study. Speed and delay study. Parking surveys; On street parking; off street parking. Accident surveys. Causes of road accidents and preventive measures; Use of photographic techniques in traffic surveys.

MODULE III **HIGHWAY CAPACITY** **7**

Importance. Space and time headway. Fundamental diagram of traffic flow. Relationship between speed; volume and density. Level of service. PCU. Design service volume. Capacity of non-urban roads. IRC recommendations. Brief review of capacity of urban roads.

MODULE IV **TRAFFIC CONTROL** **8**

Types of traffic control devices. Traffic signs; general principles of traffic signing; types of traffic signs. Road markings; types; general principles of pavement markings. Design of rotary. Grade separated intersections. Miscellaneous traffic control aids and street furniture.

MODULE V **SIGNAL DESIGN** **8**

Types of signals. Linked or coordinated signal systems. Design of signal timings by trial cycle method; approximate method; Webstor’s method and IRC method

MODULE VI **TRAFFIC REGULATION AND MANAGEMENT** **8**

Need and scope of traffic regulations. Regulation of speed; vehicles and drivers. General traffic regulations. Motor vehicle act. Scope of traffic management. Traffic management measures: restrictions on turning movements; one way streets; tidal flow operations; exclusive bus lanes; traffic restraint; road pricing.

Total Hours – 45

TEXT BOOKS:

1. Khanna S. K. and Justo C. E. G., “Highway Engineering”, Nem Chand Bros., Roorkee.

REFERENCES:

1. Kadiyali L. R., “Traffic Engg. and Transport Planning”, Khanna Publishers
2. Matson T. M., Smith W. S. and Hurd F. W., “Traffic Engineering”, McGraw Hill, New York.
3. Drew D. R., “Traffic Flow Theory”, McGraw Hill, New York.

OUTCOMES:

On completion of the course the students should be able to

- Describe the various traffic characteristic in India
- Analyze the causes for road accident and its preventive methods
- Summarize Non –urban and urban roads characteristics
- Evaluate the various traffic control devices and traffic signs for roads
- Enumerate the procedure for designing of signal timing
- Analyze the latest motor vehicle act and traffic rules and regulations.

AUCX30	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge of principle and practice of surface engineering and coating techniques
- To provide knowledge about hardfacing and plating processes.
- To familiarise about thin film coating techniques.
- To provide knowledge about high energy modification processes

MODULE I **TRIBOLOGY PROCESSES** **7**

Introduction to tribology, Wear: Types of wear - adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication and wear testing.

MODULE II **PLATING PROCESSES** **7**

Plating Processes: Fundamentals of electrodeposition, plating of nickel, chromium, tin and copper, pulsed plating, hydrogen embrittlement, plating adhesion, electroless plating, electrochemical conversion coating, selective plating for repair, plating properties, hard anodizing.

MODULE III **HARDFACING PROCESSES** **8**

SMAW, GTAW, GMAW, FCAW, SAW, PAW, Oxy-Acetylene Welding, Furnace fusing, Thermal -spray, flame spray processes - HVOF, Detonation gun and jet kote processes, hard facing consumables.

MODULE IV **SPECIAL DIFFUSION PROCESSES** **7**

Principle of diffusion processes – Boriding, Aluminising, Siliconising, Chromising, Sursulf - Selection of diffusion processes – Characteristics of diffused layer – micro structure and micro hardness evaluation – properties and applications.

MODULE V **THIN FILM COATINGS** **8**

Physical vapour deposition processes – Thermal evaporation - sputter coating - Ion plating – Chemical vapour deposition – reactive sputtering - TiC, TiN, Alumina, CBN, Diamond and DLC coatings. Structure, properties and applications.

MODULE VI **HIGH ENERGY MODIFICATION AND SPECIAL PROCESSES** **8**

Electron beam hardening/ glazing, Laser beam hardening / glazing ion inplantation, Composite surface created by laser and Electron beam. Surface cements, Wear tiles, Electro spark deposition, fused carbide cloth, thermal / chemical,Ceramic coatings, centrifugal cast wear coatings, Wear sleeves and Wear plates.

Total Hours – 45

REFERENCES:

1. William D. Callister, Materials Science and Engineering: An Introduction, 7th Edition, John Wiley & Sons, New York, 2007.
2. Yip-Wah Chung, Practical Guide to Surface Science and Spectroscopy, Academic Press, San Diego, CA, 2001.
3. Donald L. Smith, Thin-Film Deposition: Principles and Practice, McGraw-Hill, Boston, 1995.
4. Hornyak G. Louis, Tibbals, H.F., Dutta Joydeep, Fundamentals of Nanotechnology, CRC Press, Boca Raton, 2009.
5. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, New York, 2001, TK7870.15. F86 2001.
6. William M. Steen, Laser Material Processing, Springer, New York, 2003, TS183.S73.

OUTCOMES:

The students will be able to

- Evaluate various tribology processes.
- Demonstrate the different plating processes.
- Summarize the principles and key characteristics of technologies used in hardfacing processes.
- Characterize the special diffusion processes.
- Identify and describe the various thin film coatings.
- Analyze the high energy modification and special processes.

AUC X31 **ADVANCED IC ENGINE**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To gain knowledge on ideal cycle and actual cycle.
- To understand the chemical reason of fuels and combustion processes.
- To gain the knowledge in unconventional engines.
- To learn about flow analysis of combustion.

MODULE I **INTRODUCTION** **7**

Fuel air cycle and Actual cycle analysis, Properties of IC engine fuels, Refining process,chemical composition and molecular structure of fuels, octane number, cetane number. Knock rating of SI engine fuels.

MODULE II **COMBUSTION OF FUELS** **7**

Combustion Stoichiometry of petrol, diesel, alcohol and hydrogen fuels – Chemical energy and heating values – Chemical equilibrium and maximum temperature

MODULE III **SI AND CI ENGINE COMBUSTION** **7**

SI engine combustion – Flame velocity and area of flame front – performance number – CI engine combustion. Fuel spray characteristics – droplet size, penetration and atomization.

MODULE IV **COMBUSTION MODELLING** **8**

Basic concepts of engine simulation, governing equations, simulation of various engine processes for SI and CI engines. Adiabatic flame temperature, Heat release calculations. Thermodynamic and Fluid mechanic based models.

MODULE V **NON-CONVENTIONAL IC ENGINES** **8**

Adiabatic and L.H.R. engines – Variable compression ratio engine – Wankel rotary combustion engine – Free piston engine - HCCI and multi fuel engines – Stratified charge and lean burn engines – Locomotive and marine engines.

MODULE VI **COMBUSTION ANALYSIS IN IC ENGINES** **8**

Photographic studies of combustion processes – P-ϕ diagrams in SI and CI engines, Rate of heat release – hot wire and laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines

Total Hours – 45

TEXT BOOKS:

1. Ganesan .V - “IC Engines” – 4^{th} edition Tata McGraw-Hill, 2012.
2. John B. Haywodd, “Internal Combustion Engine Fundamentals”, McGraw-Hill-Indian edition,2011.

REFERENCES:

1. Ganesan .V – ‘Computer Simulation of Spark Ignition Processes’ - Universities Process Ltd, Hyderabad - 1993.
2. Ganesan.V. – Computer Simulation of compression ignition engines – Orcent Longman – 2000.
3. Richard Stone – “Introduction to IC Engines” – 2nd edition – Macmilan – 1992.

