B.S. Abdur Rahman

# Crescent

Institute of Science & Technology

Deemed to be University u/s 3 of the UGC Act, 1956

# REGULATIONS 2017

# CURRICULUM AND SYLLABI

# B.TECH.

# AERONAUTICAL ENGINEERING

## VISION AND MISSION OF THE INSTITUTION

### VISION

B.S. Abdur Rahman Crescent 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 Institution

- 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 AEROSPACE ENGINEERING**
**VISION AND MISSION**

**VISION**

Department of Aerospace Engineering aspires to be a premier hub in Aerospace Engineering Education, Training and Research and contribute to the development of Aerospace Technology.

**MISSION**

- To provide quality education and training in Aerospace Engineering to bring out motivated and capable aerospace engineers.

- To create stimulating environment and supportive infrastructure for knowledge development in Aerospace and related areas.

- To develop analytical skills and undertake collaborative research in Aerospace and related industries.

- To provide leadership qualities and team spirit through a balanced curriculum along with co-curricular, extra-curricular and professional society activities.

# PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

## B.TECH. (AERONAUTICAL)

### PROGRAMME EDUCATIONAL OBJECTIVES

- To provide fundamental knowledge in science, engineering and technology relating to Aeronautical/Aerospace Engineering.
- To impart adequate knowledge and skills required for aircraft/aerospace industry, research organization and advance their careers and achieve positions of increasing responsibility, and/ or pursue entrepreneurial endeavors.
- To develop the technical expertise in design, analysis, manufacturing and maintenance management of flight vehicles and their components.
- To provide exposure to the advancements in aeronautical science and engineering and related fields.
- To inculcate a sense of commitment to the profession through involvement with the community and professional organization.

### PROGRAMME OUTCOMES

The graduates will be able to

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Identify, formulate, research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 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.
- 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.

- 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.

- 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.

- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- 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.

- 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.

- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological

**PROGRAMME SPECIFIC OUTCOMES**

- Formulate and solve problems in Aeronautical Engineering using the knowledge acquired in core areas of aerodynamics, aircraft structures, propulsion, materials, flight dynamics and avionics.

- Design aircraft systems, components and processes to meet desired needs within realistic constraints.

## 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 ofB.S.Abdur Rahman Crescent Institute of Science and Technologywho 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  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 3$^{rd}$ to 8$^{th}$ semester will be as follows:

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

    ii)   Faculty members of all courses of the semester

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

    iv)  All faculty advisors and the class advisors.

    v)   Head of the Department

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

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

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

## 9.0 REGISTRATION AND ENROLMENT

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

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

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

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

## 10.0 COURSE CHANGE / WITHDRAWAL

## 10.1 CHANGE OF A COURSE

A student can change an enrolled course within 10 working days from the commencement of the course, with the approval of the Dean

(Academic Affairs), on the recommendation of the Head of the Department of the student.

## 10.2 WITHDRAWAL FROM A COURSE

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

## 11.0 TEMPORARY BREAK OF STUDY FROM PROGRAMME

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

## 12.0 CREDIT LIMIT FOR ENROLMENT & MOVEMENT TO HIGHER SEMESTER

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

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

- Not less than 20 credits, to move to the 3$^{rd}$ semester
- Not less than 40 credits, (20 for lateral entry) to move to the 5$^{th}$ semester
- Not less than 60 credits, (40 for lateral entry) to move to the 7$^{th}$ 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  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 inand around Chennai.
- **National Sports Organization (NSO)** will have sports, games, drillsand physical exercises.
- **Youth Red Cross (YRC)** will have social service activities in and aroundChennai.
- **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 .

**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 .

**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. AERONAUTICAL ENGINEERING
## CURRICULUM & SYLLABUS, REGULATIONS 2017

### SEMESTER I

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

### SEMESTER II

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | BS | MAC 1281 | Advanced Calculus | 3 | 1 | 0 | 4 |
| 2. | BS | - | Physics Elective | 2 | 0 | 2 | 3 |
| 3. | BS | - | Chemistry Elective | 2 | 0 | 2 | 3 |
| 4. | ESF | GEC 1211 | Basic Engineering Mechanics | 3 | 1 | 0 | 4 |
| 5. | BS | GEC 1212 | Environmental Studies | 2 | 0 | 0 | 2 |

| 6. | ESF | GEC 1213 | Computer Programming II | 1 | 0 | 2 | 2 | |
| 7. | EC | AEC 1211 | Introduction to Aeronautical Engineering | 3 | 0 | 0 | 3 | |
| 8. | EC | AEC 1212 | Aircraft Component Modeling & Drafting Lab | 0 | 0 | 3 | 1 | |
| 9. | EC | AEC 1213 | Aircraft Structure Repair Lab | 0 | 0 | 3 | 1 | **23** |

## SEMESTER III

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C | |
|---|---|---|---|---|---|---|---|---|
| 1. | BS | MAC 2181 | Partial Differential Equations and Transforms | 3 | 1 | 0 | 4 | |
| 2. | HS | - | Humanities Elective I | 2 | 0 | 0 | 2 | |
| 3. | HS | ENC 2181 | Oral Communication | 0 | 0 | 3 | 1 | |
| 4. | EC | AEC2101 | Solid Mechanics | 3 | 0 | 0 | 3 | |
| 5. | EC | AEC2102 | Engineering Thermodynamics | 3 | 1 | 0 | 4 | |
| 6. | EC | AEC2103 | Fluid Mechanics | 3 | 0 | 0 | 3 | |
| 7. | EC | EIC2181 | Basic Electrical & Electronics Engg | 3 | 0 | 0 | 3 | |
| 8. | EC | AEC2104 | Thermodynamics Lab | 0 | 0 | 3 | 1 | |
| 9. | EC | AEC2105 | Fluid Mechanics Lab | 0 | 0 | 3 | 1 | |
| 10. | EC | EIC2182 | Electrical & Electronics Engg Lab | 0 | 0 | 3 | 1 | **23** |

## SEMESTER IV

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | BS | - | Mathematics Elective I | 3 | 1 | 0 | 4 |
| 2. | HS | - | Humanities Elective II | 2 | 0 | 0 | 2 |
| 3. | HS | ENC 2282 | Written Communication | 0 | 0 | 3 | 1 |
| 4. | EC | AEC2211 | Low Speed Aerodynamics | 3 | 0 | 0 | 3 |

| | | | | L | T | P | C | |
|---|---|---|---|---|---|---|---|---|
| 5. | EC | AEC2212 | Aircraft Structural Mechanics | 3 | 1 | 0 | 4 | |
| 6. | EC | AEC2213 | Air Breathing Propulsion | 3 | 0 | 0 | 3 | |
| 7. | EC | AEC2214 | Aircraft Systems & Instruments | 3 | 0 | 0 | 3 | |
| 8. | EC | AEC2215 | Solid Mechanics Lab | 0 | 0 | 3 | 1 | |
| 9. | EC | AEC2216 | Aircraft Systems & Instruments Lab | 0 | 0 | 3 | 1 | |
| 10. | EC | AEC2217 | Propulsion Lab | 0 | 0 | 3 | 1 | **23** |

## SEMESTER V

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C | |
|---|---|---|---|---|---|---|---|---|
| 1. | MS | MSC 3181/ MSC 3182 | Leadership & CEO training / Social Entrepreneurship | 3 | 0 | 0 | 3 | |
| 2. | GE | - | General Elective I | 3 | 0 | 0 | 3 | |
| 3. | HS | ENC3181 | Communication & Soft Skill I Career Choice | 0 | 0 | 3 | 1 | |
| 4. | EC | AEC3101 | Compressors & Turbines | 2 | 0 | 0 | 2 | |
| 5. | EC | AEC3102 | Aircraft Structural Design and Analysis | 3 | 1 | 0 | 4 | |
| 6. | EC | AEC3103 | High Speed Aerodynamics | 3 | 0 | 0 | 3 | |
| 7. | EC | - | Electives | 6 | 0 | 0 | 6 | |
| 8. | EC | AEC3104 | Aerodynamics Lab | 0 | 0 | 3 | 1 | |
| 9. | EC | AEC3105 | Aircraft Structural Analysis Lab | 0 | 0 | 3 | 1 | **24** |

## SEMESTER VI

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | MS | MSC 3181/ MSC 3182 | Leadership & CEO training / Social Entrepreneurship | 3 | 0 | 0 | 3 |

| 2. | BS | - | Mathematics Elective II | 2 | 0 | 0 | 2 | |
| 3. | HS | ENC3281 | Communication and Soft skill II Confidence Building | 0 | 0 | 3 | 1 | |
| 4. | EC | AEC3211 | Rocket Propulsion | 3 | 0 | 0 | 3 | |
| 5. | EC | AEC3212 | Flight Dynamics | 3 | 0 | 0 | 3 | |
| 6. | EC | AEC3213 | Aircraft Materials and Processes | 3 | 0 | 0 | 3 | |
| 7. | EC | - | Electives | 6 | 0 | 0 | 6 | |
| 8. | EC | AEC3214 | Aircraft Design Project - I | 1 | 0 | 3 | 2 | **23** |

## SEMESTER VII

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C | |
|---|---|---|---|---|---|---|---|---|
| 1. | GE | - | General Elective II | 3 | 0 | 0 | 3 | |
| 2. | EC | AEC4101 | Avionics (Lab Integrated) | 3 | 0 | 3 | 4 | |
| 3. | EC | AEC4102 | Finite Element Method | 3 | 0 | 0 | 3 | |
| 4. | EC | AEC4103 | UAV/MAV Systems | 1 | 0 | 3 | 2 | |
| 5. | EC | - | Electives | 7 | 0 | 0 | 7 | |
| 6. | EC | AEC4104 | Aircraft Design Project – II | 1 | 0 | 3 | 2 | |
| 7. | EC | AEC4105 | CFD-Structural Analysis Lab | 0 | 0 | 3 | 1 | |
| 8. | EC | AEC4106 | Internship | 0 | 0 | * | 1** | **23** |

## SEMESTER VIII

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C | |
|---|---|---|---|---|---|---|---|---|
| 1. | EC | AEC4211 | Project Work | 0 | 0 | 24 | 12 | **12** |

**Total credits – 174**

* 15 days

** Industrial training will be undertaken during third year summer vacation.

The credit will be awarded in the 7th Semester.

## PROGRAMME ELECTIVES
## ODD SEMESTER ELECTIVES

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---------|--------------|-------------|--------------|---|---|---|---|
| 1. | PE | AECX01 | Optical Flow Diagnostics | 2 | 0 | 0 | 2 |
| 2. | PE | AECX02 | Hypersonic Aerodynamics | 3 | 0 | 0 | 3 |
| 3. | PE | AECX03 | Industrial Aerodynamics | 3 | 0 | 0 | 3 |
| 4. | PE | AECX04 | Grid Generation | 2 | 0 | 0 | 2 |
| 5. | PE | AECX05 | Wind Tunnel Model Design | 1 | 0 | 0 | 1 |
| 6. | PE | AECX06 | Theory of Elasticity | 3 | 0 | 0 | 3 |
| 7. | PE | AECX07 | Fatigue and Fracture Mechanics | 3 | 0 | 0 | 3 |
| 8. | PE | AECX08 | Structural Analysis Tools (NASTRAN and PATRAN) | 2 | 0 | 0 | 2 |
| 9. | PE | AECX09 | Smart Structures | 1 | 0 | 0 | 1 |
| 10 | PE | AECX10 | Aircraft Structural Testing and Qualification | 1 | 0 | 0 | 1 |
| 11 | PE | AECX11 | Measurement Systems | 2 | 0 | 0 | 2 |
| 12 | PE | AECX12 | NDT techniques for Aircraft Structures | 1 | 0 | 0 | 1 |
| 13 | PE | AECX13 | Airframe Repair & Maintenance | 3 | 0 | 0 | 3 |
| 14 | PE | AECX14 | Behavior of Materials at High Temperatures | 3 | 0 | 0 | 3 |
| 15 | PE | AECX15 | Heat Transfer | 3 | 0 | 0 | 3 |
| 16 | PE | AECX16 | Advanced Propulsion Systems | 3 | 0 | 0 | 3 |
| 17 | PE | AECX17 | Micro Propulsion | 1 | 0 | 0 | 1 |
| 18 | PE | AECX18 | Cryogenics | 2 | 0 | 0 | 2 |
| 19 | PE | AECX19 | Air Traffic Control and Aerodrome Design | 3 | 0 | 0 | 3 |

| 2( | PE | AECX20 | Aviation Rules and Regulation | 3 | 0 | 0 | 3 |

## EVEN SEMESTER ELECTIVES

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | PE | AECX21 | Experimental Aerodynamics | 3 | 0 | 0 | 3 |
| 2. | PE | AECX22 | Introduction to CFD | 3 | 0 | 0 | 3 |
| 3. | PE | AECX23 | Viscous Flows | 3 | 0 | 0 | 3 |
| 4. | PE | AECX24 | Aero-acoustics | 1 | 0 | 0 | 1 |
| 5. | PE | AECX25 | Wind Engineering | 3 | 0 | 0 | 3 |
| 6. | PE | AECX26 | Composite Materials and Structures | 3 | 0 | 0 | 3 |
| 7. | PE | AECX27 | Experimental Stress Analysis | 3 | 0 | 0 | 3 |
| 8. | PE | AECX28 | Theory of Vibration | 3 | 0 | 0 | 3 |
| 9. | PE | AECX29 | Hyper Mesh | 2 | 0 | 0 | 2 |
| 1( | PE | AECX30 | Aviation Fuels and Combustion | 3 | 0 | 0 | 3 |
| 1· | PE | AECX31 | Rockets and Missiles | 3 | 0 | 0 | 3 |
| 1: | PE | AECX32 | Design of Power Plants for Aircrafts | 3 | 0 | 0 | 3 |
| 1: | PE | AECX33 | Aircraft Cooling Systems | 1 | 0 | 0 | 1 |
| 1· | PE | AECX34 | Aircraft General Engineering Maintenance | 2 | 0 | 0 | 2 |
| 1! | PE | AECX35 | Product Development and 3D Printing Technologies | 2 | 0 | 0 | 2 |
| 1( | PE | AECX36 | Advanced Manufacturing Technologies | 2 | 0 | 0 | 2 |
| 1; | PE | AECX37 | Aircraft Navigation & Guidance | 3 | 0 | 0 | 3 |
| 1{ | PE | AECX38 | Control Engineering | 3 | 0 | 0 | 3 |
| 1! | PE | AECX39 | Microprocessor & Microcontroller for Aircraft Systems | 2 | 0 | 0 | 2 |

| 2( | PE | AECX40 | Mathematical Modeling & Simulation (MATLAB) | 2 | 0 | 0 | 2 |

## Physics Elective Courses

### (To be offered in II Semester)

| Sl. No. | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| 1. | PHCX 01 | Fundamentals of Engineering Materials | 2 | 0 | 2 | 3 |
| 2. | PHCX 02 | Heat and Thermodynamics | 2 | 0 | 2 | 3 |
| 3. | PHCX 03 | Introduction to Nanoscience and Technology | 2 | 0 | 2 | 3 |
| 4. | PHCX 04 | Lasers and their applications | 2 | 0 | 2 | 3 |
| 5. | PHCX 05 | Materials Science | 2 | 0 | 2 | 3 |
| 6. | PHCX 06 | Non-Destructive Testing | 2 | 0 | 2 | 3 |
| 7. | PHCX 07 | Properties of Matter and Acoustics | 2 | 0 | 2 | 3 |
| 8. | PHCX 08 | Properties of Matter and Nondestructive Testing | 2 | 0 | 2 | 3 |
| 9. | PHCX 09 | 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. | MACX 01 | Discrete Mathematics And Graph Theory | 3 | 1 | 0 | 4 |
| 2. | MACX 02 | Probability And Statistics | 3 | 1 | 0 | 4 |
| 3. | MACX 03 | Random Processes | 3 | 1 | 0 | 4 |
| 4. | MACX 04 | Applied Numerical Methods | 3 | 1 | 0 | 4 |

## Maths Elective Courses
## (To be offered in VI Semester)

| Sl. No. | Course Code | Course Title | L | T | P | C |
|---------|-------------|--------------|---|---|---|---|
| 1. | MACX 05 | Mathematical Programming | 2 | 0 | 0 | 2 |
| 2. | MACX 06 | Statistical Methods for Data Analysis | 2 | 0 | 0 | 2 |
| 3. | MACX 07 | Numerical Methods for Integral and Differential Equations | 2 | 0 | 0 | 2 |
| 4. | MACX 08 | Mathematical Modelling | 2 | 0 | 0 | 2 |
| 5. | MACX 09 | Graph Theory | 2 | 0 | 0 | 2 |

## Humanities Elective I
## (To be offered in III Semester)

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

## Humanities Elective II
## (To be offered in IV Semester)

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

## General Elective

## Group I Courses

## (To be offered in V semester)

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

## Group II Courses
## (To be offered in VII semester)

| Sl. No. | Course Code | Course Title | Offering Department |
|---------|-------------|--------------|---------------------|
| 1. | GECX201 | Green Design and Sustainability | Civil |
| 2. | GECX202 | Appropriate Technology | Civil / Mechanical |
| 3. | GECX203 | Engineering System Modelling and Simulation | Mechanical |
| 4. | GECX204 | Value Analysis and Engineering | Mechanical |
| 5. | GECX205 | Industrial Safety | Mechanical |
| 6. | GECX206 | Advanced Optimization Techniques | Mechanical |
| 7. | GECX207 | Mat Lab Simulation | EEE |
| 8. | GECX208 | Embedded 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 |
| 19. | GECX219 | Advanced Entrepreneurship | Management |

**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 A bridged by Mukul Chowdhri). Hyderabad Univeristy Press.
4. Sen, Leena. (2004) Communication Skills. Prentice Hall, New Delhi.
5. Matt Firth, Chris Sowton et.al. (2012). Academic English: An Integrated Skills

Course for EAP. Cambridge University Press, Cambridge.

**OUTCOMES:**

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

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

| ISC1181 | **ARABIC** | L | T | P | C |
|---------|-----------|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

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

**MODULE  I        PREPARATORY ARABIC             7**

Introducing Arabic Alphabets.

Listening and Reading.

Audio & Video aided listening, Tajweed listening,

Writing Arabic Alphabets (connected & unconnected).

Introducing words.

Reading simple sentences.

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

Exercises.

**MODULE  II        FUNCTIONAL ARABIC             7**

Listening Arabic texts, stories and action verbs

Communicating Simple sentences.

Jumla' Ismiyya and Jumla' Fi'liyya

Situational Conversation:

Greetings, Introduction.

Classroom, College, Picnic.

Dining and Kitchen.

Reading skills.

Exercises

**MODULE  III        FUNCTIONAL ARABIC             8**

Implication of effective listening.

Audio aids.

Writing Simple sentences.

Communicating ordinal and cardinal numbers.

Situational communication:

Playground, library.

Forms of plural – Sample sentences.

Introduction to tenses.

Exercises.

## MODULE  IV          FUNCTIONAL ARABIC                    8

Communication:

Family, travel

Market, Prayer hall

Writing skills:

Note making.

Sequencing of sentences.

Developing answers from the questions.

Exercises.

## MODULE  V          TECHNICAL ARABIC                    8

Importance of technical communication.

Reading and writing skills.

Audio & Video aided listening.

Introduction to Arabic terms related to administration.

Situation communication:

Air travel, Office administration, passport, visa.

Exercises

## MODULE  VI          TECHNICAL ARABIC                    7

Situation communication:

Contractual work, machineries and 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 & Enclopedia of Contemporary Japanese
4. Japani: Japanese Conversation for Improving Spoken Proficiency, By P.A. George, Inoue Yoriko and Itsuko Nandi, Books Plus.
5. Chukyu Nihongo, Tokyo Gaikokugo Daigaku; Nihongo II, Kokusaigakuyukai, and other supplementary material.

**OUTCOMES:**

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

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

| **PHC 1181** | **PHYSICS** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **2** | **4** |

**OBJECTIVES:**

To make students conversant with the

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

**MODULE  I          CRYSTAL PHYSICS**                                    **8**

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

**MODULE  II          ULTRASONICS AND THERMAL PHYSICS**                    **8**

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

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

**MODULE  III          APPLIED OPTICS**                                    **8**

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

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: He-Ne laser, $CO_2$ 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          RENEWABLE ENERGY SOURCES          7

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

## PRACTICALS

1. Determination of Velocity of Ultrasonic waves in a given liquid using Ultrasonic Interferometer.
2. Determination of wavelength of ultrasonic waves using Kundt's tube method.
3. Determination of thickness of a thin wire using Air Wedge method.
4. Determination of wavelength of light using spectrometer diffraction grating.
5. Determination of angle of divergence of a laser beam using He-Ne laser.
6. Determination of particle size of lycopodium powder using semiconductor laser.
7. Determination of wavelength of laser light using semiconductor laser diffraction.
8. Determination of Acceptance angle and Numerical Aperture using fiber optic cable.
9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Determination of thermal conductivity of a bad conductor by Lee's disc method.
11. Determination of solar cell characteristics.

**L – 45; P – 30; TOTAL HOURS – 75**

**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.

| 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
- different modern engineering materials  & biomaterials and their applications in engineering and medical field

## MODULE  I          CRYSTAL PHYSICS                                    8

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

## MODULE  II          ULTRASONICS AND THERMAL PHYSICS                  8

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

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

## MODULE  III          APPLIED OPTICS                                    8

Interference – Air Wedge – Michelson's Interferometer – Determination of wavelength of

light and thickness of thin transparent sheet.

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: He-Ne laser, $CO_2$ laser and Nd:YAG laser - Applications : Laser Materials Processing .

## MODULE IV        FIBRE OPTICS                                   7

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

## MODULE V        QUANTUM MECHANICS                               7

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

## MODULE VI        MODERN ENGINEERING AND BIOMATERIALS            7

Modern Engineering Materials: Shape memory alloys - Metallic glasses – Advanced Ceramics – Composites.

Bio-materials: Classification of bio-materials (based on tissue response) – Comparison of properties of some common biomaterials – Metallic implant materials (stainless steel, cobalt-based and titanium-based alloys) – Polymeric implant materials (Polyamides, polypropylene, Acrylic resins and Hydrogels) – Tissue replacement implants – Soft and hard tissue replacements.

## 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.

**L – 45; P – 30; TOTAL HOURS – 75**

**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. Gupta K.M., "Engineering Materials : Research, Applications and Advances", CRC Press, 2014

7. Qizhi Chen, George Thouas, "Biomaterials : A Basic Introduction", CRC Press, 2018.

**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
- gain knowledge about different modern engineering materials and biomaterials and their applications
- complement the knowledge acquired in the theory class.
- 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" (7th edition),Brooks/Cole cengage learning,UK.

**OUTCOMES:**

After completing the course, student will be able to

- compute the area and volume using multiple integrals.
- apply special functions to solve integration problems.
- apply differentiation in scalar and vector fields.
- find area and volume of a region using vector integration.
- verify analyticity, conformity and bilinearity of complex functions.
- evaluate complex integrals.

**GEC 1211**      **BASIC ENGINEERING MECHANICS**     **L   T   P   C**

**3   1   0   4**

**OBJECTIVES:**

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

**MODULE I      VECTOR APPROACH TO MECHANICS**      **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.
**Biodiversit**y - 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**     **8**
**DISASTER**

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**     **6**
**ISSUES**

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

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

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

**Case studies related to current situation**

                                 **TOTAL HOURS – 30**

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

**REFERENCES:**

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

**OUTCOMES:**

The student will be able to

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

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

**OBJECTIVES:**

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

**MODULE I          PROGRAMMING IN C          7**

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

**MODULE II          PROGRAMMING IN C++          8**

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

**LIST OF EXPERIMENTS:**

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

**L – 15; P – 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.

| AEC 1211 | INTRODUCTION TO AERONAUTICAL ENGINEERING | L | T | P | C |
|----------|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To introduce the overview of Aeronautical Engineering covering various disciplines including aerodynamics, propulsion, performance, stability & control, materials and structures.

**MODULE I          AVIATION HISTORY AND AIRPLANE ANATOMY          8**

Ornithopters, Lighter-than-Air Craft, Heavier- than-Aircraft, Wright Brothers and their flyer , Developments during and after the World Wars I and II , Developments in Jet transport and military aviation, Airplane configurations, components of airplanes, functions.