OUTCOMES:

The student should be able to

- Analyze the actual and ideal cycle.
- Calculate the air-fuel ratio of fuels.
- Analyze the adiabatic flame temperature and heat release.
- Analyze the combustion processes of IC engine.

AUCX32 FUEL CELL TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- The students shall understand the working principle of fuel cells and components of fuel cells
- The students will be able to know the concept of fuel cells used in automotive application
- The students shall understand about the types of fuel cells
- The students will be well versed in fuel cell performance characteristics
- The students shall understand about the fuel cell analysis

MODULE I INTRODUCTION TO FUEL CELLS 8

Principle of Fuel Cells – Application – Merits and limitations of fuel cell – Electrochemical aspects: reversible potential, Gibbs free energy – Chemical activity and the Nernst equation - Introduction – working and types of fuel cell – low, medium and high temperature fuel cell. Components of fuel cell – membrane electrode assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates.

MODULE II FUEL CELLS FOR AUTOMOTIVE APPLICATIONS 8

Fuel cells for automotive applications – technology advances in fuel cell vehicle systems – onboard hydrogen storage – liquid hydrogen and compressed hydrogen – metal hydrides, fuel cell control system – alkaline fuel cell – road map to market.

MODULE III TYPES OF FUEL CELLS 6

Proton exchange membrane fuel cell –Direct methanol fuel cell - Phosphoric acid fuel cell - Alkaline fuel cell – Molten carbonate fuel cell – Solid oxide fuel cell.

MODULE IV FUEL CELL PERFORMANCE 7

Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, ohmic resistance, kinetic performance, mass transfer effects

MODULE V FUELING 8

Hydrogen storage technology – pressure cylinders, liquid hydrogen, metal hydrides, carbon fibers – reformer technology – steam reforming, partial oxidation, auto thermal reforming – CO removal, fuel cell technology based on removal like bio-mass.

MODULE VI FUEL CYCLE ANALYSIS 8

Introduction to fuel cycle analysis – application to fuel cell and other competing technologies like battery powered vehicles, SI engine fueled by natural gas and hydrogen and hybrid electric vehicle.

Total Hours: 45

TEXT BOOKS:

1. Pukushpan, J.T., Stctanopoulon, A.G., Peng, H.,"Fuel Cell Power Systems", Springer, 2006
2. Viswanathan, B., and Aulice Scibioh, M.,"Fuel Cells Principles and Applications", Universities Press (India) Pvt. Ltd., Hyderabad, 2006

REFERENCES:

1. Fuel Cells for automotive applications – professional engineering publishing UK. ISBN 1-86058 4233, 2004.
2. Fuel Cell Technology Handbook SAE International Gregor Hoogers CRC Press ISBN 0-8493-0877-1-2003.
3. Larminie.J and Dicks.A, "*Fuel Systems Explained*", John Wiley & Sons, Ltd., New York, 2001.
4. O'Hayre.R, Suk-Woncha, Whitney Colella, Prinz, F.B., "*Fuel Cell Fundamentals*", John Wiley & Sons, New York, 2006.
5. Hoogers.G. Edr, "*Fuel Cell Technology Handbook*", CRC Press, Washington D.C., 2013.

OUTCOMES:

On completion of the course the students should be able to

- Know about the principle and components of fuel cell.
- Evaluate the technology advances in fuel cell vehicle system
- Know about the principle of various types of fuel cells and its applications
- Determine the performance characteristics of fuel cell for various parameters
- Compare the various types of hydrogen storage technology
- Enumerate the need of fuel cell with various fuel cycle analysis

AUC X33 **POWER PLANT ENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- Know the functions of various auxiliary combustion equipment
- Understand the thermal power plant systems.
- Familiarize with operation of nuclear, Diesel and gas turbine power Plants.
- Familiarize with renewable energy sources and power plant economics.

MODULE I **FUEL COMBUSTION EQUIPMENTS** **8**

Types of combustion, stokers, fuel and ash handling equipments. Draft - forced, induced and balanced drafts. Selection of fans. Heat recovery equipmentseconomisers, air preheaters and reheaters, different types of superheaters and desuperheaters. Emission control, flue gas cleaning, particulate and gaseous emission control methods.

MODULE II **THERMAL POWER PLANT SYSTEMS** **8**

Steam generators - forced circulation, high-pressure boilers and super critical boilers, fluidized bed boiler, boiler accessories and mountings. Boiler testing. Condensers: Different types, design factors, air removal, performance calculation. Cooling towers - natural and mechanical draft types.

MODULE III **NUCLEAR POWER PLANTS** **7**

General nuclear fuels used in reactors, elements of nuclear reactor, moderator, control rods, coolants, description of different types of reactors. Radiation hazards, radioactive waste disposal.

MODULE IV **DIESEL AND GAS TURBINE POWER PLANTS** **7**

Diesel power plant - Classifications, components, selection of engine type. Gas turbine plant - closed and open cycles. Combined power cycles

MODULE V **RENEWABLE ENERGY SOURCES** **8**

Solar energy - measurement, methods of utilization, flat plate and concentrating collectors, water heater, air driers, photovoltaic cell. Wind energy - Horizontal and vertical axis wind turbines. Geothermal plants, tidal power plant, biomass and biogas plants, OTEC plants.

MODULE VI **POWER PLANT ECONOMICS** **7**

Plant load factor and utilization factor, cost economics - Tariff rates, demand changes, load distributions. Energy conservation and audit. Maintenance aspects of power plants.

Total Hours – 45

TEXT BOOKS:

1. Nag.P.K, "Power Plant Engineering", Tata McGraw Hill, New Delhi, 3rd edition, 2008.

2. Arora.S.C and Domkundwar.S, "Power Plant Engineering", Dhanpat Rai & Sons, New Delhi, 2001.

REFERENCES:

1. Ramalingam.K.K, "Power Plant Engineering", Scitech Publication Pvt. Ltd, 2002.
2. Rai.G.D, "Non-Conventional Energy Sources", Khanna Publishers, 4th edition, New Delhi, 2009.
3. El Wakil.M.M, "Power Plant Technology", McGraw Hill Inc., New York, 1985.

OUTCOMES:

The student should be able to

- Analyze various sub-systems in power plant.
- Design the power plant sub-system.
- Analyze entire power plants and its efficiency.
- Design and develop low cast power plant components.

AUC X34	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 study and design various types of heat exchangers.
- To learn 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. R.B.Gupta, Automobile Engineering 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", 4 th edition, New Age International Publishers, New Delhi, 2010.
5. Nag P K., "Heat and Mass Transfer", Tata McGraw Hill Publishing Company, New Delhi, 2004.

OUTCOMES:

The student should be able to

- Choose the governing equation for different heat transfer analysis
- Conceptualize and apply the conduction modes of heat transfer to real applications.
- Conceptualize and apply the convection modes of heat transfer to real applications.
- Conceptualize and apply the radiation modes of heat transfer to real applications.
- Design heat exchangers to suit specific requirements.
- Analysis the real time mass transfer problems

AUC X35 **AUTOMOTIVE SAFETY SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- The students will have good exposure in automotive safety aspects including the understanding of the various safety equipments.
- The students able to know the design of body for safety, dimensions of a body and about the impact of a vehicle.
- The students also able to know about the safety systems in a vehicle and deformation behavior of a vehicle.
- The students also able to know about the acceleration and deceleration impact with obstacles.
- The students also able to know about the automatic working systems and features in a vehicle.

MODULE I INTRODUCTION **7**

Design of the body for safety, dummy performance, stiff cage structural concepts, crush zone, energy equation, engine location and vehicle size and structure. Energy-absorbing bumpers, bumper design for safety and pedestrian, pedestrian protection systems.

MODULE II VEHICLE COLLISION **7**

Deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, acceleration curve, concept of crumble zone, safety sandwich construction.

MODULE III VEHICLE SAFETY CONCEPTS **8**

Active safety- driving safety, conditional safety, perceptibility safety, operating safety, passive safety- exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of vehicle body, velocity and time graph.

MODULE IV SAFETY EQUIPMENTS **8**

Seat belt and tightener system, collapsible steering column, tiltable steering wheel, Air bags, Antilock braking system, Adaptive cruise control system, Stability control systems, Automatic parking system,Blind spot detection, night vision and adaptive headlamps, traction control systems, Cornering Brake Control systems.

MODULE V COLLISION AVOIDANCE SYSTEMS **8**

Collision warning system, causes of rear end collision, front and rear vehicle object detection system, Automatic braking system, Lane departure warnings system, Electronic brake force distribution systems, Emergency brake assist system.

MODULE VI COMFORT AND CONVENIENCE SYSTEM **7**

Steering and mirror adjustment, Central locking, remote control system, Tyre pressure monitoring system, Rain sensor system, garage door opening system, Environment infotainment system, Vehicle seating positions and height adjustments, Laminated windshield protection and transparency.

TOTAL: 45 PERIODS

OUTCOMES:

- The student able to analyze how the vehicle's structure absorbs impact in a crash.
- The student will be familiar in various systems that enhance vehicle safety, passenger Comfort, recent technologies in automobile field etc.
- The student will be able to Identify and locate the most important parts of a vehicle.
- The students able to describe the purpose of the fundamental automotive system in a vehicle.
- The students able to analyze the various safety equipments in a automobile vehicle.
- The students able to identify the comfort system and essential system in a vehicle.

TEXT BOOKS

1. Bosch, “Automotive Handbook”, 8th Edition, SAE publication, 2011.

2. Powloski. J., “Vehicle Body Engineering”, Business books limited, London, 1969.

REFERENCES:

1. Ronald.K.Jurgen, “Automotive Electronics Handbook”, Second Edition, McGraw-Hill Inc.,

2. Automotive Safety Handbook *Volume 325 of R: Society of Automotive Engineers by Ulrich Seiffert, Lothar Wech*

Physics Elective Courses

(to be offered in II Semester)

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 & 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. Laud.B.B., “Laser and Non-Linear Optics”, Second Edition, New Age International (p) Limited Publishers, 2011.
3. Nambiar. K.R., “Lasers Principle, Types and Applications”, New Age International (p) Ltd, 2004.
4. Wilson. J. & Hawkes J.F.B., “Opto Electronics - An Introduction”, Prentice Hall, 1992.
5. 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.

Chemistry Elective Courses
(to be offered II Semester)

		L	T	P	C
CHCX01	**ANALYTICAL INSTRUMENTATION**	**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

Absorptionspectroscopy (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

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.

L – 30; P – 30; TOTAL HOURS – 60

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
CHCX02 CORROSION AND ITS CONTROL	2	0	2	3

OBJECTIVES:

The students should be conversant with the

- 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 coating

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.

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.

L – 30; P – 30; TOTAL HOURS – 60

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:

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:

The students should be 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).

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.

L – 30; P – 30; TOTAL HOURS – 60

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

CHCX04	**ENGINEERING MATERIALS**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

OBJECTIVES:

The students should be 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 7

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.

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

L – 30; P – 30; TOTAL HOURS – 60

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.

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

L – 30; P – 30; TOTAL HOURS – 60

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:

The students will be 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.

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. *Kineticsoffirst 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.

L – 30; P – 30; TOTAL HOURS – 60

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.

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).

L – 30; P – 30; TOTAL HOURS – 60

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.

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.

L – 30; P – 30; TOTAL HOURS – 60

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.

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.

L – 30; P – 30; TOTAL HOURS – 60

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

Maths Elective Courses

(To be offered in IV Semester)

		L	T	P	C
MACX 01	**DISCRETE MATHEMATICS AND GRAPH THEORY**	**3**	**1**	**0**	**4**

OBJECTIVES:

The aims of this course are to

- introduce Logical and Mathematical ability to deal with abstraction.
- familiarize the basic mathematical ideas and terminologies used in computer science.
- translate real life situations into diagrammatic representations.

MODULE I PROPOSITIONAL CALCULUS 8

Propositions – Logical connectives – Compound propositions – Conditional and biconditional propositions – Truth tables – Tautologies and contradictions – Contrapositive – Logical equivalences and implications – DeMorgan's Laws – Normal forms – Principal conjunctive and disjunctive normal forms – Rules of inference – Arguments – Validity of arguments.

MODULE II PREDICATE CALCULUS 7+3

Predicates – Statement function – Variables – Free and bound variables – Quantifiers – Universe of discourse – Logical equivalences and implications for quantified statements – Theory of inference – The rules of universal specification and generalization – Validity of arguments.

MODULE III FUNCTIONS 7+3

Functions – Classification of functions –– Composition of functions – Inverse functions – Binary and n–ary operations – Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.

MODULE IV ALGEBRAIC SYSTEMS 8+2

Groups, Cyclic Groups, Subgroups, Cosets, Lagrange's theorem, Normal subgroups – Codes and group codes – Basic notions of error correlation – Error recovery in group codes.

MODULE V GRAPH THEORY 7+3

Graphs – incidence and degree – subgraphs – isomorphism – complement of a graph – operations on graphs

MODULE VI PATH AND CIRCUIT 8+2

Walks, trails and paths – Eulerian graphs – Konigsburg bridge problem - Hamiltonian graphs

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1 Trembly J.P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 30th Reprint 2011.

2 Kenneth H.Rosen, “Discrete Mathematics and its Applications:, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, Special Indian Edition, 2011.

REFERENCES:

1 Ralph.P.Grimaldi, “Discrete and Combinatorial Mathematics: An Introduction”, 4th Edition, Pearson Education Asia, Delhi, 2007.

2 Thomas Koshy, “Discrete Mathematics with Applications”, Elsevier Publications, 2006.

3 C.L.Liu, D.P.Mohapatra, “Elements of Discrete Mathematics”, 4th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2012.

OUTCOMES:

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

- use the concepts of propositional calculus.
- use the concepts of predicate calculus.
- identify types of functions and their importance.
- decode and encode the messages using group theory concepts.
- apply the basic concepts of graph theory.
- represent some real life situations into diagrammatic representation.

MACX 02 PROBABLITY AND STATISTICS

L	T	P	C
3	1	0	4

OBJECTIVES:

The aims of this course are to impart the

- knowledge of the theory of probability and random variables
- techniques to carry out probability calculations and identifying probability distributions
- application of statistical inference in practical data analysis

MODULE I BASICS OF PROBABILITY AND STATISTICS 8+2

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye's theorem - Descriptive Statistics.

MODULE II ONE DIMENSIONAL RANDOM VARIABLE AND PROBABILITY DISTRIBUTION FUNCTIONS 7+3

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III TWO DIMENSIONAL RANDOM VARIABLES 8+2

Joint, marginal, conditional probability distributions –covariance, correlation - transformation of random variables.

MODULE IV SAMPLING AND ESTIMATION 7+3

Sampling distributions – basic knowledge on Random , simple random , stratified and cluster samplings – Test of Hypotheses - concepts- Point estimation and Interval estimation.