**MODULE II          BASIC AERODYNAMICS          10**

Standard Atmosphere, Aerodynamics forces and Moments, Air speed, Mach Number, Reynold's Number,  Airfoil Aerodynamics, Wing Aerodynamics and Drag Polar.

**MODULE III          PROPULSION          7**

Production of thrust - Propeller Momentum theory, Jet Momentum; Types of engines, Engine components, Specific fuel consumption, Power.

**MODULE IV          AIRPLANE PERFORMANCE, STABILITY & CONTROL          7**

Coordinate systems, Equations of motion, degrees of freedom, pitch, roll ,yaw, rate of climb, absolute & service ceiling, Range, maximum endurance, glide, descent, Principles of stability and control.

**MODULE V          AIRCRAFT MATERIALS  AND STRUCTURES          7**

Development of aircraft structures, Stress, strain, stress-strain diagram, Monocoque and semi-monocoque structures – Wing, fuselage, importance of fatigue, Materials used in aircraft.

**MODULE VI          AIRCRAFT INSTRUMENTS AND SYSTEMS          6**

Air data instruments, Gyro instruments, Fly-by-wire system, ILS, Auto-Pilot, CVR,

Flight data recorder.

**TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Anderson, J.D., "Introduction to Flight", McGraw-Hill, 1995
2. Richard S. Shevell, Fundamentals of Flight, Pearson Education, 2006

**REFERENCES:**

1. Kermode, A. C., Flight without formulae, McGraw-Hill, 1997
2. B. W. McCormick, Aerodynamics, Aeronautics and Flight Mechanics, John Wiley & Sons, 1995.

**OUTCOMES:**

Students will be able to

- Identify and relate various components of aircraft and their functions.
- Estimate the aerodynamic forces on airplanes and understand their effects on aircraft structures.
- Differentiate between various types of engines and the need for thrust.
- Solve basic problems on aircraft motion and control.
- Identify different structural elements and materials used in aircraft.
- Gain knowledge about the instruments and systems required for the safe operation of airplanes.

| AEC 1212 | AIRCRAFT COMPONENT MODELING AND DRAFTING LAB | L | T | P | C |
|----------|----------------------------------------------|---|---|---|---|
|          |                                              | 0 | 0 | 3 | 1 |

**OBJECTIVES:**

- To train the students to draft basic aircraft components using modeling packages.

**LIST OF EXPERIMENTS**

1. Design of riveted joints (Lap joint).
2. Design of riveted joints (Butt joint with single and double straps).
3. Design of welded joints.
4. Layout of typical wing structure.
5. Layout of typical fuselage structure.
6. Computer aided modeling of typical aircraft wing.
7. Computer aided modeling of typical fuselage structure.
8. Computer aided modeling of landing gear
9. Three view diagram of a typical aircraft
10. Layout of control systems

**TOTAL HOURS –45**

**REFERENCES:**

1. Basant Agarwal. "Engineering graphics", first Edition, Tata McGraw Hill, 2012.
2. Frederick Ernest Giesecke, Henry C. Spencer "Technical Drawing with Engineering Graphics" Prentice Hall, 2012
3. CATIA Software tutorial manual

**OUTCOMES:**

Students will be able to,

- Gain hands-on experience in drafting aircraft components and structures using computer-aided modeling.
- Gain knowledge and experience in drawing the layout of aircraft & control systems using computer-aided modeling.

**AEC 1213      AIRCRAFT STRUCTURE REPAIR LAB      L   T   P   C**

**0   0   3   1**

**OBJECTIVE:**

- To give hands on training the students on basic repair techniques involved in the aircraft structures.

**LIST OF EXPERIMENTS**

1. Welded patch repair by Electric Arc Welding
2. Welded patch repair by TIG.
3. Welded patch repair by MIG.
4. Welded patch repair by Plasma Arc Cutting.
5. Riveted patch repairs.
6. Flaring of Pipes.
7. Fabrication of composites.
8. Sheet metal forming.
9. Patch repair of Acrylic components.
10. Repair of cracks in wood and fabrics.

**TOTAL HOURS – 45**

**REFERENCES:**

1. Kroes Watkins Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1993.
2. A& P Mechanics, " Aircraft Hand Book", FAA Himalayan Book House, New Delhi, 1996.
3. McKinley, J. L., and Bent, R. D., "Aircraft Maintenance & Repair", McGraw-Hill, 1993.

**OUTCOMES:**

Students will be able to,
- Understand the functional requirements of different Aircraft Structural components and the various repairing techniques.
- Identify the defects and repair the damaged structural components by riveting, patchwork, welding and carpentry methods and maintain them safely.
- Detect the mechanical defects in various welding processes and thereby learn to avoid them.

## SEMESTER – III

| MAC 2181 | PARTIAL DIFFERENTIAL EQUATIONS AND | L | T | P | C |
|---|---|---|---|---|---|
| | TRANSFORMS | 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**        **7+3**
                        **TRANSFORMS**

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.

| **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.

| AEC 2101 | **SOLID MECHANICS** | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To give brief descriptions on the behavior of materials subjected to axial, bending, and torsional loads and predicting the failure of materials.

## MODULE I        AXIAL LOADING                                7

Stress and Strain, Hooke's law, Stress- Strain Diagrams for different engg., Materials, elastic constants, thermal stresses, problems on bars.

## MODULE II        BEAMS                                        10

Statically indeterminate beams, Shear Force diagrams and Bending moment diagrams, Bending Stress and Shear stresses in beam sections, Constant Strength Beam, composite beams.

## MODULE III        DEFLECTION OF BEAMS                        8

Double integration method, Macauly's methods, Moment Area Method, Conjugate Beam Method, principle of superposition.

## MODULE IV        TORSION –SPRINGS – COLUMNS                6

Torsion of solid and hollow circular shaft, Shear Stress variation, Power transmissions in shaft, open and closed coil helical springs, Stresses in helical springs,.

## MODULE V        PRINCIPAL STRESSES                          7

Euler's Column curve, Columns with different end conditions  Principle Stress and Strains, Mohr's circle.

## MODULE VI            BIAXIAL STRESSES                        7

Stresses in thin-walled pressure vessels – combined bending, torsion and axial loading of circular shafts

**Total Hours : 45**

**TEXT BOOKS:**

1. James M Gere & Barry J. Goodno, Mechanics of Materials, Cenage Learning, 9th Edition, 2018.
2. R. K. Rajput, "Strength of Materials: Mechanics of Solid", Fourth edition, S. Chand Limited, 2007.

**REFERENCES:**

1. C.T. Sun, "Mechanics of Aircraft Structures", Second Edition, John Wiley & Sons. 2006.
2. R.C. Hibbeler, "Structural Analysis", Fifth Edition, Prentice-Hall, 2002.
3. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Mechanics of Materials", Firewall media, 2002.
4. Craig, R.R., 1996, Mechanics of Materials, John Wiley & Sons, New York.
5. R.S. Khurmi, "Strength of Materials", Twenty third Edition, S. Chand Limited, 2007

**LEARNING OUTCOMES:**

The students will be able to

- Predict the behavior of bars under various loadings.
- Calculate the bending and shear stress and the deflection of beams under various loadings.
- Calculate the deflection of beams under various loadings.
- Give a theoretical design of shaft for the required working conditions and predictions of the response of the springs and columns subjected to various loads.
- Predict the response of the structural elements subjected to combined loading using the theoretical and the graphical method.
- Predict the load bearing capacity of pressure vessels.

| | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **AEC 2102** | **ENGINEERING THERMODYNAMICS** | **3** | **1** | **0** | **4** |

## OBJECTIVES:

- To provide an introduction to the basic concepts of thermodynamics, energy interactions, engine cycles and applications of thermodynamics. The course will also serve as a foundation for aircraft propulsion.

## MODULE I          FUNDAMENTAL CONCEPT                    10

History and relevance of thermodynamics to engineering applications - Basic concepts: system-boundary and surroundings, property, state, equilibrium and state postulate, process,  path and cycle - Zeroth law of thermodynamics, Thermal equation of state, Ideal Gas laws -  Work transfer, Heat transfer – Modes of heat transfer.

## MODULE II          FIRST LAW OF THERMODYNAMICS          10

First law – Classical formulation of first law - concept of energy and its various forms, internal energy, enthalpy, specific heats at constant pressure and volume – First Law of thermodynamics for closed systems and open systems – Steady flow energy equation –  Examples of steady flow processes and steady flow devices.

## MODULE III          SECOND LAW OF THERMODYNAMICS          10

Statements of second law – Thermal reservoir, Heat engines, refrigerators and Heat pumps - Reversible and irreversible processes, Carnot Cycle – Carnot theorem - Absolute thermodynamic temperature scale - Clausius inequality. Concept of Entropy - Tds relations - Increase of entropy principle – isentropic process, Perpetual motion machines - Availability and second law efficiency.

## MODULE IV          GAS AND VAPOUR POWER CYCLES          12

Ideal cycles - Otto, Diesel, Dual, Bray ton cycles –  efficiency – work done - mep – Properties of Steam - Properties gas and vapor mixtures - Rankine cycle - Numerical problems.

## MODULE V          REFRIGERATION AND AIR-CONDITIONING          10

Principle of Refrigeration – Vapour compression & Vapour absorption types –

Coefficient of performance, Properties of refrigerants, Psychrometrics – Relative Humidity – WBT/DBT - Principle of Air conditioning – Types.

## MODULE VI        AIR COMPRESSOR                                8

Air compressor – Various types of compressors (descriptive treatment only) - working principle of reciprocating type air compressor, work of compression - minimum work done equation - Isothermal efficiency – multistage compression and inter-cooling.

**Total Hours : 60**

## TEXT BOOKS:

1. Yunus A. Cengal, "Thermodynamics an Engineering Approach", 8th Edition, Tata McGraw-Hill Co. Ltd., 2014.
2. Nag P. K., "Engineering Thermodynamics", 6th Edition, Tata McGraw-Hills Co., Ltd., 2017.

## REFERENCES:

1. Mayhew, A. and Rogers, B., "Engineering Thermodynamics", E.L.B.S. Edition, Longman Green & Co. Ltd., London, 1990.
2. Saad, M.A., "Thermodynamics for Engineers", Prentice-Hall of India Pvt. Ltd., 1989
3. Reynolds, "Thermodynamics", Int. Student Edition, McGraw-Hill Book Co., Ltd., 1990
4. Kroes Michael J; Wild Thomas W, "Aircraft Power  plants" 7th Edition, Tata McGraw-Hill, 2007.
5. Hill Philip, Peterson Carl, "Mechanics and Thermodynamics of Propulsion", Addison Wesly, 2nd Edition, 2009.
6. J.D. Mattingly, "Elements of Propulsion - Gas Turbines and Rockets", AIAA Education series, 2006

## COURSE OUTCOMES:

Students will able to

• Identify and relate various properties and thermodynamic system.
• Apply an appropriate formulation of the first law to relate energy, heat and work.

- Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.
- Employ temperature-entropy diagrams to analyze the gas and vapour power cycles.
- Calculate cooling load for refrigeration and air-conditioning systems.
- Determine work input for an air compressor with a given set of operating parameters.

| AEC 2103 | **FLUID MECHANICS** | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

## OBJECTIVES:

- To understand the properties of fluids and governing equations of fluid flow.
- To introduce the concepts of dimensional analysis and its applications.
- To provide basic knowledge of the working principles of pumps and turbines.

## MODULE  I          BASIC CONCEPTS AND FLUID PROPERTIES          7

Definition of fluids, Types of fluids, Classification of fluid flows, No-slip condition, Units and dimensions, Mass, Density, Specific Volume, Specific Weight' Relative density, Viscosity, Newton's law of viscosity, Compressibility, Vapor pressure, Surface tension, Capillarity, Center-of-Pressure, Thermodynamic properties of fluids.

## MODULE  II          FLUID STATICS AND PRESSURE MEASURING          7
## DEVICES

Fluid statics: concept of fluid static pressure, hydrostatic pressure distribution, hydrostatic forces on plane and curved surfaces, buoyancy and stability, pressure; absolute and gauge pressures, pressure measuring devices, different types of manometers and pressure gauges.

## MODULE  III          KINEMATICS OF FLUIDS AND GOVERNING          8
## EQUATIONS OF FLOW

Lagrangian and Eulerian approaches, Acceleration field, Material derivative, Concepts of control volume, Control surface; Types of flow, Streamlines, Path lines, Streak lines, Governing equations: Mass, Momentum, Energy. Bernoulli equation.

## MODULE  IV          INTERNAL FLOWS & DIMENSIONAL ANALYSIS          10

Reynolds number regimes, Internal versus external viscous flow, Head loss, Friction factor, Laminar fully-developed pipe flow, Turbulent pipe flow, Flow in non-circular ducts, Losses in pipe systems, Fluid meters. Dimensional homogeneity, Dimensional analysis and Similarity, Buckingham Pi theorem.

## MODULE  V          BOUNDARY LAYER CONCEPTS          6

Fundamental concepts, Boundary layer equations, Boundary layer over a flat plate, Momentum integral equation, Flow separation.

## MODULE  VI          TURBOMACHINERY          7

Introduction and classification. Pumps: Performance curves, Matching a pump to a piping system, Pump cavitations and Net Positive Suction Head, Dynamic pumps, Centrifugal pumps, Axial pumps. Pump scaling laws. Turbines: Positive-displacement turbines, Dynamic turbines, Impulse turbines, Reaction turbines, Turbine scaling laws.

**Total Hours : 45**

**TEXT BOOKS:**
1. Yunus A. Cengel and John M. Cimbala, "Fluid mechanics", McGraw Hill 2006.
2. R.K. BANSAL "Fluid Mechanics and Hydraulic Machines" Revised Ninth Edition – Laxmi Publications 2017.

**REFERENCES:**
1. Frank M. White, "Fluid mechanics", Tata McGraw Hill 2015.

2. Ira M. Cohen, Pijush. K. Kundu, David. R. Dowling "Fluid Mechanics", Fifth edition, 2015

**LEARNING OUTCOMES:**

Students will be able to

- Identify and relate to different kinds of fluids and flows.
- Apply the concept of fluid static pressure and understand the use of pressure measuring devices.
- Derive and apply the governing equations of fluid flow to solve practical problems.
- Evaluate losses in pipe flow systems, and use the principles of dimensional analysis to design realistic and accurate experiments.
- Calculate the boundary layer thickness for simple flow problems.
- Apply the knowledge of pumps and turbines to solve basic problems of fluid machinery.

**EIC 2181**   **BASIC ELECTRICAL & ELECTRONICS ENGG**   L  T  P  C
                                                        3  0  0  3

**OBJECTIVES:**

- To gain the basic knowledge on electrical circuits and machines.

- To acquaint the students to semiconductor devices and their applications.

- To introduce some knowledge about the display system and its applications.

- To introduce the basic knowledge of microprocessor and its application in digital computing.

## MODULE  I        ELECTRICAL CIRCUITS & MEASURMENTS        7

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits - Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

## MODULE  II        ELECTRICAL MACHINES        8

Construction, Principle of Operation, Basic Equations and Applications of DC Generators - DC Motors - Single Phase Transformer - single phase induction Motor.

## MODULE  III        SEMI CONDUCTOR DEVICES AND APPLICATIONS        8

Introduction to Semi conductor - PN Junction diode - Zener Diode - Transistor - BJT and FET - Silicon Controlled Rectifier, Diac and Triac - Half wave and full wave Rectifier - Filter - Ripple Factor - Regulators- Principle and Types of Transistor Amplifiers.

## MODULE  IV        LINEAR AND DIGITAL ICS        8

Number representation - Binary, Octal and Hexadecimal Number Systems - Logic families and Logic Gates - Half and full Adder - Multiplexers – De multiplexers - Decoders - Encoders - Flip-flops - Registers - Counters IC Technology - Fabrication of Linear and Digital IC's - D/A and A/D converters - Comparison between Analog and Digital systems.

## MODULE  V        FUNDAMENTALS OF DISPLAYS TECHNOLOGIES        7

Display technologies: Construction, Working and principle of  CRT  - LED - LCD - EL - Plasma panel Display - Types of Display generations - Raster and strokes - Aspect Ratio -Standard of definition SD, HD, ULD & 3D - Touch panel principles - Types of color display formats - PAL, NTSC, SECAM.

## MODULE  VI        FUNDAMENTALS OF DIGITAL COMPUTER                    7

Digital computer – Memories- Microprocessor basics- Intel 8085 microprocessor - Simple programs using 8085.

**Total Hours : 45**

## TEXT BOOKS:

1. V.K. Mehta, "Principles of Electronics", 2nd Edition, S. Chand & Co., New Delhi, 2002.
2. Muthu subramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, (2006).
3. N. Mittle "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
4. Goankar R.S, "Microprocessors, Programming to Architecture 8085", 5th Edition, Pen ram International publishing Pvt. Ltd., New Delhi, 2002.

## REFERENCES:

1.Mehta V K, "Principles of Electronics", S. Chand & Company Ltd, (1994).

2.Mahmood Nahvi and Joseph A. Ed minister, "Electric Circuits", Schaum' Outline

 Series, Mc Graw Hill, (2002).

3.Jacob Millman & Christos C. Halkias, "Electronic Devices and Circuits" TMH,

 1991

## OUTCOMES:

 Students will be able to
   - Demonstrate the ability to design a system using various electrical and semi conductor devices.

- Keep abreast knowledge of latest digital technology and design of various digital logic circuits.
- Demonstrate the fundamental understanding of the display devices and various broadcasting Methods.
- To understand the various display techniques in aircraft modern display systems.
- Describe the communication protocol and modulation techniques followed in various modern communication systems.
- To get basic knowledge of digital computer system and its processing units.

| **AEC 2104** | **THERMODYNAMICS LAB** | **L T P C** |
| | | **0 0 3 1** |

**OBJECTIVES:**

- To carry out experiments to evaluate the working of different thermodynamic systems and understand heat transfer mechanisms.

**LIST OF EXPERIMENTS:**

1. Valve timing of a 4 - stroke engine
2. Port timing of a 2 - stroke engine.
3. Performance test on a 4-stroke diesel engine
4. Performance test on a 4-stroke petrol engine.
5. Determination of the viscosity coefficient of a given liquid
6. COP test on a vapour compression refrigeration test rig
7. COP test on a vapour compression air-conditioning test rig
8. Determination of Thermal Resistance of a Composite wall.
9. Determination of effectiveness of a parallel flow & counter flow heat exchangers
10. Performance test on 2-stage air compressor.

**Total Hours : 45**

**OUTCOMES:**

Student will be able to

- Understand the thermodynamic cycles involved in 2 and 4 stroke engines.

- Evaluate the performance of refrigeration and air- conditioning systems.

- Evaluate the effectiveness of a parallel flow & counter flow heat exchangers.

- Evaluate the performance of a 4-stroke petrol & diesel engine.

| AEC 2105 | **FLUID MECHANICS LAB** | **L** | **T** | **P** | **C** |
|----------|------------------------|-------|-------|-------|-------|
|          |                        | **0** | **0** | **3** | **1** |

**OBJECTIVES:**

- This course introduces fluid mechanics applications and measurements.

**LIST OF EXPERIMENTS:**

1. Comparison of coefficients of discharge of given Orifice meter and Venturi meter.
2. Calibration of Rota meter
3. Impact of jet on flat and curved vanes
4. Verification of Bernoulli's equation
5. Determination of friction factor for the given set of pipes.
6. Performance test on a jet pump.
7. Performance study of Centrifugal pump / Submersible pump
8. Determination of maximum efficiency for the given Reciprocating pump.
9. Characteristic curves of Gear pump / Vane pump
10. Determination of the maximum power at constant speed / constant load for an Impulse turbine.
11. Performance characteristics of Reaction turbine.

**Total Hours : 45**

**OUTCOMES:**

On completing this course the student will be able to:

- Measure fluid flow through ducts and in open channels, selecting appropriate methods of   Measurements.
- Conduct designed experiments, analyze and evaluate data.
- Apply dimensional analysis techniques in fluid mechanics problems.
- Evaluate the performance of centrifugal pumps, turbines and compressors.

| EIC 2182 | **BASIC ELECTRICAL AND ELECTRONICS** | **L** | **T** | **P** | **C** |
| | **ENGINEERING LAB** | **0** | **0** | **3** | **1** |

**OBJECTIVES:**

- To impart hands on experience in verification of Electric Circuit laws and Theorems.
- To get practical exposure of the various electrical machines and its application.
- To acquaint the students to semiconductor devices and their applications.
- To introduce the basic methods of designing the digital circuits and provide the fundamental concepts used in the design of digital systems.
- To introduce some knowledge about the microprocessor and its programming

**LIST OF EXPERIMENTS**

1. Verification of Kirchhoff's Voltage and Current Laws.
2. OCC and Load characteristics of a separately excited DC generator.
3. Load characteristics of a DC shunt motor.
4. Static characteristics of PN junction diode
5. Static characteristics of Zener diode
6. Study of logic gates.
7. Design of full wave, half wave rectifiers.
8. Design of SR and JK flip flop using gates.
9. Design of T and D flip flop using gates.
10. Addition and subtraction of 8-bit and 16-bit numbers.
11. Study of Oscilloscope and measurement of sinusoidal voltage, frequency and power factor.

**Total Hours : 60**

**REFERENCES:**

1. Nagrath I. J and Kothari D. P. 'Electric Machines', Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2010.
2. Gupta. J.B. "Electronic Devices and Circuits", 3rd Edition, S.K. Kataria & Sons, New Delhi, 2010.

3. Douglas V. Hall, Microprocessor and Interfacing, Programming and Hardware.

**OUTCOMES:**

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

- Conduct basic laboratory experiments involving electrical circuits using laboratory test equipments such as power supplies, signal generators, oscilloscopes, multi meters etc.
- Implement and verify network theorems
- Conduct load test on various types of DC motors & Generators.
- Demonstrate the ability to design a system using various semiconductor devices.
- Keep abreast of the latest digital technology and design of various digital logic circuits.
- Demonstrate the fundamental understanding of the operation of the microprocessor and its interfacing devices.

## SEMESTER – IV

| ENC 2282 | WRITTEN COMMUNICATION | L | T | P | C |
|----------|------------------------|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

## OBJECTIVES:

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

## MODULE  I                                                                      4

Introduction - process of writing – Fundamentals of academicand 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). *TechnicalReport Writing Today*. Cengage Learning, 10<sup>th</sup>  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.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **AEC 2211** | **LOW SPEED AERODYNAMICS** | **3** | **0** | **0** | **3** |

## OBJECTIVES:

- To introduce the basic aerodynamic concepts like circulation, vorticity and irrotationality.
- To understand the concepts of superposition of elementary flows for linear incompressible flow.
- To introduce the concept of classical thin airfoil theory and Prandtl's lifting line theory for wings.
- Introduce the basics of viscous flow

## MODULE I    FUNDAMENTAL EQUATIONS OF AERODYNAMICS        6

Continuity, momentum and energy equations, Differential equations for streamline, angular velocity, Vorticity - circulation. Stream Function, Potential Function, Equi-potential Lines, Laplace equation - Elementary Flows and their combinations.

## MODULE II    FUNDAMENTALS OF INVISCID INCOMPRESSIBLE        8
FLOW

Bernoulli's equation, incompressible flow in a duct, pitot tube, pressure coefficient, governing equation for irrotational incompressible flow, Flow over a circular cylinder, D'Alembert's Paradox, lifting flow over a cylinder – Magnus effect – Kutta Jon kowski Theorem, Real flow over smooth and rough cylinder.

## MODULE III    AIRFOIL THEORY        9

Airfoil nomenclature, airfoil characteristics, Kutta condition, Kutta -Joukowski transformation and its applications, Karman Trefftz Profiles, Thin Airfoil theory and its applications.

## MODULE IV    THEORY OF FINITE WINGS        10

Downwash and induced drag, Vortex Filament, Biot - Savart Law, Helmholtz theorems, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Prandtl's Lifting Line Theory, lift and induced drag coefficients for elliptic lift distribution – General lift distribution – Oswald Efficiency factor - effect of aspect ratio.