MODULE V THEORY OF INFERENCE 8+2

Large sample tests – test for single and difference on proportions, single mean, difference of means, difference of variances – confidence intervals. Small sample tests – Student's t test, F test and Chi square test on theory of goodness of fit and analyses of independence of attributes.

MODULE VI DESIGN OF EXPERIMENTS 7+3

Analysis of variance – one way classification – two way classification – Completely Randomised Block Designs – Randomised Block Design – Latin square designs - Interpretations - case studies.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. T.Veerarajan, "Probability and Statistics", Tata McGraw-Hill Education, 2008.
2. Miller, I., Miller, M.,Freund, J. E., "Mathematical statistics", 7th Edition, Prentice Hall International, 1999.
3. S.P.Gupta, "Applied Statistics", Sultan Chand & Sons

REFERENCES:

1. S.M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists" Fifth Edition, Elesvier.
2. S.C.Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statistics" First edition, Sultan Chand and Sons.
3. Arora and Arora, "Comphrensive Statistical Methods", S. Chand, 2007

OUTCOMES:

On completion of the course, students will be able to

- do basic problems on probability and descriptive statistics.
- derive the probability mass / density function of a random variable.
- calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.
- calculate point and interval estimates.
- apply some large sample tests and small sample tests.
- carry out the data collection representation analysis and implications and the importance of inferences.

MACX 03 **RANDOM PROCESSES**

L	T	P	C
3	1	0	4

OBJECTIVES:

The aims of the course are to

- acquire the knowledge of the theory of probability and random variables
- study discrete and continuous probability distributions.
- demonstrate the techniques of two dimensional random variables and its distributions.
- introduce the random process, stationarity, Markov process and the study of correlation function and spectral analysis.

MODULE I **Basics of Probability** **7+3**

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye’s theorem - Tchebychev’s inequality.

MODULE II **One dimensional Random variable and Probability Distribution functions** **7+3**

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III **Two dimensional random variables** **7+3**

Joint, marginal, conditional probability distributions - covariance, correlation and regression lines - transformation of random variables.

MODULE IV **RANDOM PROCESSES** **8+2**

Classification of Random process - Stationary process - WSS and SSS processes - Poisson process – Markov Chain and transition probabilities.

MODULE V **CORRELATION FUNCTIONS** **8+2**

Autocorrelation function and its properties - Cross Correlation function and its properties - Linear system with random inputs – Ergodicity.

MODULE VI **SPECTRAL DENSITY** **8+2**

Power spectral Density Function - Properties - System in the form of convolution - Unit Impulse Response of the System – Weiner-Khinchine Theorem - Cross Power

Density Spectrum.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Veerarajan T., “Probability, Statistics and Random Processes”, Tata McGraw Hill,3rd edition, 2008.
2. Papoulis, “Probability, Random Variables and Stochastic Processes”, 4th Edition, Tata McGraw Hill Company, 2002.
3. S.M.Ross, “Introduction to Probability and Statistics for Engineers and Scientists” Fifth Edition, Elesvier

REFERENCES:

1. Scott L. Miller,Donald G. Childers, Probability and Random Processes, Academic Press,2009.
2. Trivedi K S, “ Probability and Statistics with reliability, Queueing and Computer Science Applications”,Prentice Hall of India,New Delhi,2nd revised edition, 2002

OUTCOMES:

On completion of the course, students will be able to

- do basic problems on probability.
- derive the probability mass / density function of a random variable.
- calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.
- identify and study the different random processes.
- compute correlation functions and related identities.
- compute power spectral density functions and apply Weiner-Khinchine formula.

MACX 04 APPLIED NUMERICAL METHODS

L	T	P	C
3	1	0	4

OBJECTIVES:

The aims of the course are to

- introduce basic computational methods for analyzing problems that arise in engineering and physical sciences.
- acquire knowledge about approximation theory and convergence analysis associated with numerical computation.

MODULE I NUMERICAL SOLUTIONS OF EQUATIONS 7+3

Bisection method - Regula Falsi method – Secant method - Fixed point iteration method - Newton's Raphson method –Gauss Elimination method - Gauss-Jordon method – Gauss Jacobi method - Gauss-Seidel method.

MODULE II INTERPOLATION 8+2

Finite difference operators – Gregory Newton's forward and backward interpolations – Cubic spline interpolation - Lagrange interpolation - Newton's divided difference formula.

MODULE III NUMERICAL DIFFERENTIATION AND INTEGRATION 8+2

Numerical differentiation using Newton's forward and backward formulae – Numerical integration : Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Gaussian Two Point and Three Point Quadrature formulae – Double integrals using Trapezoidal and Simpson's 1/3 rule.

MODULE IV INITIAL VALUE PROBLEMS FOR FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 7+3

Numerical solutions by Taylor's Series method, Euler's method, Modified Euler's Method - Runge – Kutta Method of fourth order – Milne's and Adam's Bashforth Predictor and Corrector methods

MODULE V INITIAL AND BOUNDARY VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 8+2

Numerical solutions by Taylor's Series method - Runge – Kutta Method of fourth order of second order ODE. Finite difference methods.

MODULE VI BOUNDARY VALUE PROBLEMS FOR PARTIAL 7+3

DIFFERENTIAL EQUATIONS

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace equation.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Grewal, B.S., "Numerical methods in Engineering and Science", 7th edition, Khanna Publishers, 2007.
2. C.F.Gerald, P.O.Wheatley, "Applied Numerical Analysis" ,Pearson Education, New Delhi, 2002.

REFERENCES:

1. Chapra S.C, Canale R.P. "Numerical Methods for Engineers", 5th Ed., McGraw Hill, 2006.
2. M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003

OUTCOMES:

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

- solve algebraic, transcendental and system of equations.
- apply interpolation techniques.
- carry out numerical differentiation and integration using different methods.
- solve first order ODE using single and multi step methods.
- solve second order ODE, initial and boundary value problems.
- solve the boundary value problems in PDE.

Maths Elective Courses
(To be offered in VI Semester)

MACX 05	MATHEMATICAL PROGRAMMING	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aims of the course are to

- acquire knowledge and training in optimization techniques.
- obtain knowledge about optimization in utilization of resources.
- understand and apply operations research techniques to industrial operations.

MODULE I LINEAR PROGRAMMING PROBLEM 10

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 ADVANCED LINEAR PROGRAMMING PROBLEMS 8

Artificial variable - Big M method – Two phase method – alternative optimal solution – unbounded solution - Duality – primal dual relationships.

MODULE III TRANSPORTATION PROBLEM 7

Transportation problems – Initial basic feasible solutions, MODI method, Unbalanced transportation problem, Degeneracy in transportation models,.

MODULE IV ASSIGNMENT PROBLEM 5

Assignment problem – Minimization and Maximization type of problems by Hungarian method.

Total Hours –30

TEXT BOOKS:

1. Hamdy A Taha, "Operations Research - An introduction", 8th edition, Phil Pearson, 2007.
2. 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

- formulate industrial problems as mathematical programming problems.
- solve linear programming problems by different methods.
- solve transportation problems by different methods.
- solve assignment problems by Hungarian method.

MACX 06	STATISTICAL METHODS FOR DATA ANALYSIS	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aim of the course is to

- introduce statistical quality control tools.

MODULE I TESTS OF HYPOTHESES AND STATISTICAL INFERENCES 8

Small sample tests – Student's ' t ' test for single mean , difference of means, paired t test – F test for difference of variances – Chi square test on theory of goodness of fit and analyses of independence of attributes.

MODULE II DESIGN OF EXPERIMENTS 7

Analysis of variance – one way classification – two way classification – Completely Randomised Block Designs – Randomised Block Design – Latin square designs - Statistical analysis -Interpretations - case studies.

MODULE III STATISTICAL QUALITY CONTROL-I 8

Quality improvement and statistics –Statistical quality control- statistical process control – control charts – design of control charts –analysis of patterns on control charts - X bar chart, R chart and S chart.

MODULE IV STATISTICAL QUALITY CONTROL-II 7

Process and product control – attribute charts – P, np and C charts – control charts performance.

Total Hours –30

TEXT BOOKS:

1. Douglas C.Montgomery, George C. Runger "Applied Statistics and probability for Engineers" V Edition – John Wiley & Sons Inc.
2. Miller, I., Miller, M., Freund, J. E. "Mathematical statistics" 7th Edition. Prentice Hall International, 1999.

REFERENCES:

1. Dekking, F.M., Kraaikamp, C., Lopuhaä, H.P., Meester, L.E. "A Modern Introduction to Probability and Statistics" Springer, 2nd Edition.
2. Chin Long chiang "Statistical Methods of Analysis "World Scientific Books,

2003.

3. S.C.Gupta and V.K. Kapoor, “Mathematical Statistics” , Sultan Chand publications.
4. Veerarajan “Fundamentals of Mathematical Statistics” I Edition, Yes Dee Publishing Pvt. Ltd., 2017.

OUTCOMES:

On completion of the course, students will be able to

- develop and test hypothesis for different statistical tests
- design an experiment and case study the experiment with different data.
- analyze the industrial data using quality control design tools statistically.
- analyze the industrial data using process and product control tools statistically.

MACX 07	NUMERICAL METHODS FOR INTEGRATION AND DIFFERENTIAL EQUATIONS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- This course aims to solve numerically integral and differential equations.

MODULE I NUMERICAL INTEGRATION 8

Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two Point and Three point Gaussian quadrature formulae.

MODULE II NUMERICAL DOUBLE INTEGRATION 6

Double integrals using trapezoidal and Simpson's 1/3 rules

MODULE III NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 8

Milne's Predictor and Corrector Method – Adam's Predictor-Corrector Method - Finite difference methods for two – point Boundary Value problems for Ordinary Differential Equations.

MODULE IV BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 8

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

Total Hours –30

TEXT BOOKS:

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003.
2. Grewal, B.S., "Numerical methods in Engineering and Science" 7th edition, Khanna Publishers, 2007

REFERENCES:

1. C.F.Gerald, P.O.Wheatley, "Applied Numerical Analysis" Pearson Education, New Delhi 2002.
2. P.Dechaumphai, N. Wansophark, "Numerical Methods in Engineering", Narosa Publications, 2012.

OUTCOMES:

At the end of the course students will be able to

- solve the integration by numerical methods.
- solve the double integration by numerical methods
- find numerical solution of ordinary differential equations in engineering problems.
- find numerical solution of partial differential equations in engineering problems.

MACX 08	MATHEMATICAL MODELLING	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aims of the course are to

- provide basic idea of formation and use of Mathematical models for different purposes.
- determine the extent to which models are able to replicate real-world phenomena under different conditions

MODULE I PRINCIPLES OF MATHEMATICAL MODELING 7

Mathematics as a modelling language - Classification of models - Building, studying, testing and using models - Black and white box models – Difference equations

MODULE II PHENOMENOLOGICAL MODELS 7

Linear, Multiple linear and nonlinear regression - Neural networks - Fuzzy model - Stability and higher dimensional systems

MODULE III MECHANISTIC MODELS –I 8

Setting up ODE models – Initial and Boundary value problems - Numerical solutions - Fitting ODE to data - Applications

L	T	P	C
2	0	0	2

MODULE IV MECHANISTIC MODELS –II 8

Linear and nonlinear equations - Elliptic, parabolic and hyperbolic equations - Closed form solutions - Finite difference and finite element methods

Total Hours –30

TEXT BOOKS:

1. G . Ledder , "Calculus, modelling , probability and dynamic systems", Springer 2013
2. Kei Velten, "Mathematical modelling and simulation", J. Wiley and sons,2009

REFERENCES:

1. Michael D Alder, "An introduction to Mathematical modelling", Heaven for Books.com
2. Alfio Quarteroni, "Mathematical models in science and engineering", Notices of AMS

3. J.N. Kapur, “Mathematical models in Biology and Medicine”, Affiliated East-West Press Private Limited, New Delhi, 1992.

OUTCOMES:

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

- identify the relationship between real world and mathematical models
- Classify the data and choose the appropriate model
- Distinguish between linear and nonlinear models
- identify the relationship between empirical and mechanistic models

MACX 09 **GRAPH THEORY** **L T P C**

2 0 0 2

OBJECTIVES:

The aims of this course are to

- represent the real life situations diagrammatically.
- appraise different methods to find solutions to graph theory problems.

MODULE I INTRODUCTION TO GRAPH THEORY 8

Graphs - finite and infinite graphs - Incident and degree-isolated vertex, pendent vertex and null vertex.

MODULE II PATH AND CIRCUIT 8

Isomorphism – sub graphs-walks, paths and circuits – connected and disconnected graphs- Euler graphs – operation on a graph.

MODULE III TREES AND FUNDAMENTAL CIRCUITS 7

Trees- some properties of trees- pendent vertices in a tree – rooted binary tree-spanning trees-fundamental circuits.

MODULE IV CUT SETS AND CUT VERTICES

Cut sets – some properties of cut sets- fundamental circuits and cut sets-network flows.

Total Hours –30

TEXT BOOKS:

1. NARSINGH DEO, Graph theory with applications to Engineering and Computer Science, Prentice Hall INC, New Delhi,
2. J.A. Pondy and U.S.R. Murthy, North Holland, Oxford, New York Graph theory with applications

REFERENCES:

1. Trembly J.P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 30th Reprint 2011
2. Kenneth H.Rosen, “Discrete Mathematics and its Applications”, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, Special Indian Edition, 2011

3. Md. Saidur Rahman, “Basic graph theory”, Springer, 2017

OUTCOMES:

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

- Demonstrate the basic concepts of Graph theory.
- Explore connected and disconnected graphs.
- Identify the real life problems with trees and circuits.
- Bring out the cut set properties and network flows properties.

Humanities Elective I

(To be offered in III Semester)

SSCX01	FUNDAMENTALS OF ECONOMICS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To identify and present the basic concepts of demand, supply and equilibrium.
- To explain and discuss the types and concepts of national income and inflation.
- To illustrate the fundamental concepts of money, banking and public finance.
- To apprise the students about Indian economy and the role of engineers in economic development.

MODULE I DEMAND AND SUPPLY ANALYSIS 8

Classification of economy – open and closed economy, Demand - Types of demand - Determinants of demand – Law of Demand - Demand elasticity - Supply - Determinants of Supply – Law of Supply - Supply elasticity - Pricing strategies.

MODULE II NATIONAL INCOME AND INFLATION 7

Concepts of National income and measurement – Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – meaning of inflation- types - causes and preventive measures

MODULE III MONEY, BANKING AND PUBLIC FINANCE 9

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and Expenditures – Fiscal policy - Its objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) .

MODULE IV INDIAN ECONOMY AND THE ROLE OF ENGINEERS 6

Economic reforms – Liberalization, Privatization and Globalization - challenges and opportunities, Engineers – Engineers' contributions to the economic growth.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Dutt and Sundharam (2013), *Indian Economy*, S. Chand & Company Pvt. Ltd, New Delhi.
2. Hussain, Moon Moon (2015), *Economics for Engineers*, Himalaya Publishing House, New Delhi.