## MODULE V    INTRODUCTION TO LAMINAR BOUNDARY LAYER        6

Laminar incompressible boundary layer, boundary layer equations, flat plate boundary layer, Blasius solution, effect of pressure gradient, similarity in boundary layer, Shape factor - laminar separation


## MODULE  VI        INTRODUCTION TO TURBULENT BOUNDARY LAYER        6

Turbulent boundary layer on a flat plate, effect of pressure gradient, Prandtl's mixing length hypothesis, free shear layers.

**Total Hours –45**

## TEXT BOOKS:

1. John D. Anderson, Jr., Fundamentals of Aerodynamics, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007.
2. H. Schlitching, Boundary Layer Theory, 7th Edition, McGraw-Hill Book Company,
   New York, 1979.
3. E. Rathakrishnan, Theoretical Aerodynamics, John Wily & Sons, 2013.

## REFERENCES:

1. Houghton, E.L., and Caruthers, N.B., Aerodynamics for Engineering students, Edward Arnold Publishers Ltd., London, 1989.

2. Katz and Plotkin, Low Speed Aerodynamics, Cambridge Univ. Press, 2002

3. Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 1985

4. John J Bertin., Aerodynamics for Engineers, Pearson Education Inc, 2002


## OUTCOMES:

Students shall be able to

- Understand the capability and limitations of potential flow theory

- Mathematically express the fundamental equations of fluid flow and elementary flow concepts.

- Perform simple calculations for the estimation of the lift characteristics of airfoils using circulation theory/ thin airfoil theory.

- Estimate the induced drag characteristics and lift characteristics of finite wings.

- Perform simple laminar boundary layer calculations.

- Perform simple calculations in wall bounded turbulent boundary layer/ free shear layers.

| AEC 2212 | **AIRCRAFT STRUCTURAL MECHANICS** | L | T | P | C |
|----------|-----------------------------------|---|---|---|---|
|          |                                   | **3** | **1** | **0** | **4** |

**OBJECTIVES:**

- To Study different types of structural members of aircraft subjected to various types of loading and support conditions.

**MODULE  I          LOADS AND STRUCTURAL COMPONENTS OF AIRCRAFT          6**

V-n Diagram, Different structural members of aircraft, loads taken by the components general definitions.

**MODULE  II          STATICALLY DETERMINATE STRUCTURES          13**

Plane truss analysis, method of joints, method of sections, 3D trusses.

**MODULE  III          STATICALLY IN DETERMINATE STRUCTURES          13**

Propped Cantilever beams, Fixed-Fixed beams, Clapeyron's 3 moment theorem, moment distribution method, Maxwell's reciprocal theorem.

**MODULE  IV          COLUMNS          8**

Inelastic buckling, Effect of initial curvature, Eccentric loading on columns, South well plot, Use of energy methods in column, Beam-columns

**MODULE  V          ENERGY METHODS          12**

Strain energy due to gradual loading (axial, bending, torsion, Shear), impact loading, Castigliano's theorems, Unit load and Dummy load methods, application of energy methods to frames, beams, trusses and rings.

**MODULE  VI          FAILURE THEORY          8**

Maximum principle Stress theory, Maximum principle Strain theory, shear stress theory, distortion energy theory, octahedral shear stress theory.

**Total Hours –60**

**TEXT BOOKS:**

1. C.T. Sun, "Mechanics of Aircraft Structures", Second Edition, John Wiley & Sons. 2006.

2. Aircraft Structures for Engg. Students, THG Megson, Elsevier (BH), 2007.

**REFERENCES:**

1. James M Gere & Barry J. Goodno, Mechanics of Materials, Cenage Learning, 9th Edition, 2018.

2. R.C. Hibbeler, "Structural Analysis", Fifth Edition, Prentice-Hall, 2002.

3. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Mechanics of Materials", Firewall media, 2002.

4. Craig, R.R., 1996, Mechanics of Materials, John Wiley & Sons, New York.

5. R.S. Khurmi, "Strength of Materials", Twenty third Edition, S. Chand Limited, 2007

6. R.K. Rajput, " Strength of Materials: Mechanics of Solid", Fourth edition, S. Chand Limited, 2007

**LEARNING OUTCOMES:**

Students will be able to

- Identify and relate different kinds of load factors experienced in aircraft flight.

- Estimate the load bearing capability of different structural members used in the construction of aircraft.

- Extend the concepts of solid mechanics to in-determinate structural problems.

- Give a theoretical design ofcolumns subjected to various loads.

- Obtain theoretical predictions of structural behavior using energy methods.

- Acquire knowledge on failure theories and to predict the values of the stress at which the structure fails.

| AEC 2213 | AIR BREATHING PROPULSION | L | T | P | C |
|----------|--------------------------|---|---|---|---|
|          |                          | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To introduce the fundamental so fair breathing propulsion and the working principles of air breathing engine components.

**MODULE I          FUNDAMENTALS OF AERO ENGINES          9**

Gas turbine Engine development for Aircraft propulsion- Working of Gas turbine engines –the thrust equation and other performance parameters – Factors affecting thrust –Variants of Aircraft jet engines: Turboprop, Turbofan, Turbojet and Turbo shaft - Performance characteristics and analysis, Ideal and Real Bray ton cycles - analysis, Methods of thrust Augmentation.

**MODULE II          PISTON ENGINES & PROPELLER THEORY          6**

 IC engines for aircraft application, performance parameters of IC engines, supercharging of aircraft IC engines - Propeller fundamentals, propeller aerodynamic theories.

**MODULE III          SUBSONIC &SUPERSONIC INTAKES          9**

Introduction to compressible flow – Internal flow and stallin subsonic intakes – Boundary layer separation – Major features of external flow near a subsonic intake- Relation between minimum area ratio and external deceleration ratio– Supersonic inlet flows - Starting problems in supersonic inlets -Shock swallowing methods- Mode so fin let operation.

**MODULE IV          COMBUSTION SYSTEMS          7**

Classification of combustion chamber - Factors affecting combustion chamber performance and design – Aero dynamic pressure losses, Combustion Efficiency, combustion Intensity. Fuel Injectors, Flame stabilization, Flame holders, Flame tube cooling - Combustion instability. Numerical Problems.

**MODULE V          NOZZLES          7**

Isentropic flow through nozzles - Choking – Area-velocity relation, Types - Effect of back pressure on convergent and converging-diverging nozzles - over-expanded and under-expanded          nozzle exit flows, Nozzle efficiency–Losses in nozzles- Fixed and variable geometry  nozzles – Ejector and Variable area nozzles, Thrust vector control, Thrust reversal.

**MODULE VI          RAMJET& SCRAMJET PROPULSION          7**

Working principle of ramjet engine –ramjet performance –sample ramjet design calculations – introduction to scramjet – preliminary concepts in supersonic combustion – integral ram-rocket –numerical problems.

**Total Hours –45**

**TEXT BOOKS:**

1. Saravanamuttoo, H.I. H., Rogers, G.F.C., CohenH., PaulStraznicky, "Gas

2. TurbineTheory",6th Edition,PearsonEducationCanada,2008.

3. Hill Philip, Peterson Carl, "Mechanics and Thermodynamics of Propulsion", Addison Wesly, 1992.

**REFERENCES:**

1. KroesMichaelJ,WildThomasW,"AircraftPowerplants",7th Edition, Tata

   C Graw Hill, 2010.

2. MattinglyJ.D.,"ElementsofGasTurbinePropulsion",TataMcGrawHill,2005.

3. El-SayedAhmed,"AircraftPropulsionandgasturbineengines",TaylorandFrancis(CRC press),2008.

4. Rolls Royce Jet Engine", 3rd Edition, 1983.

5. Roy Bhaskar," Aircraft Propulsion", Elsevier(India),2008.

**OUTCOMES:**

Students will be able to

- Get perspective of different types of jet engines used in aircraft.

- Apply design concepts in propeller blade design.

- Learn engineering features of subsonic and supersonic intakes of jet engines.

- Acquire basic knowledge on combustion systems used in jet engines.

- Apply the basic design features of exhaust nozzles.

- Acquire knowledge of ramjet & scramjet propulsion systems.

| AEC 2214 | AIRCRAFT SYSTEMS & INSTRUMENTS | L T P C |
|----------|--------------------------------|---------|
|          |                                | 3 0 0 3 |

## OBJECTIVES:

- To impart knowledge of the hydraulic and pneumatic systems components and its operation.
- To introduce the basic knowledge of flight control system and its types.
- To acquaint the students to basic engine components and their applications
- To introduce some knowledge about the cabin comfort system and its applications.
- To gain the basic knowledge of navigational instruments to the students.

## MODULE I        AIRCRAFT SYSTEMS                                8

Hydraulic systems – Study of typical workable systems –components – hydraulic systems controllers – modes of operation – pneumatic systems – working principles – typical pneumatic power system – brake system – components, landing gear systems – classification – shock absorbers– retroactive mechanism.

## MODULE II        AIRPLANE CONTROL SYSTEMS                      7

Conventional Systems – power assisted and fully powered flight controls – power actuated systems – engine control systems – push pull rod system – operating principles – modern control systems – digital fly by wire systems – auto pilot system, active control technology.

## MODULE III        ENGINE SYSTEMS                               8

Fuel systems – piston and jet engines – components – multi-engine fuel systems, lubricating systems – piston and jet engines – starting and ignition systems – piston and jet engines.

## MODULE IV        AIR CONDITIONING AND PRESSURIZING SYSTEM      7

Basic air cycle systems – vapour cycle systems, boot-strap air cycle system – evaporative vapour cycle systems – evaporation air cycle systems – oxygen systems – fire protection systems, deicing and anti icing system.

## MODULE V        AIRCRAFT INSTRUMENTS                          8

Flight instruments and navigation instruments – accelerometers, air speed indicators –

mach meters – altimeters – gyroscopic instruments– principles and operation – study of various types of engine instruments – tachometers – temperature gauges – pressure gauge – operation and principles.

## MODULE VI MODERN AIRCRAFT SYSTEMS 7

Auto pilot system - Digital fly by wire systems - Side stick intelligent flight control system active control Technology - Electronic instrument display, EADI, EHSI - communication and Instrument landing system.

**Total Hours –45**

## TEXT BOOKS:

2. Mekinley, J.L. and R.D. Bent, "Aircraft Power Plants", McGraw Hill 1993.
3. Pallet, E.H.J, "Aircraft Instruments & Principles", Pitman & Co 1993.

## REFERENCES:

1. Treager, S., "Gas Turbine Technology", McGraw Hill 1997.
2. Mckinley, J.L. and Bent R.D. "Aircraft Maintenance & Repair", McGraw Hill,1993.
3. Handbooks of Airframe and Power plant Mechanics, US dept. of Transportation, Federal, Aviation Administration, The English Book Store, New Delhi, 1995

## OUTCOMES:

Students will be able to

- Demonstrate the ability to design a various system using pneumatic and hydraulic components.

- Keep abreast knowledge on various flight control system and its recent advancements.

- Demonstrate the fundamental understanding of the operation of engine auxiliary systems.

- To understand the various cabin comfort system used in aircraft modern display systems.

- Describe principle behind the operation of various vital parameter displays and its uses in effective conduct of the flight.

- To get basic knowledge of modern aircraft system which helps in understanding the aircraft navigation system better.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **AEC 2215** | **SOLID MECHANICS LAB** | 0 | 0 | 3 | 1 |

## OBJECTIVES:

- To provide training in testing and evaluation of mechanical properties of the materials like hardness, fatigue strength, tensile strength, flexural strength, rigidity modulus etc.

## LIST OF EXPERIMENTS:

1. Hardness test - a) Vickers b) Brinell c) Rockwell.
2. Tension test.
3. Torsion test.
4. Impact test – a) Izod b) Charpy.
5. Double shear strength test.
6. Determination of stiffness and rigidity modulus on open coil spring.
7. Determination of stiffness and rigidity modulus on closed coil spring.
8. Determination of Young's modulus of a beam.
9. Microstructure study of heat treated materials.
10. Study of stress-strain curves for various engineering materials.

**Total Hours –45**

## OUTCOMES:

Student will be able to

- Evaluate the mechanical properties of materials and compare it with theoretical models.
- Understand the fracture pattern of different specimen.

| AEC 2216    **AIRCRAFT SYSTEMS & INSTRUMENTS LAB** | L | T | P | C |
|---|---|---|---|---|
| | 0 | 0 | 3 | 1 |

**OBJECTIVES:**

- To train the students to assess the Aircraft Systems and carryout maintenance practices.
- To aware the students about the safety precautions to be followed before certifying the airworthiness of an aircraft.
- To familiarize about various systems in aircraft required to maintain airworthy condition.

**LIST OF EXPERIMENTS**

1. Aircraft "Jacking Up" procedure.

2. Aircraft "Leveling" procedure.

3. Control system "Rigging check" procedure.

4. Aircraft "Symmetry Check" procedure.

5. "Flow test" to assess of filter element clogging.

6. Pressure test" to assess hydraulic External/Internal Leakage.

7. "Test of Brake System" and "Bleeding of Brake System".

8. "Pressure test" procedure on fuel system component.

9. "Break Torque Load Test" on wheel brake units.

10. Maintenance and rectification of snags in hydraulic and fuel systems.

**Total Hours – 45**

**OUTCOMES:**

Students will able to

- Understand the procedure required to handle an aircraft before testing its systems.

- Identify the snags in aircraft hydraulic and fuel systems and their rectifications.

- Understand the working of various aircraft systems.

**AEC 2217**  **PROPULSION LAB**  | L | T | P | C |
| 0 | 0 | 3 | 1 |

**OBJECTIVES:**

- To carryout experiments to study the functions of aircraft engine components, basics of heat transfer, combustion and engine exhaust characteristics.

**LIST OF EXPERIMENTS:**

1. Study of an aircraft piston engine. (Includes study of assembly of sub systems, various Components, their functions and operating principles)

2. Study of an aircraft jet engine (Includes study of assembly of sub systems, various Components, their functions and operating principles)

3. Study of forced convective heat transfer over a flat plate.

4. Study of free convective heat transfer over a flat plate.

5. Study of performance of a propeller.

6. Study of free jet.

7. Study of wall jet.

8. Determination of spray characteristics of injector.

9. Study of propellant mixing and casting process.

10. Determination of calorific value of fuels

**Total Hours – 45**

**OUTCOMES:**

Students will able to

- Understand the principles of heat transfer.

- Evaluate the performance of a typical propeller.

- Evaluate the heat of combustion of typical aviation fuels.

- Evaluate the spray characteristics of injector.

**SEMESTER -V**

| MSC 3181 | LEADERSHIP & 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.

## MODULE  VI        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.

**L – 45; T – 15; Total Hours –60**

**TEXT BOOKS:**

1. Andrew J DuBrin. "Leadership: Research Findings, Practice, and Skills", 8$^{th}$ Edition, South-Western College Pub, 2015.
2. Yukl G , "Leadership in Organisations", 8$^{th}$ Edition, Pearson Education, 2013.
3. Richard L Daft , "Leadership", 5$^{th}$ Edition, South Western Cengage Learning 2012.
4. Stephen P. Robbins and Timothy A. Judge. "Organizational Behaviour", 15$^{th}$

Edition, New Delhi: Pearson, 2013.

5. Fred Luthans, "Organizational Behavior, An Evidence Based Approach", 12<sup>th</sup> 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

**REFERENCES:**

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

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

**OBJECTIVES:**

- To create awareness of industrial trends and market demands.
- To encourage students to explore career opportunities in an industry and evaluate themselves in relation to industry preparedness

**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.

| AEC 3101 | **COMPRESSORS & TURBINES** | L | T | P | C |
| --- | --- | --- | --- | --- | --- |
| | | 2 | 0 | 0 | 2 |

**OBJECTIVES:**

- To Study and analyze design aspects and performance characteristics of axial type compressor.

- To analyze design aspects and performance characteristics of axial and radial type turbines.

- To study matching characteristics of jet engines' compressor and turbine.

## MODULE  I          COMPRESSORS                                     12

Introduction -  Aero-Thermodynamics of flow through an Axial flow Compressor stage; Axial Compressors - Basic operation - Elementary theory – Velocity triangles – Work and compression, Design parameters - Flow coefficient – loading coefficient - Degree of reaction - diffusion factor, Cascade Analysis nomenclature - Loss and Blade performance estimation, Free vortex theory, Compressor blade design, Single and multi-stage axial compressor characteristics – Performance characteristics.

Axial Fans – Fan stage parameters – Performance of axial fans. Noise problem in Axial Compressors and Fans.

## MODULE  II          AIRCRAFT ENGINE TURBINES                     12

Axial Turbines - Elementary theory – vortex theory – choice of blade profile, pitch and chord, Turbine stage - Turbine blade 2D (cascade analysis),Work done - degree of reaction - stage design, Losses, efficiency and performance, Rotor blade and disc stresses, Multi-staging of turbine, Turbine cooling technology, Overall turbine performance.

Radial flow turbines: Radial turbine - Aerodynamics and thermodynamics, Losses in radial turbine and efficiency.

## MODULE  III          MATCHING OF COMPRESSOR –TURBINE          6

Single shaft - Two shaft engines: Turbojet, Turbo-prop, Turbofan, Turbo shaft engines. Single and multi-spool - Engine operating lines – Operational details of multiple shaft engines - Intake-Compressor Matching, Turbine Nozzle matching, Compressor – Turbine matching. Free turbine.

**Total Hours : 30**

**TEXT BOOKS:**

1. Cohen, H., Rogers, G.F.C. and Saravanamuttoo, H.I.H., "Gas Turbine Theory" Pearson Education Ltd., 2009.

## REFERENCES:

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion", Pearson Education Inc., 2010.

2. Mattingly J. D., "Elements of Gas Turbine Propulsion", Tata McGraw Hill, 2005

3. Roy Bhaskar, "Aircraft Propulsion", Elsevier (India), 2008.

4. S.M. Yahya, Turbines, Compressors and Fans, McGraw Hill Education (India) Private Limited, Fourth Edition, 2011.

## OUTCOMES:

Students will be able to

- Analyze axial type compressor and fan design aspects and performance characteristics.

- Analyze axial and radial type turbines design aspects and performance characteristics.

- Do matching of jet engines' compressor and turbine.

| **AEC 3102** | **AIRCRAFT STRUCTURAL DESIGN AND ANALYSIS** | **L** **T** **P** **C** |
|---|---|---|
| | | **3** **1** **0** **4** |

## OBJECTIVES:

- To introduce the analysis of various structural components (wing, Fuselage, etc.,) under different loading conditions and the fundamentals of elasticity.

## MODULE I        UNSYMMETRICAL BENDING OF BEAMS        8

Bending Stresses in beams of unsymmetrical sections, bending of sections with skew loads, Thin walled beams, bending stress in the wing box, Structural Idealization.

## MODULE II        SHEAR FLOW IN OPEN SECTIONS        10

Concept of shear flow, shear centre, elastic axis, with one axis of symmetry, with wall effective and ineffective in bending, unsymmetrical beam sections.

## MODULE III        SHEAR FLOW IN CLOSED SECTIONS        10

Bredt – Batho formula, single and multi – cell structures. Shear flow in single & multi cell structures under torsion, Shear flow in single and multi cell under bending with walls effective and ineffective.

## MODULE IV        BUCKLING OF PLATES        12

Rectangular sheets under compression, local buckling stress of thin walled sections, crippling stresses by Needham's and Gerard's methods, thin walled column strength. Sheet stiffener panels, Effective width, inter rivet and sheet wrinkling failures.

## MODULE V        STRESS ANALYSIS IN WING AND FUSELAGE        10

Procedure – Shear and bending moment distribution of wings and fuselage, thin webbed beam. Shear resistant web beams, Tension field web beams (Wagner's).

## MODULE VI        BASICS OF ELASTICITY        10

Definitions, equations of equilibrium, strain displacement relationships, Stress– Strain relationship, Compatibility equations.

**L – 45; T – 15; Total Hours –60**

**TEXT BOOKS:**

1. T H G Megson, "Aircraft Structures for Engineering Students", 4$^{th}$ Edition, Elsevier (BH) 2007.
2. C T Sun, "Mechanics of Aircraft Structures", 2$^{nd}$ Edition, Wiley India Pvt. Ltd.

**REFERENCES:**

1. David J Peery, Jamal J Azar, "Aircraft Structures", 2$^{nd}$ Edition, McGraw Hill, 1982.
2. R.M Rivello, "Theory and Analysis of Flight Structures", Illustrated Edition, McGraw Hill, 1969.
3. B. Donaldson, "Analysis of Aircraft Structures: An Introduction", Cambridge University Press.

**OUTCOMES:**

Students will be able to

- Analyze the bending stresses of the structural members of aircraft under different loading conditions.
- Analyze the shear flow of the open walled thin sections of the aircraft under different loadings.
- Analyze the shear flow of the closed walled thin sections of the aircraft under different loadings.
- Obtain analytical solutions for the buckling of thin plates.
- Carry out stress analysis on thin walled Structures such as wing and fuselage under different loading conditions.
- Differentiate between theory of elasticity and solid mechanics approaches in solving aircraft structural problems.

| AEC 3103 | HIGH SPEED AERODYNAMICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the effect of compressibility at high speed flows.

- To understand the basics of shock and expansion waves at supersonic flows.

- To introduce the compressible flow theories to assess the flow over airfoils and wings.

**MODULE  I        ONE DIMENSIONAL COMPRESSIBLE FLOW        10**

Continuity, Momentum and Energy equations, state equations, velocity of sound, adiabatic steady state flow equations, flow through converging, diverging passages, performance under various back pressures.

**MODULE  II        NORMAL SHOCK WAVES        6**

Prandtl equation and Rankine – Hugonoit relation, normal shock equations, Pitot static tube, corrections for supersonic flows, Concept of Moving Shocks.

**MODULE  III        OBLIQUE SHOCKS AND EXPANSION WAVES        10**

Oblique shocks hodograph and pressure turning angle, shock polar, flow past wedges and concave corners, strong, weak and detached shocks, Rayleigh and Fanno Flow. Flow past convex corners, expansion hodograph, reflection and interaction of shocks and expansion waves, families of shocks, method of characteristics, two dimensional supersonic nozzle contours.

**MODULE  IV        DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY        13**
**                          COMPRESSIBLE FLOWS**

Small perturbation potential theory, solutions for supersonic flows, Mach waves and Mach angles, Prandtl- Glauert affine transformation relations for subsonic flows, linearised two dimensional supersonic flow theory, lift, drag, pitching moment and center of pressure of supersonic profiles.

**MODULE  V        AIRFOIL CHARACTERISTICS IN HIGH SPEED FLOWS        9**

Lower and upper critical Mach numbers, lift and drag divergence, shock induced separation, characteristics of swept wings, effects of thickness, camber and aspect

ratio of wings, Transonic flow, transonic area rule, tip effects.

**MODULE VI          HYPERSONIC FLOWS                    12**

Introduction of hypersonic flows, Differences between high speed flows and hypersonic flows. Simple solution methods for solving inviscid and viscous hypersonic flow problems. Effects of high temperature on hypersonic flow.

**L – 45; T – 15; Total Hours –60**

**TEXT BOOKS:**

1.    John D. Anderson, Jr., "Fundamentals of Aerodynamics", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007.

2.    Liepmann, H. W and Roshko, A., "Elements of Gas dynamics", Dover Publication, 2002.

3.    Pope, A. and Goin, L., "High Speed Wind Tunnel Testing", John Wiley, 1985

**REFERENCES:**

1.    McCormick. B. W., "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley & Sons, Inc., UK, 1995.
2.    Anderson Jr., D., "Modern compressible flow", McGraw-Hill Book Co., New York 2003

**OUTCOMES:**

Students will be able to

- Perform one-dimensional isentropic flow calculations.
- Apply Normal shock/Oblique shock relations for calculation of flow field properties.
- Use Prandtl-Meyer expansion and Method of Characteristics to obtain 2D supersonic nozzle contour.
- Apply airfoil theory for the prediction of airfoil characteristics at high speeds.
- Estimate the performance of swept wings at high speed flight.
- Identify the difference between high speed flows and hypersonic flows and basic solution methods of hypersonic flow problems.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **AEC 3104** | **AERODYNAMICS LAB** | 0 | 0 | 3 | 1 |

**OBJECTIVES:**

- To introduce the basics of subsonic Wind Tunnels and their applications for different configurations to evaluate the aerodynamic forces and moments.

- To introduce the usages of subsonic and supersonic flow visualization techniques.

**LIST OF EXPERIMENTS:**

1. Calibration of subsonic wind tunnel.
2. Pressure distribution over smooth and rough cylinder.
3. Pressure distribution over symmetric airfoils.
4. Pressure distribution over cambered airfoils
5. Force measurement using wind tunnel balance on aircraft models.
6. Flow over bluff bodies by flow visualization technique
7. Flow over streamlined bodies with different angle of attack by flow visualization technique.
8. Study of Flow over a various wing sections / Aircraft model / Car model / Building model / Launch vehicle model by flow visualization technique.
9. Aerodynamics characteristics of symmetrical and cambered airfoil
10. Supersonic flow visualization studies

**Total Hours – 45**

**OUTCOMES:**

Students will be able to

- Understand process of calibration of subsonic wind tunnel.

- Understand the airfoil pressure distribution form and its influence on the lift value.

- Visually recognize the location and formation of vortices and flow separation point by flow visualization techniques.

- Calculate the co efficient of Lift of an given Airfoil.

- Calculate the coefficient of Drag of an given Airfoil

- Know the importance of the geometry to obtain better aerodynamic characteristics by using flow visualization techniques.

**AEC 3105**     **AIRCRAFT STRUCTURAL ANALYSIS LAB**     L     T     P     C

                                                          0     0     3     1

**OBJECTIVES:**

- To carryout experiments to study the load-deflection characteristics of beams and there sponge of structural members under various loading conditions.

**LIST OF EXPERIMENTS:**

1. Determination of Young's Modulus for the given material (statically determinate beam) and verify Maxwell's reciprocal theorem for the same using extensometers

2. Determination of Young's Modulus for the given material (statically indeterminate beam) and verify Maxwell's reciprocal theorem for the same using extensometers.

3. Determine the Critical Load for a column (South well -plot).

4. Unsymmetrical bending of beams.

5. Determination of Shear center for Closed and Open Section.

6. Constant Strength Beam.

7. Beam with combined loading.

8. Calibration of photo-elastic material and determination of Stresses in circular discs and beams.

9. Vibrations of beams

10. Wagner's beam.

**Total Hours – 45**

**OUTCOMES:**

Students will be able to

- Evaluate the material properties of aircraft structural members.

- Obtain experimental results of static and dynamic structural responses and compare with that of theoretical values.

- Determine the stress pattern for different cross sections using photo-elastic apparatus.

**SEMESTER - VI**

| MSC 4181 | SOCIAL ENTREPRENEURSHIP | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

1. To be able to understand the field of social entrepreneurship and Social problems
2. To be able to describe and understand the traits of social entrepreneurs
3. To recognize the social business opportunities
4. To synthesize the resource mobilization ways for social entrepreneurship
5. To understand the social entrepreneurship models
6. 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        7**
**                              CHALLENGES**

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        7**
**                              RECOGNITION**

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        8**

**SOCIAL ENTERPRISES**

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

**L – 45; T – 15; Total Hours –60**

**TEXT BOOKS:**

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

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

**ENC 3281**      **COMMUNICATION AND SOFT SKILLS - II**      L   T   P   C
                              **CONFIDENCE BUILDING**          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

Analyzing 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 Olin's. (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.

| AEC 3211 | ROCKET PROPULSION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

## OBJECTIVES:

- To introduce different types of propellants for rocket propulsion and the study

of system performance.

## MODULE I          FUNDAMENTALS OF ROCKET PROPULSION          7

Introduction - Rockets - purpose – classifications & Applications. Expansion of gases from high pressure chamber, efflux velocity, Rocket nozzles: Nozzle Configurations, Rocket Nozzle performance parameters. Thrust Equation, Specific Impulse, Thrust Coefficient, Characteristic Velocity and other Performance Parameters;

## MODULE II          PROPELLANTS          9

Classification of solid propellant, Propellant Characteristics, Hazards, Propellant Ingredients, Liners, Insulators and Inhibitors, Combustion of Solid Propellants, Physical and Chemical Processes, Extinction or Thrust Termination, Combustion Instability. Classification of liquid propellants – Mono, Bi and Tri- Propellants; Non Hypergolic and Hypergolic Systems; Gel Propellant Systems; Essential Characteristics of Liquid Propellants; Physical Properties; Ignition Characteristics; Ignition Delay; Ignition and Combustion Properties; Performance of Selected Bipropellant Systems; Factors affecting the Performance.

## MODULE III          SOLID ROCKET MOTORS          8

Solid Propellant Rocket Motor Components –functions, Propellant Burning Rate, Basic Performance Relations. Propellant Grain Configuration, propellant grain designs considerations. Propellant Grain Stress and Strain. Ignition Process, Igniters, Rocket Motor Design Approach.

## MODULE IV          LIQUID PROPELLANT ROCKET ENGINES          7

Liquid Propellant Rocket Combustion Process, Propellant Tanks; Tank Pressurization. Liquid Propellant Feed Systems, Injectors; Thrust Chamber design consideration. Cooling in liquid rockets.

## MODULE V       HYBRID ROCKET ENGINE       7

Introduction – Classification - System Arrangement and Components. Typical Fuels and Oxidizers. Advantages and disadvantages. Application Areas. Performance and Limitations; Performance Parameters of Selected Existing Hybrid Rocket Engines. System Integration; Manufacturing Methods for Low- and High- Thrust Engines.

## MODULE VI       ADVANCED PROPULSION       7

Electric rocket propulsion – ion propulsion techniques and plasma rockets. Nuclear rocket – types. Solar sail. Preliminary concepts in nozzle less propulsion.

**Total Hours –45**

### TEXT BOOKS:

1. George P. Sutton, Oscar Biblarz, "Rocket Propulsion Elements", 7$^{th}$ Edition, John-Wiley & Sons, Ltd., 2001.

### REFERENCES:

1. R. Humble, G. Henry, and W. Larson, "Space Propulsion Analysis and Design", McGraw-Hill, New York, 1995.

2. Hill, Philip and Carl Peterson, "Mechanics and Thermodynamics of Propulsion", Prentice Hall, 1991

### OUTCOMES:

Students will be able to

- Evaluate performance parameters for rocket engines and nozzles.

- Acquire knowledge about combustion properties of solid & liquid propellants.

- Analyze solid rocket motor performance parameters and propellant grain structure.

- Acquire knowledge about different feed systems of liquid propellant rocket engine.

- Evaluate performance parameters for hybrid rocket engine.

- Acquire knowledge about advanced propulsion systems.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **AEC 3212** | **FLIGHT DYNAMICS** | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To introduce the study of various performance of an Aircraft
- To introduce the stability characteristics of aircraft under various operating conditions and atmospheric disturbances.

## MODULE  I        FORCES ON THE AIRPLANE                    10

Forces and moments acting on a flight vehicle, equation of motion of a rigid flight vehicle, different types of drag, drag polar of vehicles from low speed to high speeds, variation of thrust, power and SFC with velocity and altitudes for air breathing engines and rockets, power available and power required curves.

## MODULE  II        AIRCRAFT PERFORMANCE                    11

Performance of airplane in level flight, maximum speed in level flight, conditions for minimum drag and power required , range and endurance , climbing and gliding flight-maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide, Turning performance -Turning rate turn radius, Bank angle, Limitations of pull up and push over, V-n diagram Gust loads and load factor.

## MODULE  III        STATIC LONGITUDINAL STABILITY AND  CONTROL        11

Degree of freedom of rigid bodies in space , Static and dynamic stability– static longitudinal stability , stick fixed stability , basic equilibrium equation , stability criterion , effects of fuselage and nacelle , influence of CG location , power effects , stick fixed neutral point , stick free stability, Hinge moment coefficient , stick free neutral points, symmetric maneuvers , stick force gradients , aerodynamic balancing.

## MODULE  IV        DIRECTIONAL STABILITY AND CONTROL        10

Static directional stability rudder fixed – directional control, Stick free directional stability adverse yaw effects –slip stream rotation –crosswind during takeoff and landing, spinning, Anti symmetric power.

## MODULE  V        LATERAL STABILITY AND CONTROL                    9

Dihedral effect –estimation of airplane dihedral effect–effects of wing sweeps, flaps, power on dihedral effect, lateral control – Aileron control forces, aileron levers.

## MODULE VI        DYNAMIC STABILITY                          9

Equation of longitudinal motion –Evaluation of stability derivatives –solution of equation of motion ( stick fixed case),solution of equation of motion ( stick free case) –lateral dynamics – lateral degrees of freedom, characteristics motion of the airplane with control locked., Evaluation of stability derivatives, response to aileron control , response to aileron with adverse yaw, dynamic lateral stability rudder free, aileron free.

**L – 45; T – 15; Total Hours –60**

## TEXT BOOKS:

1. Anderson, J.D., "Aircraft performance and design", McGraw Hill, 1995.

2. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son, Inc, New York, 2011.

## REFERENCES:

1. Nelson, R.C. "Flight Stability and Automatic Control", McGraw Hill Book Co., 1998.

## OUTCOMES:

Students will be able to

- Calculate the performance parameters of the aircraft during steady level flight, climb, cruise, Range, Endurance and locate the structural limitation of the aircraft using V-n diagram.
- Construct the drag polar curve for low speed and high speed aircrafts.
- Detect several factors and its controllability to make aircraft directional stability
- Identify the different between stability and controllability
- Recognise how the various wing sections of the aircraft helps to make lateral stability.
- Acquire knowledge of dynamic stability of the aircraft

| AEC 3213 | **AIRCRAFT MATERIALS AND PROCESSES** | **L T P C** |
|---|---|---|
| | | **3 0 0 3** |

**OBJECTIVES:**

- To introduce elements of materials science.
- To gain knowledge about engineering behaviour of materials and study effects, protection against corrosion of aircraft materials.
- To study various heat treatment processes of aircraft metals and alloys.
- To acquire knowledge on basics of different ceramic and composite materials.
- To gain better understanding about metal working processes and welding methods used in aerospace industries. To identify & select suitable materials for different parts of aircraft based on their characteristics and properties.

**MODULE  I          ELEMENTS OF MATERIAL SCIENCE                    7**

Structure of solid materials – Atomic structure of materials – crystal structure – miller indices space lattices – x-ray diffraction – imperfection in crystals – physical metallurgy.

**MODULE  II          MECHANICAL BEHAVIOR OF MATERIALS &          9**
**                          CORROSION**

Linear and non linear elastic properties – Yielding, strain hardening, fracture, Bauchinger's effect – Notch effect testing – creep and fatigue - flaw detection of materials and components. – NDT Methods, Types of corrosion – effect of corrosion on mechanical properties – stress corrosion cracking – Prevention methods - corrosion resistance materials.

**MODULE  III          AIRCRAFT METAL ALLOYS & HEAT TREATMENT          8**

Iron – Carbon diagram – effect of alloying treatment - Heat treatment of carbon steel, aluminum alloys, magnesium alloys and titanium alloys used in aircraft. Heat resistant steels, maraging steels - Introduction to super alloys.

**MODULE  IV          CERAMICS AND COMPOSITES                    8**

Introduction – powder metallurgy - modern ceramic materials – cermets - cutting tools – glass ceramic –production of semi fabricated forms - plastics and rubber –

Graphene - carbon/carbon composites, fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design, open and close mould processes.

## MODULE  V          METAL WORKING PROCESSES AND WELDING          8

Metal working processes used in the manufacture of aircraft materials or components - Hot-working - Cold-working - Extruding - Casting (permanent mould and die casting) - Forging – Drawing – Metal Cutting.

Various Welding Processes - Oxyacetylene welding - Electric arc welding - Electrical resistance welding - TIG - MIG - Electron beam welding - Plasma arc welding - Thermal spraying - Laser welding – Welding Defects.

## MODULE  VI          SELECTION OF MATERIALS FOR AIRCRAFTS          5

Classification of aircraft materials - Importance of strength/weight ratio of materials for aerospace vehicles structures, Materials used for aircraft components - Factors affecting choice of material for different parts of airplane. Materials for stealth - Emerging trends in aerospace materials.

**Total Hours – 45**

**TEXT BOOKS:**

1. Titterton. G., "Aircraft Materials and Processes", V Edition, Pitman Publishing Co., 1995

**REFERENCES:**

1. F.C Campbell," Manufacturing technology for aerospace structural materials", Elsevier publication.

2. Martin, J.W., "Engineering Materials, Their properties and Applications", Wykedham Publications (London) Ltd., 1987.

3. Van Vlack. L.H., "Materials Science for Engineers", Addison Wesley, 1985.

4. Kenneth. G. Budinski & Michael .K. Budinski, "Engineering material properties and selection", Prentice Hall publications, 2010.

**OUTCOMES:**

Students will be able to

- Understand atomic structure, crystal structure of solids.

- Gain knowledge on engineering behaviour of materials and effects of corrosion on materials.

- Identify the need for different alloying materials and heat treatment processes involved.

- Acquire knowledge on types and applications of different ceramic and composite materials.

- Employ different metal working processes and welding methods used in aerospace industries.

- Select and suggest suitable materials for different parts of aircraft based on their characteristics and properties.

| | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **AEC 3214** | **AIRCRAFT DESIGN PROJECT - I** | **1** | **0** | **3** | **2** |

**OBJECTIVES:**

To train the students on preliminary aircraft design work using suitable procedures to evolve the basic configuration design.

1. Comparative configuration study of different types of airplanes

2. Comparative study on specification and performance details of aircraft

3. Preparation of comparative data sheets

4. Work sheet layout procedures

5. Comparative graphs preparation and selection of main parameters for the design

6. Preliminary weight estimations, selection of main parameters,

7. Power plant selection, Aerofoil selection, Wing tail and control surfaces

8. Preparation of layouts of balance diagram and three view drawings

9. Drag estimation

10. Detailed performance calculations and stability estimates

**Total Hours – 45**

**OUTCOMES:**

Students will be able to

- Identify information requirements and sources for aircraft design and evaluation.

- Apply the fundamental principles of Aerodynamics, Flight performance & stability and propulsion to evolve the configuration of an aircraft.

- Develop skills in design of aircraft components using computer aided tools.

- Learn to work as a team to achieve the goal.

- Apply cognitive design skills to generic design problems.

- Learn project management and time management skills.

**TEXTBOOKS**

1. John D Anderson Jr. "Introduction to Flight" 6th Edition Mcgraw Hill Publications, 2010.
2. Daniel P Raymer "Aircraft Design A Conceptual Approach" Fourth Edition AIAA Education series, 1989.

**REFERENCES**

1. Janes " All the World's Aircraft 2010 – 2011" Edited by Paul Jackson FRAeS
2. Perkins Hage" Airplane performance stability and control" , Wiley publications, 2005.

**SEMESTER - VII**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **AEC 4101** | **AVIONICS ( LAB INTEGRATED)** | **3** | **0** | **3** | **4** |

**OBJECTIVES:**

• To introduce the basic concepts of avionics systems utilized in Aircraft.

## MODULE I        INTRODUCTION                                    7

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies.

## MODULE II        PRINCIPLE OF DIGITAL SYSTEMS                7

Digital computer –Digital number system- number systems and codes-fundamentals of logic and combinational logic circuits- Digital arithmetic-interfacing with analogue systems- Microprocessor basics- intel 8085,8086 microprocessor- Memories.

## MODULE III        DIGITAL AVIONICS ARCHITECTURE:                8

Avionics system architecture – salient features and application of Data buses – MIL-STD-1553B – ARINC 429 –ARINC 629.

## MODULE IV        FLIGHT DECKS AND COCKPITS:                8

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – direct voice input (DVI)- civil and military cockpits: MFDS, HUD, MFK, HOTAS.

## MODULE V        AVIONICS SYSTEM (AIR DATA INSTRUMENTS &        8
                        POWER PLANTS INSTRUMENTS)

Air data instruments- Airspeed, altitude, vertical speed indicators- Angle of attack measurements- Pressure measurements- Temperature measurements, fuel quantity measurement, engine power and control instruments- measurements of RPM, EPR, fuel flow, engine vibration.

## MODULE VI        AVIONICS SYSTEMS( COMMUNICATION & NAVIGATIO        8
                        INSTRUMENTS )

Communications systems- Navigation systems – flight control systems – radar –

electronic warfare – utility systems reliability and maintainability –certification.

**Total Hours – 45**

## TEXT BOOKS:

1. Spitzer, C.R. "Digital Avionics Systems", McGraw Hill, 1993.
2. Gaokar, R.S., "Microprocessors Architecture-Programming and Applications", Wiley and Sons Ltd., New Delhi, 1990.
3. Pallet, E.H.J., "Aircraft Instruments & integrated systems", Longman Scientific and Technical, McGraw Hill, 1992.

## REFERENCES:
1. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
2. Brain Kendal, "Manual of Avionics", 3rd Edition, The English Book House, New Delhi,

## OUTCOMES:
Students will be able to,

• Understand the basic principles, theory and operation of modern avionics systems
• Implement various modern avionic systems for both civil and military aircraft.
• Understand the principles of various avionics systems like navigation, communication and electronic warfare.

| AEC 4102 | FINITE ELEMENT METHOD | **L** | **T** | **P** | **C** |
| | | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- To introduce the concept of finite element analysis of structural components.

**MODULE I        INTRODUCTION                                6**

Basic steps in fem, Solution of differential equations using weighted residual methods, Rayleigh and Ritz Method, Convergence criteria of finite element method.

**MODULE II        DISCRETE ELEMENTS                          8**

1 D elements, Bar elements (both Mechanical and thermal Loading), Beam element, Use of local and natural coordinates, Truss Analysis.

**MODULE III        CONTINUUM ELEMENTS                        10**

Constant and linear strain triangular elements, Plane stress, Plane strain, Axisymmetric problems.

**MODULE IV        ISOPARAMETRIC ELEMENTS                     7**

Mapping of Elements, shape function for quadrilateral elements, stiffness matrix, consistent load vector, Serendipity elements, Gaussian integration.

**MODULE V        FIELD PROBLEMS                              6**

Heat transfer problems, steady state fin problems, torsion problems, Flow Field Problems.

**MODULE VI        VIBRATION ANALYSIS                         8**

Single degree of Freedom , Multiple degrees of Freedom System, Transverse vibrations of strings, Longitudinal, Lateral and Torsional vibrations.

**Total Hours –60**

**TEXT BOOKS:**

1.  J.N. Reddy, "An Introduction to Finite Element Method", 3rd Edition, Tata McGraw Hill, 2006.

2. Chandrupatla and Belegundu, "Introduction to Finite Elements in Engineering", 4th Edition(revised), Pearson Education, 2011.

**REFERENCES:**

1. Seshu. P., "Textbook of Finite Element Analysis", Illustrated Reprint, Prentice Hall of India Learning Pvt Ltd., 2003.

2. R. D. Cook., "Concepts and Applications of Finite Element Analysis", 2nd Edition, Wiley, 1981.

3. David V. Hutton., "Fundamentals of Finite Element Analysis", Tata McGraw Hill, 2005.

4. S.S. Rao, "Finite Element Analysis", 4th Edition, Elsevier Butterworth Heinemann, 2011

5. O. C. Zienkiewicz and Y.K. Cheung., "The Finite Element Method: Its Basis and Fundamentals", 6th Edition (Reprint), Butterworth Heinemann, 2005.

6. G Lakshmi Narasiah., "Finite Element Analysis", Illustrated Edition, B S publications, 2009.

**OUTCOMES:**

Students will be able to

- Apply weighted residual methods to solve differential equations.
- Obtain finite element equations for and 1D and 2D problems and apply the same to solve the structural problems.
- Understand Mapping of elements and formulate Shape functions for different types of elements.
- Obtain finite element equations and solve field problems involving fluid flow and heat transfer.

| | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **AEC 4104** | **AIRCRAFT DESIGN PROJECT - II** | **1** | **0** | **3** | **2** |

**OBJECTIVES:**

• To introduce the detailed design procedure to be adapted for the design of selected type of aircraft


Each student is assigned with work in continuation of the design project – I. The following sequence is to be carried out.

1. V-n diagram for the design study
2. Gust and maneuverability envelopes
3. Critical loading performance and final V-n graph calculation
4. Structural design study – theory approach
5. Load estimation of wings
6. Load estimation of fuselage.
7. Balancing and maneuvering loads on tail plane, aileron and rudder loads.
8. Detailed structural layouts
9. Design of some components of wings, fuselage
10. Preparation of a detailed design report with CAD drawings.

**Total Hours –45**


**OUTCOMES:**

Students ill be able to

• Finalize the V-n diagram of the selected aircraft
• Estimate the limiting loads on the aircraft during flight
• Apply suitable design methods and design structural elements/ systems for a given aircraft
• Prepare CAD drawings of the designed aircraft.

| AEC 4105 | CFD-STRUCTURAL ANALYSIS LAB | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1 |

**OBJECTIVES:**

• To familiarize the students with the application of CFD/ CSM codes and their applications in aeronautics.

• To train the students to compute the flow features and stress distributions over aircraft components.

**LIST OF EXPERIMENTS**

CFD Analysis of

(i) Flow over an airfoil

(ii) Flow over a cone cylinder fuselage configuration

(iii) Free jet flow

Computational Structural Analysis of

(i) Wing spar

(ii) Fuselage bulkhead

**Total Hours –45**

**OUTCOMES:**

Students will be able to

• Identify suitable computational domains, boundary conditions for simple flow problems

• Select the appropriate meshing techniques and suitable solver for the flow problems

• Simulate the flow around various configurations and interpret the results obtained

• Analyse the structural response of different Aircraft structural components for various loads.

**PROFESSIONAL ELECTIVES**

| | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **AECX 01** | **OPTICAL FLOW DIAGNOSTICS** | **2** | **0** | **0** | **2** |

**OBJECTIVES:**

- To introduce the optical flow diagnostic and fundamentals of image processing.
- To describe the basics of each technique and its limitations.
- To identify a suitable optical diagnostic for a particular flow problem.

**MODULE I          INTRODUCTION TO OPTICAL DIAGNOSTICS          8**

Line of sight measurements - surface measurements - planar measurements - volumetric measurements - image pre processing - image based data analysis.

**MODULE II          VECTOR MEASUREMENTS          7**

Introduction to particle image velocimetry (PIV) - planar/stereo/ tomography PIV - laser Doppler velocimetry – uncertainties.

**MODULE III          SCALAR MEASUREMENTS          8**

Mie/Rayleigh scattering - Laser induced fluorescence - thermography - pressure/temperature sensitive paints – uncertainties.

**MODULE IV          METHOD OF SELECTION & INSTRUMENTATION          7**

Steady & unsteady - laminar & turbulent - liquids & gases - incompressible & compressible - internal & external - free shear/mixing layer & wall shear layer - reacting & non-reacting flows.

**Total Hours – 45**

**REFERENCES:**

- Buchhave P et al., Optical Diagnostics for Flow Processes, Springer, 1994
  Markus R et al., Particle Image Velocimetry: A Practical Guide, Springer, 2018
- Mayinger F., Feldmann O. (eds) Optical Measurements. Heat and Mass Transfer. Springer, Berlin, Heidelberg
- Handbook of Experimental Fluid Mechanics, Tropea, Cameron; Yarin, Alexander L.; Foss, John F. Springer, 2007.

**OUTCOMES:**

- Knowledge on optical flow diagnostics.
- Understanding the limitations of such techniques.
- Selection of particular technique for a particular flow problem.

| | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **AECX02** **HYPERSONIC AERODYNAMICS** | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- To introduce the basic concepts of hypersonic flows and their effects on flight Vehicles.

**MODULE  I          FUNDAMENTALS OF HYPERSONIC AERODYNAMICS          7**

Introduction to hypersonic aerodynamics, differences between hypersonic aerodynamics and supersonic aerodynamics, concept of thin shock layers, hypersonic flight paths, hypersonic Similarity parameters, shock wave and expansion wave relations of in viscid hypersonic flows.

**MODULE  II          SIMPLE SOLUTION METHODS FOR HYPERSONIC          8**
**                         INVISCID FLOWS**

Local surface inclination methods, Newtonian theory, modified Newtonian law, tangent wedge and tangent cone methods, shock expansion methods, approximate theory-thin shock layer theory.

**MODULE  III          VISCOUS HYPERSONIC FLOW THEORY          7**

Boundary layer equation for hypersonic flow-hypersonic boundary layers, self-similar and non self-similar boundary layers, solution methods for non self-similar boundary layers aerodynamic heating.