REFERENCES:

1. Cleaver Tony (2004), "*Economics: The Basics*", Routledge, London.
2. Mell Andrew and Walker Oliver (2014), "*The Rough Guide to Economics*", Rough Guide Ltd.

OUTCOMES:

On successful completion of this course,

- Students will have had exposure to the basic concepts of demand, supply and various pricing strategies.
- Students will have understood the macroeconomic concepts of national income and inflation.
- Students will be able to apply the knowledge of money, banking and public finance in their real life situations.
- Students will have an overview of the economic reforms introduced in Indian economy.

SSCX02	PRINCIPLES OF SOCIOLOGY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To acquaint the students with Concepts and perspectives of Sociology
- To explain the reflection of society in Individuals and vice versa
- To describe the hierarchical arrangement of individuals and groups in society
- To explicate the dimensions, forms and factors of Social change.
- To examine the context, impact and agencies of Globalization

MODULE I THE FOUNDATIONAL CANON 8

Sociology-Definition, scope and importance; Major theoretical perspectives-Functionalism, Conflict Theorising and Interactionism; Elements of social formation-Society, Community, Groups and Association; Associative Social Process- Co-operation, Accommodation and Assimilation; Dissociative Social Process-Competition and Conflict.

MODULE II INDIVIDUAL AND SOCIETY 7

Culture-definition, characteristics, functions, types, cultural lag and civilization, Socialization – definition, process, stages, agencies and anticipatory socialization; Social Control- definition, characteristics, importance, types & agencies.

MODULE III SOCIAL INEQUALITY AND STRATIFICATION 7

Concepts- inequality, hierarchy, differentiation, Social Exclusion, and Social Stratification. Forms of Social Stratification- Caste, Class and Estate. Gender and Social Stratification- sex and gender, patriarchy, factors perpetuating gender stratification; Globalization and gender inequality

MODULE IV SOCIAL CHANGE AND GLOBALIZATION 8

Social Change-definition, nature, direction; Forms- evolution, development, progress and transformation; Factors of social change- demography, economy, technology, polity and culture. Globalization- definition, characteristics, historical and social context and Impact, agencies of globalization- IGOs, INGOs, Nation-State, MNEs and Media

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Giddens A. 1989. “Sociology” Cambridge: Polity Press.

2. Heald Haralambos, R.M(2014) . ‘‘Sociology Themes and Perspectives”, Oxford, New Delhi-92
3. Bhushan Vidya and D.R. Sachdeva (2012). ‘‘Fundamental of Sociology”, Pearson, Delhi.

REFERENCES:

1. Das Gupta, Samir and Paulomi Saha (2012), ‘‘An Introduction to Sociology”, Pearson, Delhi
2. Bottomore, T.B. 1972. *Sociology- A Guide to Literature and Problems*, New Delhi,

OUTCOMES:

On successful completion of this course,

- Students will have exposure to the fundamentals tenets of Sociology.
- Students will be trained to understand social reality with sociological perspective.
- Students will be oriented to constructively analyze human interactions, social relationship and social issues
- Students will gain exposure to the dynamics of human society with special reference to the contemporary trends of globalization.

SSCX03	SOCIOLOGY OF INDIAN SOCIETY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To present a portrayal of the components of the Indian Social structure
- To describe the nature and contemporary structure of Indian social Institutions.
- To examine the causality and magnitude of social problem facing the contemporary India.
- To elucidate the processes forms and impact of change and development in Indian society

MODULE I INDIAN SOCIAL STRUCTURE 7

Unity and Diversity; Concepts of unity and diversity- racial, religious, ethnic and linguistic composition of India. Types of communities-rural, urban and tribal; Social backwardness- OBC, SC and ST; Indian minorities- religious, ethnic, linguistic and LGBT

MODULE II INDIAN SOCIAL INSTITUTIONS 7

Family- definition, types, characteristics, functions of family; Joint Family- definition features, utility, changes; Marriage- definition, characteristics, marriage as sacrament or contract. Caste- definition, principles, contemporary changes, dominant caste, caste -class interface.

MODULE III SOCIAL PROBLEMS IN INDIA 8

Social Problem-definition, nature, social disorganization; Population explosion-causes, effects, relationship with development; Child Labour- causes, magnitude and consequences; Unemployment-nature , types, causes and effects; Gender issues-social status of women, violence against women and women in work place; Contemporary issues- communalism, terrorism and corruption.

MODULE IV SOCIAL CHANGE AND DEVELOPMENT IN INDIA 8

Socio-cultural Change- Sanskritization, Westernization, Secularization, Modernization; Processes of Social change- Industrialization, Urbanization, Globalization; Development- definition, elements, role of government, industry and corporate sector. Technology and change- invention and innovation, impact of technology on social institutions, technology and development.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Sharma,K.L.2008. *Indian Social Structure and Change*. Jaipur: Rawat Publications,.
2. Shah, A.M. 1998. *The Family in India: Critical Essays*. New Delhi: Orient Longman,
3. Ahuja Ram. 1999. *Social problems in India*, Rawat Publication: New Delhi.
4. Ahuja Ram. 2014. *Society in India,*, Rawat Publication: New Delhi.

REFERENCES:

1. Jayapalan, N.(2001), **"**Indian Society and Social Institutions" Atlantic Publishers & Distri,
2. Atal, yogesh (2006), "Changing Indian Society" Rawat Publications, Jaipur

OUTCOMES:

On successful completion of this course,

- Students will gain an in-depth understanding of the social structure and social institutions that constitute society in India.
- Students will be sensitized to the various categories ,Inequalities and their challenges
- Students will be exposed to the social problems encountered in contemporary India.
- Students will gain knowledge about the various forms and trends of the social change.
- Students will become aware about the challenges in the path of progress of Indian society and realize relevance of their role in bringing about development

Humanities Elective II

(To be offered in IV Semester)

SSCX04	ECONOMICS OF SUSTAINABLE DEVELOPMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To have an increased awareness on the concept and components of sustainable development.
- To develop the ability to demonstrate the need of sustainable development and international responses to environmental challenges.
- To have an insight into global environmental issues and sustainable globalization.
- To establish a clear understanding of the policy instruments of sustainable development.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 7

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components.

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 8

Need for sustainability – Global environmental challenges: population growth, resource depletion, pollution, energy use, climate change, pollution, growing water scarcity, other urban problems, loss of biodiversity, hazardous wastes disposal.International responses to environmental challenges - Global policy such as Kyoto Protocol, Montreal Protocol, Basel Convention.

MODULE III GLOBALIZATION AND ENVIRONMENT SUSTAINABILITY 8

Impact of Globalization on sustainable development, Co - existence of globalization and Environment sustainability, Globalization and Global Governance.Green economy - Renewable energy, sustainable transport, sustainable construction, land and water management, waste management.

MODULE IV POLICIES FOR ACHIEVING SUSTAINABLE DEVELOPMENT 7

Principles of environmental policy for achieving sustainable development: precautionary principle and polluter pays principle – Business Charter for Sustainable

Development.Policy instruments for sustainable development: direct regulation – market based pollution control instruments such as pollution tax, subsidy, pollution permits.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Anderson, David A (2010), "*Environmental Economics and Natural Resource Management*", Routledge, 3rd edition.
2. Karpagam M (1999), "*Environmental Economics: A Textbook*", Sterling Publishers Pvt. Ltd, New Delhi.