**MODULE  IV          VISCOUS INTERACTIONS IN HYPERSONIC FLOWS          7**

Introduction to the concept of viscous interaction in hypersonic flows, strong and weak viscous interactions, hypersonic viscous interaction similarity parameter, introduction to shock wave boundary layer interactions.

**MODULE  V          INTRODUCTION TO HIGH TEMPERATURE EFFECTS          8**

Nature of high temperature flows, chemical effects in air-real and perfect gases-Gibb's free energy and entropy-chemically reacting mixtures-recombination and dissociation.

**MODULE  VI          HYPERSONIC WIND TUNNELS          8**

Impulse facilities, hypersonic wind tunnels, shock tunnels, gun tunnels.

**Total Hours – 45**

**TEXT BOOKS:**

- John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dyanmics", McGraw hill Series, New York, 1996.

**REFERENCES:**

- John. D. Anderson. Jr ., "Modern compressible flow with historical perspective".
- McGraw Hill Publishing Company, New York, 1996.
- John. T Bertin, "Hypersonic Aerothermodynamics", published by AIAA

  Inc., Washington.D .C., 1994.

**OUTCOMES:**

Students will be able to:

- Differentiate between hypersonic and supersonic aerodynamics.
- Gain knowledge of simple solution methods to find the approximate solution for the in viscid hypersonic flows.
- Apply the viscous flow concept and solution methods for boundary layer and heating.
- Predict the viscous interactions in hypersonic flows
- Gain knowledge on the effect of chemistry at high temperature.
- Acquire knowledge on various experimental facilities for hypersonic flows.

|  |  | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|

**AECX03**        **INDUSTRIAL AERODYNAMICS**

**3    0    0    3**

**OBJECTIVES:**

- To familiarize with non-aeronautical uses of aerodynamics such as Atmospheric studies, Road vehicles, Wind turbines, building aerodynamics and problems of flow induced vibrations, air pollution.

**MODULE  I        ATMOSPHERIC BOUNDARY LAYER        7**

Atmospheric circulation, Local winds, Terrain types, Mean velocity profiles, Power law and logarithm law - wind speeds, Turbulence profiles, Roughness parameters, simulation techniques in wind tunnels.

**MODULE  II        VEHICLE AERODYNAMICS        8**

Boundary layers and separation, Two dimensional wake and vortex formation-Strouhal and Reynolds numbers, Separation and reattachments, Power requirements and drag coefficients of automobiles, Effects of cut back angle, aerodynamics of trains.

**MODULE  III        WIND ENERGY COLLECTORS        7**

Horizontal and vertical axis machines, energy density of different rotors, Power Coefficient, Betz coefficient by momentum theory.

**MODULE  IV        BUILDING AERODYNAMICS        8**

Pressure distribution on low rise buildings, wind forces on buildings, Environmental winds in city blocks, special problems of tall buildings, building codes, ventilation and architectural aerodynamics.

**MODULE  V        FLOW INDUCED VIBRATIONS        8**

Vortex shedding, lock & effects of Reynolds number on wake formation in turbulent flows across wind galloping-wake galloping-along wind galloping of circular cables-oscillation of tall structures under wind loads-stall flutter.

**MODULE  VI        AIR POLLUTANT DISPERSION        7**

Effectiveness of dispersion, stack height and separation, air pollution control devices, filters, gaseous pollutant scrubbers, absorbers, vapor emissions, dust suppression, open burning, trench burning, air pollution.

**Total Hours – 45**

**TEXT BOOKS:**

- Scorer R.S "Environmental Aerodynamics", Ellis Harwood Ltd, England, 1978.
- Sachs P "Wind Forces in Engineering", Pergamum Press, 1988.
- Blevins R.D "Flow Induced Vibrations", Van No strand, 1990.

**REFERENCES:**

- Rose Mc called, Fred Brow and, James Rose The aerodynamics of heavy vehicle- Trucks, buses and trains Springer Berlin Heidelberg Newyork,2004
- Sovran, M(ed) "Aerodynamic drag mechanism of bluff bodies and road vehicles", Plenum Press, N.Y, 1978
- Calvert N.G "Wind Power Principles", Charles Griffin & Co London, 1979.
- IS Code 875 Part 3 – for wind loads.

**OUTCOMES:**

Students will be able to

- Understand the wind environment in the atmosphere and the structure of the atmospheric boundary layer

- Gain knowledge on applications of Aerodynamics in stability of road vehicles, Drag reduction techniques.
- Understand wind turbine physics, various types of wind turbines and design constraints
- To apply the knowledge of Aerodynamics to building designs and learn about building codes.
- Understand the practical problems involved flow induced vibrations and wind loads
- Understand air pollutant dispersion influenced by natural winds.

|   |   | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **AECX06** | **THEORY OF ELASTICITY** | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- To introduce the theoretical concepts of material behavior with elastic properties.

**MODULE  I          ANALYSIS OF STRESS                                    7**

Definitions, stress tensors, notations and sign conventions for stress, equations of equilibrium, principle stresses in three dimensions, Saint Venant's principle, problems.

**MODULE  II          ANALYSIS OF STRAIN                                    7**

Strain – displacement relations, stress – strain relations, Lame's constant – cubical dilation, compressibility of material, bulk modulus, shear modulus, compatibility equations for stresses and strains, problems.

**MODULE  III          PLANE STRESS AND PLANE STRAIN PROBLEMS          9**

Airy's stress function, bi-harmonic equations, polynomial solutions, simple two-dimensional problems in cartesian coordinates like bending of cantilever and simply supported beams, etc.

**MODULE  IV          POLAR COORDINATES                                    7**

Equations of equilibrium, strain displacement relations, stress-strain relations, problems axi-symmetric Equilibrium and strain displacement relations.

**MODULE  V          STRESS CONCENTRATION                                7**

Stress due to concentrated load, stress distribution near concentrated load acting on beam, Kirsch and Boussinesque problems.

**MODULE  VI          TORSION                                                8**

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, the semi-inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections.

**Total Hours – 45**

**TEXT BOOKS:**

- Timoshenko, S., and Goodie, T.N., "Theory of Elasticity", Tata McGraw Hill, 2010.
- Ansel C. Ugural and Fender S. K., "Advanced strength and applied elasticity", 4th Edition, prentice hall, 2003.

**REFERENCES:**

- Martin H Sadd, "Elasticity: Theory, Applications and Numerics" Elsevier, 2005.
- T H G Megson, " Aircraft Structures for Engineering Students" 3rd Edition, Butterworth-Heinemann, 2003
- Egor P PoPov, Mechanics of Material, 2nd Edition, Pearson, 2015
- Atkins, R.J., & Fox, N., "An Introduction to the theory of Elasticity", Dover publication, 2005.

**OUTCOMES:**

Students will be able to

- Determine the components of stress and strain tensors.
- Apply the conditions of compatibility and equations of equilibrium.
- Express the mechanical characteristics of materials, constitutive equations and generalized Hook law.
- Use the equilibrium equations stated by the displacements (Lame equations) and compatibility conditions stated by stresses (Beltrami-Michell equations).
- Determine the boundary restrictions in calculations.
- Solve the basic problems of the theory of elasticity by using Airy function expressed as inharmonic function.

| | | **L** | **T** | **P** | **C** |
| --- | --- | --- | --- | --- | --- |

**AECX07**        **FATIGUE AND FRACTURE MECHANICS**

        **3    0    0    3**

**OBJECTIVES:**

- To introduce the mechanisms involved in failure of components due to fatigue and fracture

## MODULE  I        PLANE ELASTICITY        6

In plane and out of plane problems, Airy's Stress Function, Plates with circular and elliptical hole.

## MODULE  II        PHYSICAL ASPECTS OF FATIGUE        5

Phase in fatigue life, Crack initiation, Crack growth , Final Fracture, Dislocations, Fatigue fracture surfaces.

## MODULE  III        FATIGUE OF STRUCTURES        10

S.N. curves , Endurance limits, Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams, Notches and stress concentrations, Neuber's stress concentration factors, Plastic stress concentration factors, Notched S.N. curves.

## MODULE  IV        STATISTICAL ASPECTS OF FATIGUE BEHAVIOR        8

Low cycle and high cycle fatigue, Coffin - Manson's relation, Transition life, cyclic strain hardening and softening, Analysis of load histories, Cycle counting techniques , Cumulative damage, Miner's theory , Other theories.

## MODULE  V        FRACTURE MECHANICS        10

Strength of cracked bodies, Potential energy and surface energy, Griffith's theory, Irwin - Orwin extension of Griffith's theory to ductile materials, stress analysis of cracked bodies, Effect of thickness on fracture toughness, stress intensity factors for typical geometries.

## MODULE  VI        FATIGUE AND FRACTURE DESIGN AND TESTING        6

SafelifeandFail-safedesignphilosophies,ImportanceofFractureMechanics inaerospacestructures-Applicationtocompositematerialsandstructures.

**Total Hours –45**

**TEXT BOOKS:**

- Prashant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill, New Delhi, India,2009.
- BarriosW, Ripley, E. L., "Fatigue of Aircraft Structure", Pegamon press. Oxford, 1983.

**REFERENCES:**

- K.R. Y. Simha, "Fracture Mechanics for Modern Engineering Design", Universities Press(India)Limited,2001.
- D. Broek, "Elementary Engineering Fracture Mechanics", Kluwer Academic Publishers, Dordrecht, 1986.
- T.L. Anderson, "Fracture Mechanics-Fundamentals and Applications",3rd Edition, Taylor and Francis Group, 2005.
- Knott, J.F., "Fundamentals of Fracture Mechanics", Butterworth & Co., (Publishers)  Ltd.,  London, 1983.

**OUTCOMES:**

Students will be able to

- Solve the plane elasticity problems related to fatigue and fracture
- Identify the different phases in fatigue life of structures.
- Evaluate the fatigue life of structures theoretically.
- Evaluate the strength of cracked bodies.
- Analyze the stress of the cracked bodies and their intensities for different geometries.
- Apply the theories for predicting the fracture life of aerospace structures and composite materials.

| | L | T | P | C |
|---|---|---|---|---|

**AECX13**       **AIRFRAME REPAIR AND MAINTENANCE**

**3   0   0   3**

**OBJECTIVES:**

- To make the students to understand the Airframe components and the tools used to maintain the components.
- Defect investigation, methods to carry out investigation and the detailed maintenance and practice procedures.
- To make student understand the basic safety practices to be followed in Aircraft maintenance.

**MODULE I       WELDING IN AIRCRAFT STRUCTURAL COMPONENTS     7**

Equipments used in welding shop and their maintenance - ensuring quality welds - welding jigs and fixtures - soldering and brazing- sheet metal repair and maintenance - selection of materials; repair schemes - fabrication of replacement patches - tools: power/hand - repair techniques - close tolerance fasteners -  sealing compounds - forming/shaping.

**MODULE II       PLASTICS IN AIRCRAFT     7**

Review of types of plastics used in airplanes -maintenance and repair of plastic components - repair of cracks, holes etc.- various repairs schemes - scopes.

**MODULE III       ADVANCED COMPOSITES IN AIRCRAFT     7**

Cleaning of fiber reinforced plastic (FRP) materials prior to repair; break test; repair schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; tools/equipment; vacuum-bag process. special precautions - Autoclaves.

**MODULE IV       AIRCRAFT JACKING, ASSEMBLY AND RIGGING     9**

Airplane jacking and weighing and C.G. location. Balancing of control surfaces - inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

**MODULE V       REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM     9**

Trouble shooting and maintenance practices - service and inspection – inspection and maintenance of landing gear systems. - Inspection and maintenance of conditioning and pressurization system, water and waste system. installation and maintenance of instruments - handling - testing - inspection. inspection and maintenance of auxiliary systems - fire protection systems - ice protection system - rain removal system -

position and warning system - auxiliary power units (APUs).

**MODULE  VI**          **SAFETY PRACTICES**          **6**

Hazardous materials storage and handling, aircraft furnishing practices -equipments. Trouble shooting. Theory and practices.

**Total Hours –45**

**TEXT BOOKS:**

- Kroes, Watkins, Delp, "Aircraft Maintenance and Repair ", McGraw Hill, New York, 1992.

**REFERENCES:**

- Larry Reithmeir, "Aircraft Repair Manual ", Palamar Books, Marquette, 1992.
- Brimm D.J. Bogges H.E., " Aircraft Maintenance ", Pitman Publishing corp., New York, 1940

**OUTCOMES:**

Students will be able to

- Understand the need for periodical maintenance to ensure flight safety
- Gain knowledge of the standard maintenance practices for aircraft systems.
- Troubleshoot the hydraulic and pneumatic system of the aircraft.
- To undergo inspection of various types of materials used in airframe and repair it.
- Know the basic safety measures to be carried out during the airframe maintenance.
- To repair the composite and plastic components of the aircraft.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **AECX 14** | **BEHAVIOR OF MATERIALS AT HIGH TEMPERATURES** | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To introduce the effect of high temperatures on the behavior of materials and material properties.

**MODULE I        CREEP                                                12**

Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate, Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

**MODULE II        FRACTURE                                            9**

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, and ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

**MODULE III        OXIDATION                                          5**

Oxidation, Pilling, Bed worth ratio, kinetic laws of oxidation, defect structure and control of oxidation by alloy additions.

**MODULE IV        CORROSION                                          7**

Hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods to combat hot corrosion.

**MODULE V        SUPERALLOYS                                        7**

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

**MODULE VI        ABLATION                                          5**

Ablative materials, Applications, Advantages and Disadvantages, Ablative heat

transfer–case studies.

**Total Hours –45**

**TEXT BOOKS:**

- HertzbergR. W., "Deformation and Fracture Mechanics of Engineering materials",$4^{th}$ Edition,JohnWiley,USA,1996.
- Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.

**REFERENCES:**

- Bressers.J., "Creepand Fatigue in High Temperature Alloys", Applied Science, 1981.
- Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985.
- BoyleJ.T, SpencerJ,"StressAnalysisforCreep",Butterworth's,UK,1983.
- McLeanD., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.
- Mars G. Fontana., "Corrosion Engineering", Mc Graw Hill, India; 3 edition 2008.

**OUTCOMES:**

Students will be able to

- Identify factors influencing functional life of components at elevated temperatures.
- Evaluate fracture mechanism types and Interpret data from fracture maps of different alloys.
- Apply laws of oxidation and control of oxidation by alloy additions.
- Gain knowledge of hot gas corrosion methods and suggest methods to combat hot corrosion.
- Gain knowledge of the role of super alloys in high temperature applications.
- Comprehend ablative heat transfer phenomenon and suggest suitable ablative materials for space applications.

| | L | T | P | C |
|---|---|---|---|---|
| **AECX15**    **HEAT TRANSFER** | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- To introduce the heat transfer principles and the behavior of thermal systems.
- To expose students to the governing differential and algebraic equations associated with thermal systems.
- To expose students to the heat transfer applications in Aerospace industries

**MODULE  I        HEAT CONDUCTION                                          10**

conduction–convection–radiation, Steady and unsteady state heat conduction insolids-effect of variation of thermal conductivity on heat transfer insolids, conduction with heat generation, heat transfer problems in infinite and semi infinite solids, critical radius of insulation- extended surfaces, application of numerical techniques..

**MODULE  II       FREE CONVECTION                                           8**

Basic equations, boundary layer concept, dimensional analysis, Laminar boundary layer equation, free convection in atmosphere free convection on a vertical flat plate, integral method, empirical relation in free convection–external flows.

**MODULE  III      FORCED CONVECTION                                         7**

Forced convection, laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations-numerical techniques in problem solving.

**MODULE  IV      RADIATIVE HEAT TRANSFER                                    7**

Concept of black body-Intensity of radiation-Laws of black body radiation- radiation from non black surfaces, real surfaces, radiation between surfaces, radiation shape factors, radiation shields.

**MODULE  V       HEAT EXCHANGERS                                           6**

Types-overallheattransfercoefficient-LMTD-NTUmethodofheatExchanger     analysis, Thin fin Analysis.

**MODULE  VI      HEAT TRANSFER PROBLEMS IN AEROSPACE              7
                  ENGINEERING**

Heat transfer problems in gas turbine combustion chambers-rocket thrust chambers-aerodynamic heating-ablative heat transfer.

**Total Hours –45**

**TEXT BOOKS:**

- YunusA.Cengel.,"HeatTransfer–Apracticalapproach",2nd Edition, Tata McGraw-Hill,2002.

- Incropera.F.P.andDewitt.D.P.,"IntroductiontoHeatTransfer",JohnWiley andSons,2002..

**REFERENCES:**

- Lienhard, J.H.,"AHeatTransferTextBook",Doverpublication,2011.

- Holman, J.P."HeatTransfer",6th Edition, McGraw-Hill Book Co., Inc., New York,1991.

**OUTCOMES:**

Students will be able to

- Differentiate the different modes of heat transfer in various media and solve the simple cases of conduction, convection and radiation using their governing equations.
- Differentiate forced convection from free convection and solve the simple cases of forced convection using analytical as well as numerical techniques.
- Use the concept of black body to solve simple ideal cases of radiation using its governing equations.
- Apply the laws of heat transfer in the cases of heat exchangers of standard types.
- Apply the heat transfer concept and explain the problems involving heat transfer in the aerospace vehicles.

|  |  | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **AECX 16** | **ADVANCED PROPULSION** | | | | |
|  |  | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- List and explain the characteristics and performance of different advanced rocket propulsion systems.
- Carry out review of advanced propulsion schemes to meet specified requirements.

**MODULE  I          ADVANCED CHEMICAL PROPULSION SYSTEM          7**

High Performance Chemical Propulsion Systems, Tripropellants, Metalized Propellants, Free Radical Propulsion, Hybrid Rocket Propulsion Systems. TBCC RBCC Concepts.

**MODULE  II          RAMJET ENGINES AND AIR AUGMENTED ROCKETS          7**

Ideal and Actual Ramjet engine cycle analysis - Preliminary performance calculations – Diffuser design and hypersonic inlets – combustor and nozzle design – Air augmented rockets – Engines with supersonic combustion.

**MODULE  III          SCRAMJET PROPULSION          8**

Introduction to Hypersonic Propulsion, Developments in High Speed Vehicle Propulsion System, Aerodynamic Shape of a Hypersonic Vehicle with  an Air Breathing Engine, Dual-mode Combustion System. Scramjet propulsion System, Scramjet Inlets, Supersonic Combustion, Supersonic Flow Combustors, Scramjet Performance.

**MODULE  IV          NUCLEAR PROPULSION SYSTEMS          7**

Types of Nuclear Propulsion Systems, Heat Transfer Nuclear Rockets, Gaseous Core Nuclear Rockets, Pure Nuclear Propulsion System; Operation, Performance and Application Areas, Nuclear Hazards, Nuclear Power Generation in Space. Nerva Nuclear engine for rocket vehicle applications.

**MODULE  V          ELECTRIC PROPULSION SYSTEMS          8**

Overview of Application Areas, Ideal Flight Performance, Electro-thermal Thrusters – Resisto jets and Arc jets. Pure Electric Thrusters – Electrostatic, Electro Magnetic and Hall- effect Thrusters, Optimum Flight Performance, Electric Power Generation in Space. Magneto Plasma dynamic thruster, Pulsed Plasma Thrusters and Ion thrusters.

**MODULE  VI          MICRO-PROPULSION SYSTEM          8**

Recent Micro Spacecraft Developments, Micro-propulsion Options, Primary Set of Micro-propulsion Requirement, Chemical Propulsion Options, Review of Electric Propulsion Technologies for Micro and Nano- satellites  Emerging Technologies: MEMS and MEMS- Hybrid Propulsion System.

**Total Hours –45**

**TEXT BOOKS:**

- MartinTajmar,"AdvancespacePropulsionsystems",1st Edition, Springer; Softcoverreprintoftheoriginal,2003.

- WilliamH.HeiserandDavidT.Pratt,"HypersonicAirbreathingpropulsion", AIAAEducationSeries,2001.

- Corin Segal, "The scramjet engine–Processes and characteristics", CambridgeUniversityPress,2009.

**REFERENCES:**
1. Sutton, G.P.,  "Rocket Propulsion Elements", 8th Edition, John Wiley & Sons Inc., New York, 2010

2. Roy Bhaskar, "Aircraft Propulsion", Elsevier (India), 2008

3. Gordon, C.O., "Aerothermodynamics of Gas Turbine and Rocket Propulsion", 3rd Edition, AIAA Education Series, New York, 1998.

4. Paul, Z, Developments in High Speed Vehicle Propulsion System, Progress in Astronautics & Aeronautics, AIAA, Vol.165.

5. Paul, Z, Scramjet Propulsion, Progress in Astronautics & Aeronautics, AIAA, Vol. 189.

6. Paul, Z, Micro-propulsion for Small Spacecraft, Progress in Astronautics & Aeronautics, AIAA, Vol. 187.

**OUTCOMES:**

Students will able to

- Explain the different features and capabilities of advanced chemical rocket propulsion systems.
- Calculate the Performance parameters of Ramjet.
- Acquire the knowledge of hypersonic propulsion system and their design issues.
- Identify different Nuclear PropulsionSystem types and gain knowledge about

their combustion phenomena.

- Acquire the knowledge of various Electric Propulsion System thrust generation techniques.
- Explain the Requirement of Micro-propulsion and their features

| **AECX 19** | **AIR TRAFFIC CONTROL AND** | **L** | **T** | **P** | **C** |
| | **AERODROME DESIGN** | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- To introduce the various flight rules and airspace used in Air Traffic Control.
- To gain the basic knowledge of Aircraft separation in space and procedure for scheduling the flight plan.
- To understand RADAR based separation and flight information services using RADAR.
- To know the physical characteristics and classification of runway.
- To impart the knowledge of navigation and landing aid used in runway.

**MODULE  I          AIR TRAFFIC CONTROL - INTRODUCTION          8**

Objectives of ATS - parts of ATC service - scope and provision of ATCs - VFR & IFR operations - classification of ATS air spaces - varies kinds of separation - altimeter setting procedures - establishment, designation and identification of units providing ATS - division of responsibility of control.

**MODULE  II         AIR TRAFFIC SERVICES AND SEPARATION          10**
**                   PROCEDURES**

Area control service, assignment of cruising levels minimum flight altitude ATS routes and significant points - RNAV and RNP - vertical, lateral and longitudinal separations based on time / distance -ATC clearances - flight plans - position report.

**MODULE  III        RADAR IN AIRCRAFT SEPARATION AND          6**
**                   IDENTIFICATION**

Radar service, basic radar terminology - identification procedures using primary / secondary radar - performance checks use of radar in area and approach control services.

**MODULE  IV         RADAR IN EMERGENCY AND COORDINATION          5**
**                   PROCEDURES**

Glide path assurance control and co-ordination between radar / non radar control - emergencies - flight information and advisory service - alerting service- co-ordination and emergency procedures - rules of the air.

**MODULE  V          PHYSICAL CHARACTERISTICS OF RUNWAY AND          8**
**                   OBSTACLE RESTRICTION**

Aerodrome data - basic terminology - aerodrome reference code - aerodrome reference point - aerodrome elevation - aerodrome reference temperature - instrument runway, physical characteristics; length of primary / secondary runway - width of runways - minimum distance between parallel runways etc. - obstacles restriction.

## MODULE VI        VISUAL AIDS FOR NAVIGATION AND LANDING        8

Visual aids for navigation wind direction indicator - landing direction indicator location and characteristics of signal area - markings, general requirements various markings - lights, general requirements - aerodrome beacon, identification beacon - simple approach lighting system and various lighting systems - VASI & PAPI - visual aids for denoting obstacles; object to be marked and lighter - emergency and other services.

**Total Hours –45**

### TEXT BOOKS:

- "AIP (India) Vol. I & II", The English Book Store, 17-1, Connaught Circus, New Delhi.

### REFERENCES:

- "Aircraft Manual (India) Volume I", latest Edition - The English Book Store, 171, Connaught Circus, New Delhi.
- "PANS - RAC - ICAO DOC 4444", Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi..

### OUTCOMES:

Students will be able to

- Understand various airspace and flight rules followed in Air Traffic Services
- To know the various types of separation followed in the airspace for safe operation of air traffic.
- To know the use of RADAR in separation and co-ordination of various Air traffic services
- To plan the layout of runway and aerodrome construction procedures.
- To understand usage of various navigation aids for aircraft landing.
- To understand the obstacle and obstacle clearance near the airfield.

| | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **AECX20** | **AVIATION RULES AND REGULATION** | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

• To introduce the civil aviation regulations followed by Directorate General of Civil Aviation.

**MODULE  I**   **C.A.R SERIES 'A' - PROCEDURE FOR CIVIL AIR**   **8**
**WORTHINESS QUIRMENTS AND RESPONSIBILITY**
**OPERATORS VIS-À-VIS AIR WORTHINESS**
**DIRECTORATE**

Responsibilities of operators / owners; procedure of CAR issue, amendments etc., objectives and targets of airworthiness directorate; airworthiness regulations and safety oversight of engineering activities of operators. C.A.R. SERIES 'B' - ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, CDL: Deficiency list (MEL & CDL); preparation and use of cockpit check list and emergency list.

**MODULE  II**   **C.A.R. SERIES 'C' - DEFECT RECORDING,**   **7**
**MONITORING, INVESTIGATION AND REPORTING**

Defect recording, reporting, investigation, rectification and analysis; flight report;reporting and rectification of defects observed on aircraft; analytical study of in-fight readings & recordings; maintenance control by reliability method. C.A.R. SERIES 'D' - AND AIRCRAFT MAINTENANCE PROGRAMMES: reliability programme (engines); aircraft maintenance programme & their approval; on condition maintenance of reciprocating engines; TBO - revision programme; maintenance of fuel and oil uplift and consumption records - light aircraft engines; fixing routine maintenance Total Hours and component tbos - initial & revisions.

**MODULE  III**   **C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS:**   **10**
Approval of organizations in categories A, B, C, D, E, F, & G; requirements of

infrastructure at stations other than parent base. C.A.R. SERIES 'F' - AIR WORTHINESS AND CONTINUED AIR WORTHINESS: Procedure relating to registration of aircraft; procedure for issue / revalidation of type certificate of aircraft and its engines / propeller; issue / revalidation of certificate of airworthiness; requirements for renewal of certificate of airworthiness.

**MODULE IV          C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE          8**
**                   ENGINEE LICENSING**

Issue of AME licence, its classification and experience requirements, complete Series 'L'. C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS: mandatory modifications / inspections.

**MODULE V          C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT          6**
Flight testing of (series) aircraft for issue of C of A; fight testing of aircraft for which C or A had been previously issued. C.A.R. SERIES 'X' – MISCELLANEOUS

**REQUIREMENTS:** Registration Markings of aircraft; weight and balancecontrol of an aircraft; provision of first aid kits & physician's kit in an aircraft; use furnishing materials in an aircraft; concessions

**MODULE VI          AIRCRAFT DOCUMENTS PROCEDURE AND          6**
**                   PERMITS**
Aircraft log books; document to be carried on board on indian registered aircraft; procedure for issue of taxy permit; procedure for issue of type approval of aircraft components and equipment including instruments.

**Total Hours –45**

**REFERENCES:**

1.    " Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2.    " Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ",

Published by DGCA, The English Book Store, 17-1, Connaught Circus,New Delhi.

3.  " Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA.
4.  " Advisory Circulars ", form DGCA. as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Cod e of Conduct

**OUTCOMES:**

Students will be able to

- Understand the maintenance requirement for airworthiness of aircraft and systems.
- Gain knowledge of the procedure followed for airworthiness certificate.

## 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 help students to acquire the properties and applications of conducting and semiconducting materials.
- To familiarize students with basic ideas about the properties of dielectric and magnetic materials and their applications.
- To familiarize students with basic knowledge of nanomaterials and its electrical, electronic, mechanical and magnetic properties.
- 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 concentration, 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 Ferroelectric Random Access Memory (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, graphene - nanocomposites – applications of nano materials.

## 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.

**L – 30; P – 30; TOTAL HOURS – 60**

## REFERENCES:

1. William D. Callister, "Material Science and Engineering", Wiley Publications, 2006.
2. Raghavan, V., "Materials Science and Engineering", 5$^{th}$ 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 , 2$^{nd}$ 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

- apply the concepts of conducting and semiconducting materials for solid state devices.
- comprehend the significance of properties of dielectric magnetic materials and derive these properties from synthesized materials.
- differentiate between the properties of the nanomaterials compared to bulk  materials.
- 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 of 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 and available energy – temperature – entropy diagram for Carnot's cycle - Third Law of thermodynamics (qualitative).

## 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 good conductor-Forbe's method

5. Determination of thermal conductivity of a bad conductor-Lee's disc method

**L – 30; P – 30; TOTAL HOURS – 60**

**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.
- apply the knowledge 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 synthesis and 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, grapheme - 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.

## 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.

**L – 30; P – 30; TOTAL HOURS – 60**

**REFERENCES:**

1. Charles P.Poole and Frank J. Owens, "Introduction to nanotechnology", Wiley (India), 2009.

2. Cao. G., "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2004.

3. Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., "Handbook of NanoScience Engineering and Technology", CRC Press, 2002.

4. Pradeep. T., "Textbook of Nanoscience and Nanotechnology", McGraw Hill Education (India) Private Limited, New York, 2012.

5. Chris Mack, "Fundamental Principles of Optical Lithography: The Science of Microfabrication", John Wiley & Sons, 2008.

6. Bandyopadhyay A.K., "Nano Materials", New Age International Publishers, New Delhi, 2008.

**OUTCOMES:**

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

- understand the importance and basic concepts of the nanomaterials.
- comprehend the imaging techniques for nanomaterials.
- illustrate the various nanofabrication techniques.
- complement the knowledge acquired in the theory class and correlate the results for applications.

**PHCX 04**     **LASERS AND THEIR APPLICATIONS**     L     T     P     C

                                                      2     0     2     3

**OBJECTIVES:**

- To recognize the fundamentals of laser and its characteristics.
- To comprehend and compare the different laser systems.
- To apply lasers in metrology and material processing.
- To understand the working of laser instrumentation.
- To correlate the experimental results for applications.

## MODULE  I          LASER THEORY                                    8

Spontaneous and stimulated emission - Population inversion – Einstein's A & B coefficients - Threshold condition – super-radiance Laser – Three level and four level laser systems -conditions for CW and pulsed laser action. Q-Switching - experimental methods - cavity dumping - Mode locking - experimental methods - Spatial and Temporal coherence.

## MODULE  II         DIFFERENT LASER SYSTEMS                         8

Laser systems – General description - Laser structure - excitation mechanism - Different laser systems- He-Ne laser, Carbon-dioxide laser - Excimer laser – Free electron laser-  Alexandrite laser - Ti-Sapphire laser – Semiconductor diode laser - Diode pumped solid state laser - Pulsed-CW dye laser- Fibre laser.

## MODULE  III        METROLOGICAL  AND  MATERIAL  PROCESSING        8
##                    APPLICATIONS

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                          7

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.

**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.

**L – 30; P – 30; TOTAL HOURS – 60**

**REFERENCES:**

1. William T. Silfvast, "Laser Fundamentals", Cambridge University Press, 2009.
2. Ghatak. A. & Thyagarajan. K. "Optical Electronics", Cambridge University, 1994.
3. Laud.B.B., "Laser and Non-Linear Optics", Second Edition, New Age International (p) Limited Publishers, 2011.
4. Nambiar. K.R., "Lasers Principle, Types and Applications", New Age International (p) Ltd, 2004.
5. Wilson. J. & Hawkes. J.F.B., "Opto Electronics - An Introduction", Prentice Hall, 1992.
6. William M.Steen, "Laser Material Processing", Springer-Verlag, Berlin, Third Edn., 2005.

**OUTCOMES:**

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 basic understanding of 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          10

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          6

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                                    7

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.

## 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 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.

**L – 30; P – 30; TOTAL HOURS – 60**

## 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 concepts and applications of Dielectric and 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.

## 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.

**L – 30; P – 30; TOTAL HOURS – 60**

**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.

## MODULE 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.

## 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.

**L – 30; P – 30; TOTAL HOURS – 60**

## 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.
- apply the fundamental concept of photo elasticity 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.**

**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.
   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.

**L – 30; P – 30; TOTAL HOURS – 60**

**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.
- know 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.

## 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.

**L – 30; P – 30; TOTAL HOURS – 60**

## 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)**

| **CHCX01** | **ANALYTICAL INSTRUMENTATION** | **L** | **T** | **P** | **C** |
| | | **2** | **0** | **2** | **3** |

**OBJECTIVES:**

To make the student conversant with

- principles, instrumentation and applications of different electroanalytical techniques
- different chromatographic techniques
- principles, instrumentation and applications of various types of absorption and emission spectroscopy
- different thermal analytical methods and their applications

**MODULE  I        ELECTROANALYTICAL TECHNIQUES        7**

Principle and applications: conductometric titrations – potentiometrIc titrations, ion-selective electrodes and pH-metry – coulometry – voltammetry - polarography, amperometric titrations.

**MODULE  II        CHROMATOGRAPHY        8**

Basic concepts of chromatography – paper chromatography – column chromatography – thin layer chromatography – gas chromatography – high performance liquid chromatography – gel permeation chromatography.

**MODULE  III        SPECTROSCOPY        8**

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, 8$^{th}$ 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, 7$^{th}$ Edition, CBS Publication, New Delhi Reprint, 2004.

3. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5$^{th}$ Edition, Prentice Hall, London, 2008.

4. Christian G.D., Analytical Chemistry, 6$^{th}$ Edition, John Wiley, Singapore, 2003.

5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5$^{th}$ Edition, Blackwell Publication, London, 2000.

6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

**OUTCOMES:**

The student will be able to

- state the principle and applications of various electro-analytical techniques
- identify the right separation method for a given sample using different chromatographic techniques
- explain the principle, instrumentation & applications of various spectroscopic methods and also to interpret the data
- elaborate the principle, instrumentation and applications of various thermal analytical techniques and interpret the data.

| CHCX02 | CORROSION AND ITS CONTROL | L | T | P | C |
|--------|---------------------------|---|---|---|---|
|        |                           | 2 | 0 | 2 | 3 |

**OBJECTIVES:**

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        8
                   APPLICATIONS**

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 | 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, 2$^{nd}$ 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, 47$^{th}$ 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    8
POLYMERS

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, 3$^{rd}$ Edition, John Wiley and Sons, New York, 1994.
2. George Odian, Principles of Polymerisation, 3$^{rd}$ Edition, McGraw Hill Book Company, New York, 1991.
3. Michael L. Berins, Plastics Engineering Hand Book, 5$^{th}$ 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, 2$^{nd}$ 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**

**IVSemester)**

| MACX 01 | DISCRETE MATHEMATICS AND GRAPH THEORY | L | T | P | C |
|---------|---------|---|---|---|---|
| | | 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          7+3**
**PROBABILITY DISTRIBUTION FUNCTIONS**

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**        **7+3**
                        **Distribution functions**

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**        **7+3**
                                **ORDINARY DIFFERENTIAL EQUATIONS**

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**        **8+2**
                                **ORDINARY DIFFERENTIAL EQUATIONS**

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",

4$^{th}$ edition, Thomson learning, 2007.

2. Frederick. S. Hiller and Gerald J Lieberman, "Operations Research Concepts and Cases", 8$^{th}$ 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", 2$^{nd}$ edition, John Wiley & Sons, New York, 1992.

4. Robertazzi. T.G., "Computer networks and systems-Queuing theory and performance evaluation", 3$^{rd}$ 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       8
                       INFERENCES**

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**    **L   T   P   C**
                         **AND DIFFERENTIAL EQUATIONS**      **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 1/3rules

**MODULE III**      **NUMERICAL SOLUTIONS OF ORDINARY**      **8**
                   **DIFFERENTIAL**                **EQUATIONS**

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**      **8**
                         **DIFFERENTIAL EQUATIONS**

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 |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

## 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
                                                         3   0   0   3

**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, 30$^{th}$ Reprint 2011
2. Kenneth H.Rosen, "Discrete Mathematics and its Applications", 7$^{th}$ 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)

**SSCXO1**       **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.

| SSCXO2 | 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.

| SSCXO3 | 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)**

| SSCXO4 | ECONOMICS OF SUSTAINABLE | L | T | P | C |
|--------|--------------------------|---|---|---|---|
|        | DEVELOPMENT              | 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         8**
**                    SUSTAINABILITY**

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         7**
**                    DEVELOPMENT**

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.

**SSCXO5**   **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.

**SSCXO6**                    **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 give an exposure to various environmental hazards and disasters: and various concepts and principles to manage disaster.
- To give exposure to various environmental policies & programs in India for disaster management

**MODULE I          ENVIRONMENTAL HAZARDS                              7**

Environmental hazards, Environmental Disasters and Environmental stress-Meaning and concepts. Vulnerability and disaster preparedness.

**MODULE II        NATURAL DISASTERS                                   7**

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire.

**MODULE III       MAN-MADE DISASTERS                                 7**

Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion

**MODULE IV        DISASTER MANAGEMENT                                8**

Emerging approaches in Disaster Management- Preparing hazard zonation maps, Predictability / forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication. Disaster resistant house construction, Population reduction in vulnerable areas, Awareness - Rescue training for search & operation at national & regional level - Immediate relief, Assessment surveys, Political, Administrative, Social, Economic, Environmental Aspects.

**MODULE V         NATURAL DISASTER REDUCTION &                       8**
**                  MANAGEMENT**

Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards

**MODULE VI     ENVIRONMENTAL POLICIES & PROGRAMMES IN     8 INDIA**

Regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.

**L – 45; Total Hours –45**

**REFERENCES:**

1. Satender, "Disaster Management in Hills", Concept Publishing Co., New Delhi, 2003.
2. Singh, R.B. (Ed.), "Environmental Geography", Heritage Publishers, New Delhi,1990.
3. Savinder Singh, "Environmental Geography", Prayag Pustak Bhawan,1997.
4. Kates, B.I. and White, G.F., "The Environment as Hazards", Oxford University Press, New York, 1978.
5. Gupta, H.K., (Ed), "Disaster Management", University Press, India, 2003.
6. Singh, R.B.,"Space Technology for Disaster Mitigation in India (INCED)", University of Tokyo, 1994.
7. Bhandani, R.K., "An overview on Natural & Manmade Disaster & their Reduction", IIPA Publication, CSIR, New Delhi, 1994.
8. Gupta, M.C., "Manuals on Natural Disaster management in India", National Centre for Disaster Management, IIPA Publication, New Delhi, 2001.

**OUTCOMES:**

At the end of the course, the students will

* achieve sufficient knowledge on the disaster prevention strategy, early warning system, disaster preparedness, response and human resource development.
* be familiar with the National Policy on Disaster Management.

**GECX102**          **TOTAL QUALITY MANAGEMENT**     **L   T   P   C**
                                                      **3   0   0   3**

**OBJECTIVES:**

- To understand the various principles, practices of TQM to achieve quality.
- To get acquainted with the various statistical tools and approaches for quality control and continuous improvement.
- To get aware of the importance of ISO and Quality Systems.

**MODULE  I          INTRODUCTION                                      8**

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

**MODULE  II         TQM PRINCIPLES                                    7**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits.

**MODULE  III        TQM IMPROVEMENT PROCESS                           8**

Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

**MODULE  IV         STATISTICAL PROCESS CONTROL (SPC)                 8**

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

**MODULE V       TQM TOOLS                                    7**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

**MODULE VI       QUALITY SYSTEMS                            7**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System– Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits

**L – 45; Total Hours –45**

**TEXT BOOKS:**

1. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education, Inc. 2003.

**REFERENCES:**

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

**OUTCOMES:**

The student should be able to

• apply the various statistical tools and approaches for Quality control.

• achieve continuous process improvement through TQM.

| GECX103 | ENERGY STUDIES | L | T | P | C |
|---------|---------------|---|---|---|---|
|         |               | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.
- To understand the basic need for energy conservation and waste heat recovery.
- To learn the important aspects of energy audit and management.
- To get acquainted with the global environmental issues and carbon credits.

**MODULE  I          GLOBAL AND NATIONAL ENERGY SCENARIO          7**

Role of energy in economic development, various energy resources - overall energy demand and availability- Energy consumption in various sectors and its changing pattern - Exponential increase in energy consumption and projected future demands. Need for renewable energy.

**MODULE  II         SOLAR ENERGY          8**

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

**MODULE  III        OTHER RENEWABLE ENERGY SOURCES          8**

Power from wind – wind turbine working and types, solar thermal power plants– low medium and high power generation, power from wave , tidal, geothermal sources, OTEC system. MHD power plants – working, types, merits and demerits. Energy from biomass.

**MODULE  IV        COGENERATION, WASTE HEAT RECOVERY AND          8**
**                          COMBINED CYCLE PLANTS**

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.

**L – 45; Total Hours –45**

**TEXT BOOKS:**

1.  S.S. Rao and B.B. Parulekar, "Energy Technology", 3$^{rd}$ Edition, Khanna Publishers, New Delhi, 2011.

2.  O. Callaghn. P.W., "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.


**REFERENCES:**

1.  G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.

2.  Archie, W Culp. "Principles of Energy Conservation", McGraw Hill, 1991.

3.  D Patrick and S W Fardo, "Energy Management and Conservation", PHI,1990

4.  P. O'Callaghan: "Energy Management", McGraw - Hill Book Company, 1993.

5.  Kenney, W. F., "Energy Conservation in Process Industries", Academic Press, 1983.

**OUTCOMES:**

The student should be able to

•   Realize the global and national energy status and need to switch over to renewable energy technology.

•   Energy audit and suggest methodologies for energy savings.

•   Utilize the available resources in an optimal way.

•   Concern about the global environmental issues & promote carbon credits.

**GECX104**     **ROBOTICS**     **L  T  P  C**
                                   **3  0  0  3**

**OBJECTIVES:**

To learn about the robots, various components, of Robots, programming and their applications.

**MODULE  I**                                                    **8**

Definition- Need - Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence- basic parts - functions – specifications. of robot, degrees of freedoms, end effectors – types, selection

**MODULE  II        ROBOT DRIVES AND CONTROL**                   **8**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

**MODULE  III        ROBOT SENSORS**                             **8**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

**MODULE  IV        ROBOT PROGRAMMING & AI TECHNIQUES**          **7**

Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

**MODULE  V        ROBOTIC WORK CELLS AND APPLICATIONS OF**      **7**
                    **ROBOTS**

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots – Application of robots in surgery, Manufacturing industries, space and underwater.

## MODULE VI ROBOT KINEMATICS AND DYNAMICS 7

Forward and inverse Kinematic equations, Denvit – Hartenbers representations Fundamental problems with D-H representation, differential motion and velocity

of frames - Dynamic equations for sing, double and multiple DOF robots – static force analysis of robots.

**L – 45; Total Hours –45**

### REFERENCES:

1. Yoram Koren," Robotics for Engineers", Mc Graw-Hill, 1987.
2. Kozyrey, Yu, "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R. "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", Mc Graw- Hill, Int. 1986.
6. Timothy Jordanides et al,"Expert Systems and Robotics", Springer – Verlag, New York, May 1991.

### OUTCOMES:

Students would be able to
• Understand about the robots, its various components.
• Design Robots for industrial applications.
• Do programming for robots and apply them in real time applications.

**GECX105**  **TRANSPORT MANAGEMENT**  L  T  P  C

3  0  0  3

**OBJECTIVES:**

- To understand the transport fleet and their related activities for minimizing operational cost.
- To understand the need of maintenance and its importance.
- To understand the functions and applications of various types of transport system.

## MODULE  I  INTRODUCTION  7

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

## MODULE  II  ORGANISATION AND MANAGEMENT  7

Forms of Ownership – principle of Transport Management – Staff administration – Recruitment and Training – welfare – health and safety. Basic principles of supervising. Organizing time and people. Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing - Vehicle operation and types of operations.

## MODULE  III  TRANSPORT SYSTEMS  9

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

## MODULE  IV  SCHEDULING AND FARE STRUCTURE  8

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

**MODULE V       MOTOR VEHICLE ACT           7**

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional    regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

**MODULE VI       MAINTENANCE               7**

Preventive maintenance system in transport industry, tyre maintenance procedures.   Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

**L – 45; Total Hours –45**

**TEXT BOOKS:**

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2. Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992

**REFERENCES:**

1. Government Motor Vehicle Act, Publication on latest act to be used as on date.

**OUTCOMES:**

Upon completion of the course, students will

- Know about different aspects related to transport system and management.
- Features of scheduling, fixing the fares
- Know about the motor vehicle act and maintenance aspects of transport.

| GECX106 | **CONTROL SYSTEMS** | **L** | **T** | **P** | **C** |
|---------|---------------------|-------|-------|-------|-------|
|         |                     | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- To understand the system modeling and to derive their transfer function.
- To provide adequate knowledge of time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of Control systems.

**MODULE I        BASIC CONCEPTS AND SYSTEM                8**
**REPRESENTATION**

Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

**MODULE II        TIME RESPONSE ANALYSIS AND DESIGN        8**

Time response – Time domain specifications – Types of test input – First and Second order system - Type I and Type II System – Response - Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

**MODULE III        FREQUENCY RESPONSE ANALYSIS AND DESIGN        7**

Performance specifications - correlation to time domain specifications - bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

**MODULE IV        STABILITY                8**

Characteristics equation – Location of roots in s plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

**MODULE V        COMPENSATOR DESIGN                8**

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus technique.

**MODULE VI      CONTROL SYSTEM COMPONENTS AND            6**
**                APPLICATION OF CONTROL SYSTEMS**

Synchros – AC servomotors - DC Servo motors - Stepper motors - AC Tacho generator - DC Tacho generator - Typical applications of control system in industry.

**L – 45; Total Hours –45**

**REFERENCES:**

1.    K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.

2.    I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.

3.    C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.

4.    I.J.Nagarath and M.Gopal, "Control System Engineering", Wiley Eastern Ltd., Reprint, 1995.

5.    R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley (MATLAB Reference), 1995.

**OUTCOMES:**

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

•    Proper understanding of basics of Control Systems.
•    Ability and skill to carry-out time domain and frequency domain analysis.
•    Capable of determining stability of the system using Routh Hurwitz criterion, Root locus and Nyquist criterion.
•    Ability to design lag, lead and lag lead compensator networks.

**GECX107**        **INTRODUCTION TO VLSI DESIGN**     **L   T   P   C**

                                                                **3   0   0   3**

**OBJECTIVES:**

- Basic concepts of HDL.

- Verilog language and its syntax constructs.

- Programmable Logic Devices and FPGAs

- MOS devices theory

- CMOS based combinational and sequential circuits

**PREREQUISITES:**

Fundamentals of Electronics

Basics knowledge in Digital Electronics.


**MODULE I**        **REVIEW OF BASIC DIGITAL SYSTEMS**        **7**

Boolean algebra, Building blocks of combinational logic design-Adders, multiplexer, encoder, decoder, comparator, Latches & flip-flops, counters, shift registers.


**MODULE II**       **LOGIC DESIGN USING VERILOG HDL**       **8**

Overview of Digital Design with Verilog HDL, Levels of Design Description, Concurrency, Hierarchical Modeling Concepts, Modules and Ports, Component instantiation Data flow and RTL, structural, gate level, switch level modeling and Behavioral Modeling.


**MODULE III**      **LANGUAGE CONSTRUCTS OF VERILOG HDL**      **7**

Identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments, conditional statements Variable types, arrays and tables, Tasks and functions, Test bench.


**MODULE IV**      **BUILDING BLOCKS OF DIGITAL VLSI SYSTEMS**      **8**

HDL Design -Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements. Programmable logic elements and AND-OR arrays, FPGAs programming methods.