REFERENCES:

1. Karpagam M and Jaikumar Geetha (2010), "*Green Management Theory and Applications*", Ane Books Pvt. Ltd, New Delhi.
2. Sengupta Ramprasad (2004), "*Ecology and Economics: An Approach to Sustainable Development*", Oxford University Press, New Delhi.

OUTCOMES:

On successful completion of this course,

- The students will have understood the concepts and components of sustainable development.
- The students will have a holistic overview on the challenges of sustainable development and International responses to environmental challenges.
- The students will have gained knowledge on the global environment issues and demonstrate responsible globalization through global governance.
- The students will have developed awareness of the ethical, economic, social and political dimensions that influence sustainable development.

SSCX05	INDUSTRIAL SOCIOLOGY	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To introduce sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.
- To explain the structure and functions of industrial organizations.
- To elucidate the dynamics of organizational behavior, leadership and communication.
- To inculcate professional ethics and values to equip students to work in organizational settings.

MODULE I INTRODUCTION 8

Industrial Sociology- definition, scope and importance; Theoretical approaches- scientific management, human relations approach, theory of bureaucracy, Fordism and post-fordism; Production system- concept and characteristics of factory system, automation and rationalization; Industrial conflict- strike , lockout and trade unions.

MODULE II INDUSTRIAL ORGANIZATION 7

Formal organization- definition, features, utility; Informal organization- definition, characteristics, types and relevance; Structure of industrial organization- features and functions of line organization, characteristics and roles of staff organization, distinction;

Industrial hierarchy-white collar, blue collar, supervisors and managers.

MODULE III DYNAMICS OF INDUSTRIAL RELATIONS 8

Group dynamics- Definition, Group behaviour model, Group decision making process, group cohesiveness; Leadership- definitions, style and effective supervision; Communication- concepts, types, model barriers; Job satisfaction- nature, employee compensation and job satisfaction.

MODULE IV PROFESSIONAL ETHICS AND VALUES 7

Concepts- values- morals, and ethics, Integrity, work ethics , service learning - Civic Virtue - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - commitment - empathy - Self-Confidence - Environmental Ethics, Cyber issues - computer ethics, cyber crimes, plagiarism Ethical living-concept of harmony in life.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
2. Gisbert Pascal, Fundamentals of Industrial Sociology, Tata Mc. Graw Hill Publishing Co., New Delhi, 1972
3. Schneider Engeno. V, Industrial Sociology 2nd Edition, Mc. Graw Hill Publishing Co., New Delhi, 1979.

REFERENCES:

1. Robbins, Stephen, Organizational Behaviour , Prentice Hall of India PVT ltd new Delhi, 1985
2. Devis Keith , Human Behaviour at work place, Mc. Graw Hill Publishing Co., New Delhi,1984

OUTCOMES:

On successful completion of this course,

- Students will have acclimatized with sociological perspectives for dealing with social relationships in production and service organizations.
- Students will be familiar with structure of authority, roles and responsibility in organizational settings.
- Students will imbibe leadership, communication and behavioral acumen to govern organization
- Students will be sensitized to standards of desirable behavior to engage in industrial and corporate sector.

SSCX06 **LAW FOR ENGINEERS**

L	T	P	C
2	0	0	2

OBJECTIVES:

- To understand the Constitution and Governance of our country.
- To apprise the students of human rights - local and international and redressal mechanism.
- To have an insight into the industrial, corporate and labour laws of our country.
- To establish a clear understanding about the importance of intellectual property related laws.

MODULE I INDIAN CONSTITUTION AND GOVERNANCE 8

Constitution – salient features, Preamble, Citizenship, Fundamental rights, Fundamental duties, Directive principles, Union executive, Legislature – Union – State and union territories – Election Commission – Election for parliament and state legislature, Judiciary- basic functioning of the Supreme Court and High Courts, Right to information Act 2005 – evolution – concept – practice.

MODULE II HUMAN RIGHTS 7

Human rights – meaning and significance, Covenant on civil and political rights, Covenant on Economic, Social and Cultural rights, UN mechanism and agencies, The Protection of Human Rights Act, 1993 – watch on human rights and enforcement.

MODULE III INDUSTRIAL, CORPORATE AND LABOUR LAWS 8

Corporate laws – meaning and scope, Companies Act 1956 – Indian Contract Act 1872 - Principles of Arbitration - Industrial Employment (Standing Orders) Act 1946 - Industrial Disputes Act 1947 - Workmen's Compensation Act 1923 - The Factories Act, 1948.

MODULE IV LAWS RELATED TO IPR 7

IPR – meaning and scope, International organization – WIPO – TRIPS, Major Indian IPR Acts – Copyright laws, Patent and Design Act, Trademarks Act, Trade Secret Act, Geographical Indicator.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. M.P. Jain (2005) *Indian Constitutional Law*, Wadhwa & Co.
2. H. D, Agarwal (2008), *International Law and Human Rights,* Central Law Publications,
3. Rao, Meena (2006), *Fundamental Concepts in Law of Contract*, 3rd edn., Professional offset.
4. Ramappa (2010), *Intellectual Property Rights Law in India*, Asia Law House.
5. Singh, Avtar (2007), *Company Law*, Eastern Book Co.
6. R.F, Rustamji (1967), *Introduction to the Law of Industrial Disputes*, Asia Publishing House.

REFERENCES:

1. Acts: Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act.

OUTCOMES:

On successful completion of this course,

- Students will `be able to apply the basic concepts of Indian Constitution, Governance and power in their real life situation.
- Students will have gained knowledge in human rights, cultural, social and political rights.
- Students will have synthesized knowledge about industrial, corporate and labour laws of our country.
- Students will have an overview of IPRs and laws related to Intellectual Property Rights.

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 introduce the concept of various environmental hazards and its management measures.
- To give exposure on the natural disasters- causes and prevention strategies.
- To give exposure on various man-made disasters -causes and prevention strategies.
- To make them understand the different segments of disaster management.
- To introduce the concept of different relief measures to be adopted in the time of 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 & MANAGEMENT 8

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.

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 be able to

- describe the origin, changes and management of environmental hazards.
- Develop the knowledge on natural disasters.
- Develop the knowledge on man-made disasters.
- discuss the different segments of disaster management.
- explain the concept of different disaster relief measures.
- Achieve sufficient knowledge on 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 IINTRODUCTION **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

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 advantages, different combinations and practical scope.

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.

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 all 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.

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 test for competence to. time, drive.

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.

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 able to

- 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 REPRESENTATION 8

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

Total Hours –45

REFERENCES:

- K. Ogata, “Modern Control Engineering”, 4th Edition, Pearson Education, New Delhi, 2003
- I.J. Nagrath & M. Gopal, “Control Systems Engineering”, New Age International Publishers, 2003
- C.J.Chesmond, “Basic Control System Technology”, Viva student edition, 1998
- I.J.Nagarath and M.Gopal, “Control System Engineering”, Wiley Eastern Ltd., Reprint, 1995
- 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 NTRODUCTION 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 Inverters

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:

- 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
- 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.

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.

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

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.

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 Edison, Pearson Education, 2003.

2. William Stallings, “Cryptography and Network Security – Principles and Practices”, 3rd Edison, 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. 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 & 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

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:

1. To acquire knowledge and training in optimization techniques.
2. To get knowledge about optimization in utilization of resources.
3. 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.

Total Hours –45

TEXT BOOKS:

1. Hamdy ATaha, “Operations Research an introduction”, 8th edition, Phil Pearson, 2007.
2. 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. 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

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 & 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 MAINTENANCE 8

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 MAINTENANCE 8

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 & AIR CONDITIONING 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.