**MODULE V**        **TRANSISTOR THEORY**                        **7**

Introduction to MOS Transistors-NMOS & PMOS Characteristics, Current Equations, Complementary CMOS Inverter-DC Characteristics, Static Load MOS 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:**

1. M.Morris Mano "Digital Design", 3rd Edition, Prentice Hall of India Pvt. Ltd New Delhi, 2003

**REFERENCES:**

1. Michael D. Ciletti"Advanced Digital Design with the Verilog HDL" (2nd Edition) Hardcover – January 31, 2010
2. J.Bhasker: Verilog HDL primer, BS publication, 2001.
3. J. P. Uyemura, "Introduction to VLSI Circuits and System", Wiley, 2002
4. Neil Weste and K. Eshragian, "Principles of CMOS VLSI Design: A System Perspective," 2nd edition, Pearson Education (Asia) Pvt.Ltd., 2000
5. Douglas A Pucknell& Kamran Eshragian , "Basic VLSI Design" PHI 3rd Edition (original edition – 1994)

**OUTCOMES:**

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

- Create basic Register Transfer Level (RTL) models for combinational circuits & Sequential circuits using Verilog HDL.
- Create basic behavioral models for combinational circuits & Sequential circuits using Verilog HDL.
- Describe the usage of Programmable Logic Devices and FPGAs.
- Describe MOS devices theory and inverter circuit DC characteristics
- Design the basic digital building blocks using MOS circuit.
- Apply VLSI design concepts based on the requirements to conduct experiments or projects

| GECX108 | PLANT ENGINEERING | L | T | P | C |
|---------|-------------------|---|---|---|---|
|         |                   | 3 | 0 | 0 | 4 |

**OBJECTIVES:**

- To provide in depth knowledge on Plant Engineering
- To introduce detail engineering and P&ID
- To  learn about the support to Instrumentation from other disciplines
- To study about the Installation and commissioning

**MODULE  I        INTRODUCTION OF PLANTS                    7**

General Project Cycle – Feed – Sales - Plant Description, Component / Areas of Plant, Plant Layout, Plant Interfaces, Plant Location

**MODULE  II        ELEMENTS OF PLANT                    8**

Main Elements of a Plant, Process Flow Scheme (PFD – Process Flow Diagram) P&ID's, Plant Legend Finalization.

**MODULE  III        DETAIL ENGINEERING                    10**

P& ID Development with PFD's, Major Discipline Involvement & Inter discipline Interaction, Major Instrumentation & Control Systems - Development Phase – Instrument List , I/O Count, Specification Sheets, Instrument Installation ( Hook ups) ,  Control Philosophy – Detail Engineering.

**MODULE  IV        SUPPORT FROM OTHER DISCIPLINE                    8**

Other Discipline Supports to Instrumentation – Plot Plan, Piping / Equipment Plan, Electrical Area Classification, Fire Hazardous Classification Telecommunication Systems - Control Network architecture.

**MODULE  V        INSTALLATION AND COMMISSIONING                    7**

Plant Construction - Key Drawings for Construction Support Construction Activities, System Testing, Startup / Commissioning, Production.

**MODULE  VI        CASE STUDIES                    5**

Case studies of Water Treatment Plant - Paper Industry – Power Plant etc

**L – 45; Total Hours –45**

**REFERENCES:**

1. Duncan C Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto,2014 McGraw-Hill Education

2. Gabriel Salvendy, Handbook of Industrial Engineering – Technology and operations Management, John Wiley & Sons, 2001.

3. Robert C Rosaler , Standard Handbook of Plant Engineering, Mc Graw Hill third Edition, 2004

4. R. Keith Mobley,  Plant Engineer's Handbook, Technology and Engineering, 2001.

**OUTCOMES:**

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

- Review and correct P&IDs

- Do installation and commissioning of new plants

- Apply plant engineering in design and maintenance of  water treatment plant / power plant etc

| GECX109 | NETWORK SECURITY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

The students should be able to

- Discuss the basic concepts of computer security, model and attacks
- Examine the major types of threats and the associated attacks
- Identify the encryption techniques in real time applications
- Understand the special requirements for wireless security and how authentication is implemented in wireless systems
- Understand the functions of Network Security Device Firewall and its types
- Interpret the various network intrusion such as computer viruses, network worms etc

**MODULE I INTRODUCTION 6**

Computer Security Concepts - The OSI Security Architecture - Security Attacks - Security Services - Security Mechanisms - A Model for Network Security - Standards – classical encryption techniques.

**MODULE II SYMMETRIC ENCRYPTION AND MESSAGE 7 CONFIDENTIALITY**

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 8 AUTHENTICATION**

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 8 TRANSPORT-LEVEL SECURITY**

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        8**
**                 MAIL SECURITY AND IP SECURITY**

IEEE 802.11 Wireless LAN Overview -IEEE 802.11i Wireless LAN Security - Wireless Application Protocol Overview - Wireless Transport Layer Security - WAP End-to-End Security - Pretty Good Privacy - S/MIME – Domain Keys Identified Mail- IP Security Overview -IP Security Policy - Encapsulating Security Payload - Combining Security Associations - Internet Key Exchange - Cryptographic Suites

**MODULE  VI        SYSTEM SECURITY                                 8**

Intruders -Intrusion Detection -Password Management - Types of Malicious Software - Viruses Virus Countermeasures – Worms - Distributed Denial of Service Attacks- The Need for Firewalls - Firewall Characteristics - Types of Firewalls - Firewall Basing - Firewall Location and Configurations

**L – 45; Total Hours –45**

**REFERENCES:**

1. William Stallings,"Network security Essentials:Applications and standards", Prentice Hall, Fifth Edition , ISBN-13: 978-0134527338, 2013

2. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson, ISBN-13:978-0-273-79335-9,2013

3. Behrouz Forouzan, Debdeep Mukhopadhyay,Cryptography and network security (sie) 2nd edition, ISBN-13: 978-0070702080, 2016

4. Wikipedia, "Network Security and Management" ,
    https://en.wikipedia.org/wiki/Book:Network Security and Management, 2014.

5. Nitesh Dhanjani, Justin Clarke, "Network Security Tools", O'Reilly Media,
    ISBN-13:   9780596007942, 2005.

**OUTCOMES:**

   Students who complete this course will be able to
   - Recognize the computer security concepts, architecture attacks and model
   - Distinguish the symmetric and asymmetric encryption techniques
   - Apply the cryptographic algorithms in different  applications
   - Express the network security designs using available secure solutions

such as PGP,SSL, IPSec, etc.
- Describe the firewalls principles and different types of firewalls applied in organization
- Identify abnormalities within the network caused by worms, viruses and Network related security treats.

| GECX110 | KNOWLEDGE MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit

 knowledge of highly mobile individual employees.

- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's

 knowledge base.

- Brings out the paradigm in terms of information technology and intellectual capital.

**MODULE I        KNOWLEDGE MANAGEMENT        6**

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

**MODULE II        KNOWLEDGE MANAGEMENT SYSTEMS AND        9**
**                    MODELS**

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

**MODULE III        CAPTURING KNOWLEDGE AND SHARING        9**

Tacit knowledge capture - Explicit knowledge codification – Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

**MODULE IV        KNOWLEDGE MANAGEMENT TOOLS        9**

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery – Content management tools - Knowledge sharing and dissemination tools – Group ware

and Collaboration tools - Intelligent filtering tools.

## MODULE  V            KNOWLEDGE APPLICATION                    6

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels – Knowledge repositories - Knowledge reuse -Case study: e-learning.

## MODULE  VI          VALUE OF KNOWLEDGE MANAGEMENT            6

KM return on investment and metrics - Benchmarking method – Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

**L – 45; Total Hours –45**

## TEXT BOOKS:

1. Elias M. Awad, Hassan M. Ghaziri, "Knowledge Management", Prentice Hall, 2nd Edition, 2010.
2. Jay Liebowitz, "Handbooks on Knowledge Management", 2nd Edition, 2012.
3. Irma Becerra-Fernandez, Rajiv Sabherwal, "Knowledge Management: Systems and Processes", 2010.

## OUTCOMES:

Students who complete this course will be able to
  • Describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
  • Explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
  • Critically evaluate current trends in knowledge management and apply it for e-learning

**GECX111**          **CYBER SECURITY**          **L   T   P   C**
                                                      **3   0   0   3**

**OBJECTIVES:**

- To understand the basics of Cyber Security Standards and Policies.
- To know the legal, ethical and professional issues in Cybersecurity.
- TounderstandCyberFraudsandAbuseanditsSecurityMeasures.
- To know the technological aspects of CyberSecurity.

**MODULE  I          FUNDAMENTALS OF CYBER SECURITY          7**

Securityproblemincomputing–CryptographyBasics–HistoryofEncryption– Modern Methods – Legitimate versus Fraudulent Encryption methods– EncryptionusedinInternet.

**MODULE  II          CYBERCRIME AND CYBEROFFENSES          8**

Cybercrime and Information Security – Cybercriminals – Classifications of Cybercrimes – Email Spoofing – Spamming – Cyber defamation – Internet Time Theft – Forgery – Web jacking – Hacking – Online Frauds – Software Piracy – Mail Bombs – Password Sniffing – Cyberoffenses – Categories – Planning the attacks – Cyberstalking – Cybercafe and Cybercrimes – Botnets.

**MODULE  III          CYBERCRIME: MOBILE AND WIRELESS DEVICES          8**

Proliferation of Mobile and Wireless Devices – Trends in Mobility – Credit card frauds in Mobile and Wireless Computing – Security Challenges – Authentication Service Security – Attacks on Mobile Phones.

**MODULE  IV          TOOLS AND METHODS USED IN CYBERCRIME          8**

Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers and Spywares – Virus and Worms – Trojan Horses and Backdoors – Steganography – DoS and DDoS Attacks.

**MODULE  V          SECURITY POLICIES          7**

Introduction -  Defining User Policies – Passwords – Internet Use – Email Usage – Installing/ Uninstalling Software – Instant Messaging – Defining System Administrative Policies – Defining Access Control Developmental Policies Standards, Guidelines and Procedures – Basics of assessing a system

**MODULE VI          COMPUTER FORENSICS                    7**

General Guidelines – Finding Evidence on the PC - Finding Evidence in System Logs – Windows Logs – Linux Logs – Getting Back Deleted Files – Operating System Utilities – The Windows Registry.

**L – 45; Total Hours –45**

### TEXT BOOKS:

1. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley, 2011.

2. Chuck Easttom, "Computer Security Fundamentals", 2$^{nd}$ Edition, Pearson Education,2012.

### REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing",

3$^{rd}$Edition, Pearson Education,2003.

2. WilliamStallings,"CryptographyandNetworkSecurity–Principlesand

   Practices", 3$^{rd}$ Edition, Pearson Education,2003.

3. AtulKahate,"CryptographyandNetworkSecurity",TataMcGrawHill,2000.

### OUTCOMES:

Uponcompletionofthiscourse, students will be able to

- Explain the general security issues.
- Discuss various cybercrimes and offenses.
- Outline the occurrence of Cybercrime in mobile and wireless environment.
- Use relevant tools and methods in cybercrime
- Apply security policies in cyber forensics.
- Outline the strategies adopted in computer forensics.

| GECX112 | GENETIC ENGINEERING | L | T | P | C |
|---------|---------------------|---|---|---|---|
|         |                     | 4 | 0 | 0 | 4 |

**OBJECTIVES:**

The course aims to provide an advanced understanding of the core principles and topics of Cell and Organism reproduction and the Principles of heredity and their experimental basis, and to enable students to be able to apply these principles in assessment of pedigrees to identify genotypes and predict the mating outcomes.

**MODULE  I          GENETICS AND ORGANISM                    10**
Genetics and human affairs, Genetics and Biology, Genes and Environment, Techniques of genetic analysis, The chromosome theory of heredity, Sex chromosomes, Sex linkage, The parallel behaviour of autosomal genes and chromosomes.

**MODULE  II         MENDELISM AND LINKAGE                    12**
Mendel's laws of inheritance, Interaction of genes, Variations on dominance, Multiple alleles, Lethal alleles, Several genes affecting the same character, Penetrance and expressivity, Linkage- Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Examples of linkage maps.

**MODULE  III        FINE STRUCTURE OF GENES                  10**
The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. The concept of extranuclear genome in higher plants and animals, Overview of mitochondrial genome, Chloroplast genome.

**MODULE  IV         RECOMBINATION IN BACTERIA AND VIRUSES       10**
Conjugation recombination and mapping the E.coli chromosomes, Transformation, Transduction, Chromosome mapping. Population genetics: Darwin's revolution, Variation and its modulation, The effect of sexual reproduction on variation, The sources of variation, Selection quantitative genetics

**MODULE  V          PRINCIPLES OF PLANT BREEDING                 9**
Objectives, Selfing and crossing techniques, Male sterility,Incompatability,

Hybrid vigour.

## MODULE VI        HUMAN GENOME PROJECT                          9

Genetic diseases in humans, Genetics and society

**L – 45; T – 15; Total Hours –60**

## REFERENCES:

1. In Introduction to genetic analysis, Griffiths, Miller, Suzuki, Lewontin and Gelbart,  Freeman and  Company.
2. Genetics, A.V.S.S. Sambamurty, Narosa Publishing House.
3. Concepts of Genetics, Klug & Cummings, Prientice Hall.
4. Molecular Cloning, Moniatisetal, Cold Spring Harbor Laboratory.

## OUTCOMES:

At the end of the course students will be able to

- Describe the structure, function and replication of DNA as the genetic material
- Describe gene structure, expression and regulation
- Describe the chromosomal basis of inheritance and how alterations in chromosome number or structure may arise during mitosis and meiosis

| GECX113 | FUNDAMENTALS OF PROJECT | L | T | P | C |
| | MANAGEMENT | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

The students would gain knowledge on

- Technicalities attached to Project Management and Significance of Quality Consideration
- Project management methodologies – tools and techniques, supplemented with examples from case studies
- The importance of Efficient HR team and role of Communication in executing Projects.
- Managing Risks in Project Management

**MODULE  I         INTRODUCTION TO PROJECT MANAGEMENT          9**

Introduction to Project and Project Management-Project Management as a Career-Project Management Skill Sets-Project Scope Management: Project Charter, Scope Creep, Scope Validation, Scope Change Control-Type of Organization: Organization Structure-Influence of Organization Structure on Project, Project Stakeholders and Organizational Productivity.

**MODULE  II        PROJECT MANAGEMENT PROCESS, TOOLS AND      8**
**                    TECHNIQUES**

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           10**
**                    MANAGEMENT**

Triple constraints of project-quality, cost and schedule-Quality Planning, Quality Assurance and Quality Control, Process Control, Cost of Quality, Seven Tools of Quality Control- Cost Management: Cost Estimating Methods, Estimating Completion Cost, Earned Value Management, Budgeting, Life-Cycle Cost analysis- Project Time Management: Duration Estimation Method, FS/FF/SS/ SF Relations, Lead/Lag, Arrow Diagram Method and Precedence Diagram Method for Scheduling-Resource Allocation

### MODULE IV    PROJECT HR MANAGEMENT    5

Organizational Goals- (MBO/MBE/MBP)-Responsibility Assignment Matrix (RAM)-Types of Powers- Manage or Lead-Conflict management Techniques-Performance Evaluation Process-Motivation Theories and its Application for execution of Projects-Leadership Styles-Project Team Building-Project Staffing Constraints/Policies

### MODULE V    COMMUNICATION MANAGEMENT    5

Communication Management: Understanding Body languages of Project Personnel-Effective Communications- Interpersonal Skills for project Managers-PMIS-Communicating with the Customer-Communicating with Management- Formal vs. Informal Communications-Written, Verbal and Non-Verbal Communications.

### MODULE VI    PROJECT PROCUREMENT & RISK MANAGEMENT    8

Introduction to Project Procure Management: Soliciting RFQ/RFP-Contract Proposals-Contract Negotiation-Contract Closure-Risk Management: Defining risks-Risk management process-Risk identification-Qualitative and Quantitative Risk-Probability and Decision trees-Risk Response strategies / methods-Expected monetary value-Risk vs. life cycle phases

**L – 45; Total Hours –45**

**REFERENCES:**

1. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015
2. Bob Hughes, Mike Cotterrel "Software Project Management", Tata McGraw-Hill, 2009

**OUTCOMES:**

• Learners will be able to identify the Key Knowledge Areas and apply PM process in hypothetical project assignments given as continuous assessment.

• They would be able to suitably recognize tools and techniques required for various phases included in a project.

• They would also be able to manage scope, time, cost and other major components that would help them to execute the project efficiently.

GECX114        **OPERATIONS RESEARCH**     L   T   P   C
                                                    3   0   0   3

**OBJECTIVES:**

- To acquire knowledge and training in optimization techniques.
- To get knowledge about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations

**MODULE  I        LINEAR PROGRAMMING PROBLEM        8**

Linear programming – formulation of the problem -  graphical interpretation of optimality - Simplex method –  to obtain basic feasible solution – types of linear programming solution – complications and their resolution.

**MODULE  II       ARTIFICIAL VARIABLE AND TWO PHASE METHOD,    6**
                             **DUALITY**

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     8**
                             **PROBLE**

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    8**
                             **AND GAME THEORY**

Types of inventory- Inventory cost - EOQ - Deterministic inventory problems – Introduction to probabilistic models & system level inventory control - Replacement models – Replacement of items that deteriorate with time – value of money changing with time – not changing with time – Individual and group replacement policy - Game theory – simple games.

**L – 45; Total Hours –45**

**TEXT BOOKS:**

3. Hamdy ATaha, "Operations Research an introduction", 8th edition, Phil Pearson, 2007.
4. Winston.W.L., "Operations Research", 4th edition, Thompson-Brooks/Cole, 2003.

**REFERENCES:**

1. Wayne.L. Winston, "Operations Research applications and algorithms", 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald.J.Lieberman, "Operations Research concepts and cases", 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.
3. A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research:Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.
4. Robertazzi. T.G., "Computer networks and systems-Queuing theory and performance evaluation", 3rd edition, Springer, 2002.

**OUTCOMES:**

At the end of the course students will be able to
- solve linear programming problems
- solve transportation and assignment problems.
- solve network and sequencing problems.
- apply the operations research techniques to solve industrial problems.

| GECX115 | **NANO TECHNOLOGY** | **L** | **T** | **P** | **C** |
|---------|---------------------|-------|-------|-------|-------|
|         |                     | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- To introduce the basic concepts of Nanoscience relevant to the field of engineering.
- To provide an exposure about the importance of various synthesis method.
- To enrich the knowledge of students in various characterisation techniques.

**MODULE  I          INTRODUCTION & CLASSIFICATION OF          9**
**NANOMATERIALS**

Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic,transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

**MODULE  II          TYPES OF NANOMATERIALS          9**

Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

**MODULE  III          PRODUCTION OF NANOPARTICLES          7**

Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

**MODULE  IV          CARBON BASED NANOMATERIALS          6**

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

**MODULE  V          NANOPHOTONICS          7**

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

**MODULE  VI          CHARACTERISATION TECHNIQUES          7**

Basic principles of scanning Electron Microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe

microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

**L – 45; Total Hours –45**

## TEXT BOOKS:

1. Hari Singh Nalwa, "Handbook of Nanostructured Materials and Nanotechnology", Academic Press, 2000.
2. Guozhong Cao, "Nanostructures and Nano materials-Synthesis, Properties and Applications", Imperial College Press (2011).
3. Zhong Lin Wang, "Handbook of Nanophase and Nanomaterials (Vol 1 and II)", Springer, 2002.
4. Mick Wilson, Kamali Kannangara, Geoff smith, "Nanotechnology: Basic Science and Emerging Technologies", Overseas press, 2005.

## REFERENCES:

1. A. Nabok, "Organic and Inorganic Nanostructures", Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: "Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, "Nano Technology – Basic Science and Emerging Technologies", 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, "Nanoscience and Nanotechnology: Fundamentals to Frontiers", Wiley, 2013.

## OUTCOMES:

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

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

| GECX116 | VEHICLE MAINTENANCE | L | T | P | C |
|---------|---------------------|---|---|---|---|
|         |                     | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To know about the various methods of maintaining procedure, vehicle insurance and basic problems in a vehicle.
- The student able to impart knowledge in maintaining of engine components and subsystems.
- The student able to impart knowledge in maintaining of transmission, driveline, steering, suspension, braking and wheels.
- The student able to impart **carefully maintaining their vehicle and can increase driving safety.**

**MODULE  I              MAINTENANCE, WORKSHOP PRACTICES,              7**
**                             SAFETY AND TOOLS**

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

**MODULE  II             ENGINE AND ENGINE SUBSYSTEM                   8**
**                             MAINTENANCE**

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls.

**MODULE  III            TRANSMISSION AND DRIVELINE 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 AND AIR CONDITIOING**      **8**
                               **MAINTENANCE**

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

**L – 45; Total Hours –45**

**TEXT BOOKS:**

1. Ed May, "Automotive Mechanics Volume One" , Mc Graw Hill Publications, 2003
2. Ed May, "Automotive Mechanics Volume Two" , Mc Graw Hill Publications, 2003
3. Vehicle Service Manuals of reputed manufacturers
4. Vehicle maintenance and garage practice by  Jigar A.Doshi  Dhru U.Panchal,Jayesh P.Maniar. 2014
5. A Practical Approach to Motor Vehicle Engineering and Maintenance 3rd Edition by Allan Bonnick.

**REFERENCES:**

1. Bosch Automotive Handbook, Sixth Edition, 2004.
2. Advanced Automotive Fault Diagnosis by Tom Denton 2011.
3. Nissan Patrol Automotive Repair Manual: 1998-2014 by Haynes Manuals Inc.
4. Automobile electrical manual a comprehensive guide by Haynes manual car repair.

**OUTCOMES:**

On completion of the course student should be able to
- Prepare maintenance schedules and procedures with appropriate tools.
- Demonstrate the procedure and methods to repair and calibrate the engine.
- **Analyze the causes and remedies for fault in transmission and drive line systems.**
- **Analyze the causes and remedies of steering and suspension systems.**
- **Analyze the causes and remedies of brake system.**
- **Demonstrate the procedure for wheel alignment and wheel balanced.**

| GECX117 | FUNDAMENTALS OF DIGITAL IMAGE PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

## OBJECTIVES:

- Describe and explain basic principles of digital image processing
- Design and implement algorithms that perform basic image processing
- Design and implement algorithms for advanced image analysis
- Assess the performance of image processing algorithms and systems

## PRE-REQUISITES:

- Basic knowledge of transforms in Mathematics

**MODULE I          DIGITAL IMAGE FUNDAMENTALS          8**

Elements of Image Processing System, Fundamentals steps in Digital Image Processing, Image Sampling & Quantization, Spatial and Gray Level Resolution.

**MODULE II          COLOR IMAGE PROCESSING          8**

Fundamental of color image processing, color models- RGB, CMY, HIS, Pseudo color image processing

**MODULE III          IMAGE ENHANCEMENT          7**

Basic gray level Transformations, Histogram Processing, Spatial Filtering

**MODULE IV          IMAGE TRANSFORMS          7**

2D-DFT, DCT, Haar Transform,Fundamentals of 2D-wavelet transform, sub-band coding

**MODULE V          IMAGE SEGMENTATION AND RESTORATION          8**

Point, line and edge detection methods ,Image Segmentation and its types, Restoration: Noise model, Inverse filter and Wiener filter.

**MODULE VI          IMAGE COMPRESSION          7**

Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, JPEG and MPEG Compression standards.

**TOTAL HOURS   45**

**TEXT BOOKS**

1. Gonzalez and Woods, "Digital Image Processing", 3$^{rd}$ Edition, Pearson Education, 2016.
2. Anil. K. Jain, "Fundamentals of Digital Image Processing"; 4$^{th}$ Edition, PHI, 2007

**REFERENCES**

1. Pratt William, "Digital Image Processing", John Wiley & Sons, 2007.
2. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", PHI, 2006.

**OUTCOMES:**

On completion of the course, students will be able to

- Explain the fundamental concepts of digital image processing.
- Discuss about color image processing
- Recognize & apply various image enhancement techniques.
- Apply various transforms for image processing.
- Apply various techniques for image segmentation and restoration.
- Identify and use appropriate image compression techniques

**Group II courses**
**(To be offered in VII Semester)**

**GECX201      GREEN DESIGN AND SUSTAINABILITY      L   T   P   C**

                                                                 **3   0   0   3**

**OBJECTIVES:**

- To impart knowledge to face challenges, the technology poses for water, energy, and climate change by implementing sustainable design.

**MODULE  I        CONCEPTS OF SUSTAINABLE DEVELOPMENT        7**

Objectives of Sustainable Development - Need for sustainable development-Environment and development linkages - Globalisation and environment-Population, poverty and pollution- global, regional and local environment issues-Green house gases and climate change.