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 on the concepts of sustainable development and fundamentals of socio economic systems.
- To understand the basics of green building and frame work for the attainment of sustainability.
- To enhance the student's interest in the design of green building and energy efficient measures in buildings.

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 ECONOMIC SYSTEMS 8

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.

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", 2nd Edition, John Wiley and sons, 2007.

OUTCOMES:

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

- explain the objective, need for the sustainability and also the link between the globalization and environment.
- Address the economic, environmental, and social concerns in the sustainable development.
- Acquire knowledge on the performance indicators, constraints and barrier for sustainability.
- Explain the relationship between sustainability and emergence of green building practices.
- Recommend relevant energy conservation measures in a building
- describe the elements in green building design and suggest ideas for attainting sustainability in building.

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 TO BUILDING DESIGN CONCEPTS OF SUSTAINABLE DEVELOPMENT 7

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

MODULE III WATER, HEALTH AND SANITATION MANAGEMENT 7

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.

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

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. Geoffrey Gordon, “Systems Simulation”, Prentice Hall, 2002
4. 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 ENGINEERING **L 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 & 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 EVALUATION, INVESTIGATION & RECOMMENDATION 8

Design department - Materials department - Production Planning & Control Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies

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.

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.

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

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

- Formulate a real life situation as an optimization the problem
- Identify the appropriate solution methodology and provide a solution

GECX207 MATLAB SIMULATION 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 & COMPUTER REPRESENTATION OF NUMBERS 7

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 1^{st} order, ordinary differential equations (Euler's method and Runge-Kutta)- Use of ODE function in MATLAB.

MODULE V NON-LINEAR DIFFERENTIAL EQUATIONS 8

Converting 2^{nd} order and higher ODEs to systems of 1^{st} 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.

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:

- Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
- Write programs using first principles without automatic use of built-in ones.
- 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.
- 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.
- Make use of Maltab visual capabilities for all engineering applications.
- 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 & TOOLS 8

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.

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 SUPPLY, DEMAND AND INVENTORY 8

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

Total Hours –45

REFERENCES

- Sunil Chopra and Peter Meindl, "Supply Chain Management-Strategy Planning and Operation", Pearson Education, 5th Indian Reprint, 2013.
- Jananth Shah "Supply Chain Management – Text and Cases" Pearson Education, 2008.
- Altekar Rahul V, "Supply Chain Management-Concept and Cases", Prentice Hall India, 2005.
- 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 DEVELOPMENT 7

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 8

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

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

REFERENCES:

- Materials science and Engineering: A first course by V. RAGHAVAN, 6th ed., Eastern Economy edition,Prentice Hall of India,2015
- Materials science and Engineering: An Introduction by William D. Callister Jr., 7th ed. John Wiley & Sons Inc. 2007
- 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 & COMMUNITY DEVELOPMENT SKILLS 8

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.

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 & 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.

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 VEHICLE 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

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.

Total Hours – 45

TEXT BOOKS:

1. 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

3. Identify various communication systems and the corresponding modulation schemes

- Identify various communication systems and the corresponding modulation schemes.
- Predict the characteristics of various analog and digital modulation schemes.
- Interpret the effect of noise and bandwidth in a communication systems
- Apply the Nyquist criteria for a given baseband signals.
- Evaluate the performance of communication receivers.
- Demonstrate the applications of common communication systems.

GECX217 LEAN MANAGEMENT L T P C

` ` **3 0 0 3**

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.

MODULE VI **8**

The lean enterprise and supply chain management Costs and risks of lean initiatives - Measuring lean initiatives

Total Hours –45

TEXT BOOKS:

1. The Toyota Way Field book, 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.

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.

GECX219	ADVANCED ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the importance of growth and to be able to chart a path towards growth
- To revisit your business model
- To give a growth orientation to customer acquisition, operations, revenue and sales strategy
- To list and comply with the requirements relating to regulatory compliance
- To be able to effectively pitch venture to potential stakeholders

PRE-REQUISITES:

High Entrepreneurship drive and Expectation from Students:

- The advanced course will build upon the concepts covered in the Basic program and help students understand the processes required to grow a business beyond the early adoption by initial customers. It helps them iterate several versions of the business models, identify new revenue channels and build their sales teams. Students will learn to work on their financial model and develop a pitch deck to share with external stakeholders. In the process, they will build their Sales, Ops, Hiring, and Technology Plans. They will also understand the basics of incorporating a new business and the related regulations and compliances. Students can either apply the techniques learned in the course to growing the „campus" venture at a minimum or build and grow a "real" venture.

MODULE I ORIENTATION TO GROWTH 9

Differences between growth stage and startup phase - Product-Market fit - Case study. Assessment of readiness for growth; Charting a growth path - Tools and Frameworks: Ansoff Matrix; Adjacency mapping.

MODULE II EXPANDING CUSTOMER BASE 9

Revisit of business model and develop few variants (more business model types); Identify additional customer segments to provide solution. Evaluate business models for the new customer segments; Relook at the Problem Statement (expansion, scope and scalability of business by repositioning problem statement); Exploring additional ways to monetize

MODULE III TRACTION 7

How to gain traction beyond early customers; Defining traction (in quantifiable terms) and identifying the most important metrics to measure traction; Calculate cost of new customer acquisition; Estimate customer lifetime value (LTV); Identifying waste in operations and focusing team on what is important for traction; The Bullseye framework; Identify Channels using Bulls Eye Framework; Measuring the effectiveness of selected channels; Budgeting and planning

MODULE IV GROWING REVENUES AND SALES 9

Stabilizing key revenue streams; Developing additional revenue streams (licensing, franchising); Exploring new channels and partnerships; Understanding why customers buy and how buying decisions are made; Listening skills; Sales planning, setting targets; Unique Sales Proposition (USP); Art of the sales pitch (focus on customers‟ needs, not on product features); Follow-up and closing a sale; Asking for the sale; Building a professional sales team; Sales compensation and incentives; Sales planning, setting targets; Testing price elasticity; Optimizing costs and operational expenses; Advanced concepts of unit costing; Financial modeling of venture's growth ; Analyzing competitor and peer's financial models

MODULE V SUPPORT 8

Overview of legal issues and their impact on entrepreneurs; Importance of getting professional help (legal and accounting); Importance of being compliant and keeping proper documentation; Patents and Intellectual property; Trademarks; The importance of a Mentor and how to find one; Role of business advisors and experts for specific targets in your growth plan

Total Hours –45

TEXT BOOKS:

1. Entrepreneurship Rajeev Roy oxford, 2012
2. https://lms.learnwise.org

REFERENCES:

1. The Process of social value creation : A multiple case study on Social Entrepreneurship in India , Archana Singh Springer 2016
2. “Social Entrepreneurship: New models of sustainable social change”. Alex Nicholls, Oxford University Press 2006

OUTCOMES:

On completion of the course, students will be able to

1. Set up Traction Metric and Channels, Decide Branding Strategy, Sales, Ops Plan, Hiring and Technology Plan, Decide Finance Model
2. Apply the techniques learned in the course to growing the „campus‟ venture at a minimum or build and grow a "real" venture
3. Grow a business beyond the early adoption by initial customers
4. Iterate several versions of the business models, identify new revenue channels and build their sales teams
5. Work on their financial model and develop a pitch deck to share with external stakeholders
6. Build their Sales, Ops, Hiring, and Technology Plans