**MODULE  II       SUSTAINABLE DEVELOPMENT OF SOCIO        8**
                  **ECONOMIC SYSTEMS**

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth- Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

**MODULE  III      FRAME WORK FOR ACHIEVING SUSTAINBAILITY      7**

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

**MODULE  IV       GREEN BUILDINGS        8**

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

**MODULE  V        ENERGY CONSERVATION AND EFFICIENCY        7**

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation-Energy conservation measures for buildings- Energy wastage- impact to the environment.

## MODULE VI    GREEN BUILDINGS DESIGN    8

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

**L – 45; Total Hours –45**

### TEXT BOOKS:

1. Kirby, J., Okeefe, P., and Timber lake, "Sustainable Development", Earthscan Publication, London, 1995.

### REFERENCES:

1. Charles Kibert, J., "Sustainable Construction: Green Building Design and Delivery", 2nd Edition, John Wiley and sons, 2007.

### OUTCOMES:

At the end of the course, the students will be able to
- Explain the relationship between sustainability and emergence of green building practices.
- Address the economic, environmental, and social concerns.

| GECX202 | APPROPRIATE TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To impart students knowledge about the basics and applications of various appropriate technologies in the field of civil engineering.

**MODULE I        BASICS CONCEPTS                                    7**

Back ground, Tools, Choices and Implications, Appropriate Technology Movement (an overview) - Basic design process, basic financial analysis-discounted cash flow, and energy fundamentals.

**MODULE II        APPROPRIATE TECHNOLOGY WITH REFERENCE        7**
**                    TO BUILDING DESIGN**

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

**MODULE III        WATER, HEALTH AND SANITATION                7**
**                    MANAGEMENT**

Water Storage: Designing Dams and Pipelines, Appropriate Selection for Sanitation Technique, Sewerage, Communal Health and Waste Water Recycling.

**MODULE IV        WASTE MANAGEMENT                            8**

Types of Waste - Sources - Collections and On-Site Processing -Transferring Stations - Disposal Systems - Recycling.

**MODULE V        ENERGY EFFICIENT TECHNIQUES                8**

Green building concepts-renewable energy sources- Solar – Steam and wind-Biofuels - Biogas – Electricity.

**MODULE VI        TECHNOLOGY POLICY                            8**

Government Policies- Energy Policy-Appropriate technology Development Centre-its function and responsibilities-Building policies-Case Studies.

**L – 45; Total Hours –45**

**TEXT BOOKS:**

1. Barrett Hazeltine and Christopher Bull, "Appropriate Technology: Tools Choices and Implications", Academic Press, Orlando, USA, 1998.
2. Ken Darrow and Mike Saxenian, "Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology", Stanford, 1986.

**REFERENCES:**

1. Richard Heeks, "Technology and Developing Countries: Practical Applications Theoretical Issues", 1995.
2. John Pickford, "The Worth of Water : Technical Briefs on Health, Water and Sanitation", Intermediate Technology Publications, 1998.

**OUTCOMES:**

• At the end of the course, the students will be able to use suitable technologies for various conditions for sustainable development.

**GECX203**      **ENGINEERING SYSTEM MODELLING AND**    **L**    **T**    **P**    **C**

**SIMULATION**      **3**    **0**    **0**    **3**

**OBJECTIVES:**

•    To learn the concepts, techniques, tools for modeling and simulation systems and environments through the use of computers.

•    To study the various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

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

Systems – Modelling – types – systems components – Steps in model building- Simulation Algorithms and Heuristics; Simulation Languages.

**MODULE II**      **RANDOM NUMBERS / VARIATES**      **7**

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc. – Testing of Random variates – Monte Carlo Simulation.

**MODULE III**      **MODELLING PROCESS**      **7**

Primitive Models : Establishing relationships via physical laws; Establishing relationships via curve fitting; Parameters estimation problems; Elementary state transition models.

**MODULE IV**      **DESIGN OF SIMULATION EXPERIMENTS**      **9**

Steps on Design of Simulation Experiments – Development of models using of Highlevel language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

**MODULE V**      **SIMULATION LANGUAGES**      **10**

Need for simulation Languages – Comparisons & Selection of Languages – GPSSARENA- EXTEND – Study of any one of the languages.

**MODULE VI**      **CASE STUDIES USING SIMULATION LANGUAGES**      **6**

Case Study using simulation languages

**L – 45; Total Hours –45**

**REFERENCES:**

1. Law, A.M., & W.D. Kelton, "Simulation Modelling and Analysis", McGraw

Hill, Singapore, 2000.

2.  Harrel, C.R., et. al., "System Improvement Using Simulation", 3$^{rd}$ Edition, JMI Consulting Group and ProModel Corporation, 1995.

3.  Harrel, C.R. & T. Kerim, "Simulation Made Easy, A Manager's Guide", IIE Press, 1995.

4.  Geoffrey Gordon, "Systems Simulation", Prentice Hall, 2002.

5.  David Kelton, Rondall P Sadowski, David T Sturrock, "Simulation with Arena", Mc Graw Hill, 2004.

**OUTCOMES:**

The student should be able to

*   Model and simulate systems and environments through the use of computers.
*   Conduct experiments with discrete dynamic, stochastic system models on a computer.

**GECX204**  **VALUE ANALYSIS AND 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 AND**     **6**
**RECOMMENDATION**

Paired comparison and Evaluation Matrix techniques - Criteria for selection of

VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

**MODULE VI        IMPLEMENTATION PHASE AND CASE STUDIES        8**

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

**L – 45; Total Hours –45**

**TEXT BOOKS:**

1. Mudge, Arthur E. "Value Engineering- A systematic approach", McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), "Value Engineering", Narosa Publishing House, 2005.

**REFERENCES:**

1. Park RJ, "Value Engineering: A Plan for Invention", St.Lucie Press, New York, 1999.
2. Lawrence, D.M., "Techniques of Value Analysis and Engineering", McGraw Hill 1988.
3. George, E.D., "Engineering Design: a Material and Processing Approach", McGraw Hill, 1991.
4. Heller, D.E., "Value Management, Value Engineering and Cost Reduction", Addison Wesley, 1988.

**OUTCOMES:**

• The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.

| GECX205 | INDUSTRIAL SAFETY | L | T | P | C |
|---------|-------------------|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the various safety measures to be taken in different industrial environments.

**MODULE I       SAFETY MANAGEMENT         7**

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

**MODULE II       SAFETY IN MANUFACTURING         7**

Safety in metal working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

**MODULE III       SAFETY IN CONSTRUCTION         8**

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

**MODULE IV       ELECTRICAL SAFETY         8**

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

**MODULE V       SAFETY IN MATERIAL HANDLING         8**

General safety consideration in material handling devices - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.
Ergonomic consideration in material handling, design, installation, operation and

maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.

Storage and Retrieval of common goods of shapes and sizes in a general store of a big industry.

**MODULE VI       SAFETY EDUCATION AND TRAINING                    7**

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

**L – 45; Total Hours –45**

**REFERENCES:**

1.   Krishnan N.V, "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
2.   Blake R.B., "Industrial Safety", Prentice Hall, Inc., New Jersey, 1973.
3.   Fulman J.B., "Construction Safety, Security, and Loss Prevention", John Wiley and Sons, 1979.
4.   Fordham Cooper W., "Electrical Safety Engineering", Butterworths, London, 1986.
5.   Alexandrov M.P., "Material Handling Equipment", Mir Publishers, Moscow, 1981.

**OUTCOMES:**

Students would be able to
•    Acquire knowledge on various safety Hazards.
•    Carry out safety measures for different industrial environments.

**GECX206**      **ADVANCED OPTIMIZATION TECHNIQUES**    **L   T   P   C**
                                                                     **3   0   0   3**

**OBJECTIVES:**

- To introduce the various advanced optimization tools.
- To provide an understanding to deal with ill identified and fuzzy problems.

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

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

**MODULE II**        **HEURISTICS METHODS**                        **8**

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming
– Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing.

**MODULE III**        **GENETIC ALGORITHM**                          **7**

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation -genetic algorithms in search, optimization and machine learning- practical genetic algorithms.

**MODULE IV**        **ANT COLONY OPTIMIZATION**                **8**

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History
– The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring – Advantages & Disadvantages

**MODULE V**        **FUZZY LOGIC AND ANN**                       **8**

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations
– Design example – Biological foundations to intelligent systems: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

**MODULE VI       IMPLEMENTATIONS & APPLICATIONS              7**

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

**L – 45; Total Hours –45**

**REFERENCES:**

1.  Singiresu S. Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1996.
2.  Ravindran – Phillips –Solberg, "Operations Research – Principles and Practice, John Wiley and Sons, 1987.
3.  Fredrick S.Hillier and G.J.Liberman, "Introduction to Operations Research", McGraw Hill Inc. 1995.
4.  Kalymanoy Deb, "Optimization for Engineering Design", PHI, 2003
5.  Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006

**OUTCOMES:**

At the end of the course student will be able to

1.  Formulate a real life situation as an optimization the problem.
2.  Identify the appropriate solution methodology and provide a solution

| GECX207 | MATLAB SIMULINK | L | T | P | C |
|---------|-----------------|---|---|---|---|
|         |                 | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

**MODULE I       INTRODUCTION MATLAB  DATA PRESENTATION       7**

Vectors, Matrices -Vector/Matrix Operations & Manipulation- Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically- Least squares regression -Curve fitting.

**MODULE II       MATLAB PLOT FUNCTION       7**

Introduction- Plot Function – Animation- 3D Plots-Customizing Plots – Plot Applications- Saving &Painting Plots.

**MODULE III       ROOT FINDING AND COMPUTER       7**
**                        REPRESENTATION OF NUMBERS**

Linearization and solving non-linear systems of equations- The Newton-Rapson method- Integers and rational numbers in different bases- Floating point numbers- Round off and errors in basic arithmetic-Significant digits when reporting results

**MODULE IV       ORDINARY DIFFERENTIAL EQUATIONS       8**

Numerical integration and solving $1^{st}$ 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.

**L – 45; Total Hours –45**

**REFERENCES:**

1. Griffiths D V and Smith I M, Numerical Methods for Engineers, Blackwell, 1991.
2. Laurene Fausett, Applied Numerical Analysis Using MATLAB, Pearson 2008.
3. Moin  P, Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB.  CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving , Mathematical Exploration with MATLAB,  Cambridge University Press, 1999.

**OUTCOMES:**

At the end of this unit students will be able to:

1. Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
2. Write programs using first principles without automatic use of built-in ones.
3. Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
4. Be fluent in exploring Matlab's capabilities, such as  using matrices as the fundamental data-storage unit, array manipulation, control flow, script and function m-files, function handles, graphical output.
5. Make use of Maltab visual capabilities for all engineering applications.
6. An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering fields

**GECX208** **EMBEDDED SYSTEMS AND ITS APPLICATIONS** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To provide a detailed overview of embedded system.
- To equip students with the software development skills necessary for practitioners in the embedded systems field.
- To understand entire software development lifecycle and examine the various issues involved in developing software for embedded systems.

**MODULE I  EMBEDDED SYSTEMS OVERVIEW  8**

Introduction –Embedded Systems vs. General computing systems- Fundamental Components of embedded systems- Characteristics- Challenges-Examples- Embedded System design process.

**MODULE II  EMBEDDED COMPUTING PLATFORM  8**

Overview of Processors and hardware units in an embedded system-CPU buses – Memory devices –Memory types- I/O devices – Designing with computing platforms- Consumer electronics architecture-Design example: Alarm clock.

**MODULE III  REAL TIME EMBEDDED SYSTEMS  8**

Programming embedded systems in assembly and C – Real time systems – Hard and Soft real time systems- Need for RTOS in Embedded Systems- Multiple tasks and processes –Context switching-Scheduling policies- Interprocess communication and synchronization.

**MODULE IV  EMBEDDED SOFTWARE DEVELOPMENT PROCESS  8 and TOOLS**

Development process of an embedded system-software modules and tools for implementation of an embedded system- Integrated development environment- Host and target machines-cross compiler-cross assembler-Choosing right platform.

**MODULE V  PROGRAM MODELING IN EMBEDDED SYSTEMS  8**

Program Models – Data Flow Graph model-control DFG model-Synchronous DFG model- Finite state machines- UML modeling – UML Diagrams.

## MODULE VI     EMBEDDED SYSTEMS APPLICATION     5

Application specific embedded system – case study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card.

**Total Hours –45**

**TEXT BOOKS:**

1. Marilyn Wolf , "Computers as components", Elsevier 2012.
2. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
3. Rajkamal, "Embedded Systems Architecture, Programming and Design",1st Reprint,Tata McGraw-Hill, 2003
4. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.

**REFERENCES:**

1. Sriram V Iyer and PankajGupta ,"Embedded Realtime Systems Programming "Tata McGraw-Hill,2008
2. Qing Li and Carolyn Yao," Real-Time Concepts for Embedded Systems", CMPBooks, 2003
3. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003

**OUTCOMES:**

On completion of this course, the students will be able to
- Identify the suitable processor and peripherals in embedded applications
- Develop embedded programs in assembly and c
- Choose the right platform for designing an embedded system
- Explore different scheduling mechanism in rtos
- Design the program model for embedded applications.
- Analyze different domain specific applications in embedded systems.

| GECX209 | USABILITY ENGINEERING | L | T | P | C |
|---------|------------------------|---|---|---|---|
|         |                        | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

**MODULE I      INTRODUCTION        6**

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

**MODULE II      USER INTERFACES        8**

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

**MODULE III      INTERACTION DESIGN        8**

Process of Interaction Design - Establishing Requirements – Design,Prototyping and Construction - Evaluation and Framework.

**MODULE IV      USABILITY TESTING        8**

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

**MODULE V      USABILITY ASSESSMENT METHODS        8**

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual Use, User Feedback, Usability Methods – Interface Standards - National, International and Vendor Standards, Producing Usable In-House Standards.

## MODULE VI    USER INTERFACES    7

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces – Future Developments – Case Study.

**L – 45; Total Hours –45**

### TEXT BOOKS:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, "Interaction Design: Beyond Human - Computer Interaction", John Wiley & Sons, 3$^{rd}$ 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, 5$^{th}$ Edition, 2010.

2. Laura M. Leventhal, Julie A. Barnes, "Usability Engineering: Process, Products, and Examples", Pearson/Prentice Hall, 2008

### OUTCOMES:

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

| GECX210 | SUPPLY CHAIN MANAGEMENT | L | T | P | C |
|---------|--------------------------|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

**MODULE I   INTRODUCTION TO SUPPLY CHAIN                7**

Understanding Supply Chain - Decision phases - Supply chain performance - Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

**MODULE II   SUPPLY CHAIN DRIVERS AND DESIGN                7**

Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

**MODULE III   AGGREGATE PLANNING AND MANAGING            8
                SUPPLY, DEMAND AND INVENTORY**

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

**MODULE IV   MANAGING INVENTORY IN SUPPLY CHAIN            8**

Managing Economies of Scale in a Supply Chain : Cycle Inventory- Managing uncertainty in a Supply Chain Safety Inventory- Determining optimal level of Product Availability

**MODULE V   SOURCING AND TRANSPORTATION                8**

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers - Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

**MODULE VI   INFORMATION TECHNOLOGY IN A SUPPLY CHAIN   7**

Information technology in a supply chain – CRM, ISCM, SRM in supply chain -

Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

**L – 45; Total Hours –45**

**REFERENCES:**

1. Sunil Chopra and Peter Meindl, "Supply Chain Management-Strategy Planning and Operation", Pearson Education, 5th Indian Reprint, 2013.
2. Jananth Shah "Supply Chain Management – Text and Cases" Pearson Education, 2008.
3. Altekar Rahul V, "Supply Chain Management-Concept and Cases", Prentice Hall India, 2005.
4. Monczka et al., "Purchasing and Supply Chain Management", Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

**OUTCOMES:**

• After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.

• The student decision making capability specific to supply chain issues in an industry is improved.

• The student can plan a well defined execution of supply chain strategy in companies.

• The student will be able to design a optimal distribution network as per the demands of the industry.

• The student can also determine the most favorable transportation plan for a company.

• The student will also be able to bring in company from paper environment to paperless environment.

**GECX211**          **SYSTEMS ANALYSIS AND DESIGN**          L    T    P    C

                                                                3    0    0    3

**OBJECTIVES:**

- To describe the phases of the systems development life cycle
- To teach the automated tools for system development
- To develop and evaluate system requirements.
- To explain the organizational issues in system implementation
- To teach the usability testing and electronic data interchange
- To elucidate the importance of System analysis and design in electronic commerce.

**MODULE  I          FUNDAMENTALS OF SYSTEM DEVELOPMENT          8**

System Concept – Characteristics – Elements of System – Types of System – Modern Approach to System Analysis and Design – System Development Life Cycle – Approaches to Improving Development – Tools for System Development – Succeeding as a System Analyst – Skills – Managing the Project.

**MODULE  II          AUTOMATED TOOLS FOR SYSTEMS          7**
**                    DEVELOPMENT**

What is requirements determination? Fact finding techniques, Tools for documenting procedure and decision-CASE Tools-Need for CASE tools-Reverse engineering and reengineering- phases of the software life cycle-Ranking projects-Value Chain Analysis- Corporate Strategic Planning vs. Information Systems Planning.

**MODULE  III          SYSTEM ANALYSIS          8**

Determining System Requirements – Traditional Methods - Modern Methods – Radical Methods – Structuring System Requirements – Process Modeling – Data Flow Diagramming – Logic Modeling – Conceptual Data Modeling – E-R Modeling.

**MODULE  IV          SYSTEM DESIGN          8**

System Implementation – Software Application Testing – Installation – Documentation – Training and Support – Organizational Issues in Systems Implementation – Maintaining Information System – Conducting System Maintenance.

## MODULE V        USABILITY AND MEASURING USER        7
### SATISFACTION

Usability Testing-User satisfaction test- A tool for analyzing user satisfaction – Unified Modeling Language(UML)- Case study: System Design: Application in Human Resource-Financial Applications

## MODULE VI        SAD IN E-COMMERCE        7

Systems analysis and design in the era of electronic commerce: B2B, B2C and C2C e-commerce -advantages and disadvantages of e-commerce. E-commerce system architecture – physical networks, logical network, World Wide Web, web-services - HTML, XML - case studies-EI electronic data interchange: EDI standards - virtual private networks - XML and EDI

**L – 45; Total Hours –45**

### REFERENCES:

1. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, "Modern Systems Analysis and    Design",Fifth Edition, Prentice Hall,March 2007.
2.Ned Kock, "Systems Analysis & Design Fundamentals" Sage South Asia, May 2008.
3. Joseph S. Valacich, Jeffrey A. Hoffer, Joey F. George, "Essentials Of System Analysis And Design" Prentice Hall , August 2005.
4. Rumbaugh et al, "Succeeding with Booch and Rambaugh Methods", Addisson Wesley, second Edition, 1998.
5.Larman, C.," Applying UML and Patterns. An introduction to Object-Oriented Analysis and Design". Prentice-Hall PTR, 2002.

### OUTCOMES:

- List the characteristics of the system and specify the approaches in the development of the system.
- Summarize the phases of the software life cycle
- Differentiate Corporate Strategic Planning and Information Systems Planning.
- Illustrate the system requirements through various modeling diagrams.
- Use tools and techniques for process and data modeling.
- Solve realistic systems analysis problems and perform user satisfaction test.

| GECX212 | ADVANCED MATERIALS | L | T | P | C |
|---------|---------------------|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To make the student conversant with

- Dielectric materials
- Magnetic materials
- Energy materials
- Nano materials
- Semi conductors
- Smart materials

**MODULE  I**        **8**

Dielectric Materials- Polarization and Mechanism-Internal or local field-Clausius-Mossotti relation- Dielectric loss- Temperature and Frequency effect- Measurement of Dielectric constant and loss using Scherring bridge- electric break down- ferro, piezo, pyroelectric materials and its application.

**MODULE  II**        **8**

Magnetic Materials- Terminology and classification of magnetic materials (Dia, Para, Ferro & Ferri) – Magnetic moments due to electrospin – Domain theory of Hysteresis – Heisenberg theory of Exchange Interaction (without derivation)- Structure and properties of Ferrites- Properties of Soft and Hard Magnetic Materials- Application: floppy disk, CD ROM, Magneto optical recording.

**MODULE  III**        **8**

Energy Materials (Nuclear) - Introduction to nuclear materials- Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials- Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers-Radiation proof materials- Brief discussion of safety and radioactive waste disposal.

**MODULE  IV**        **7**

Nano Materials- The nanosize range- classification of nanomaterials-processing of nanomaterials-properties of nanomaterials- mechanical, electrical, magnetic properties- other properties- carbon based nanomaterials- other nanomaterials and its application.

**MODULE  V**                                                              **7**

Semiconductors- The energy gap in solids-Extrinsic Semiconductors- Intrinsic Semiconductors- Hall Effect in semiconductors- Application of Hall Effect- Basic ideas of compound semiconductors -Semiconductor materials- Fabrication of Integrated Circuits- Some semiconductor Devices

**MODULE  VI**                                                             **7**

Smart materials- aerospace materials Ni and Co based super alloys, Special steels, Titanium alloys, Intermetallics, ceramics and their composites, New High strength material, Properties of Materials, Materials in Medical Applications, Stainless steel alloys,Cobalt based alloys, titanium based alloys, polymers

**L – 45; Total Hours –45**

**REFERENCES:**

1. Materials science and Engineering: A first course by V. RAGHAVAN, 6$^{th}$ ed., Eastern Economy edition,Prentice Hall of India,2015
2. Materials science and Engineering: An Introduction by William D. Callister Jr., 7$^{th}$ ed. John Wiley & Sons Inc. 2007
3. Material science by Dr.M.Arumugam, Anurasha agencies ,third revised edition ,2002

**OUTCOMES:**

Students will be able to know

- significance of  dielectric materials
- types and applications of magnetic materials
- applications of nuclear materials for energy harvesting
- applications of nano materials
- significance of semi conductor devices
- applications of smart materials

**GECX213**      **NATIONAL SERVICE SCHEME**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**OBJECTIVES:**

Primary Objective: Personality development through community service.

To achieve the above objective, the following should be adhered:

1. To provide an understanding about the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
2. To develop certain basic skills for personality development through community development.
3. Understand the community in which they work and their relation
4. Identify the needs and problems of the community and involve them in problem-solving and
5. Practice national integration and social harmony.

**MODULE I**      **INTRODUCTION TO NSS**      **8**

Orientation and structure of NSS,-Aims and Objectives of National Service Scheme- The history of NSS- Symbol and meaning- NSS hierarchy from national to college level – Role and responsibilities of various NSS functionaries

**MODULE II**      **PERSONALITY AND COMMUNITY DEVELOPMENT**      **8**
                    **SKILLS**

Importance of youth Leadership, Traits of Good Leadership and Personality Development. Role of youth in creating awareness through NSS Programmes on Health & Hygiene; Environmental Conservation and Enrichment for Sustainable Development; Sanitation and Swachh Bharat.

**MODULE III**      **UNDERSTANDING YOUTH**      **7**

Definition and Profiles of youth categories, Youth Issues, Challenges and Opportunities for Youth, Youth as agent of social change & Community Mobilization .Role of Youth in Nation Building. National Youth Policy.

**MODULE IV**      **SOCIAL HARMONY AND NATIONAL INTEGRATION**      **7**

National Integration, Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc. Role of youth in Peace building and conflict resolution-Globalization and its Economic Social Political and

Cultural impacts.

**L – 30; Total Hours –30**

**TEXT BOOKS:**

1. National Service Scheme – A Youth Volunteers Programme for Under Graduate students as per UGC guidelines J.D.S.Panwar et al. Astral International. New Delhi.
2. National Service Scheme Revised Manual, 2006.Govt. of India. Ministry of Youth Affairs & Sports. New Delhi.
3. Social Problems in India, *Ram Ahuja.*

**REFERENCES:**

1. National Youth Policy-2014. Ministry of Youth Affairs & Sports. .Govt. of India

**OUTCOMES:**

On successful completion of this course-

- Students will have exposure to the the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- Students will be trained to skills for personality development through community development.
- Students will gain knowledge about national integration and social harmony.
- Students will be exposed to the role of youths in Nation building  Students will gain

| GECX214 | AUTOMOTIVE POLLUTION AND CONTROL | L | T | P | C |
|---------|---------------------------------|---|---|---|---|
|         |                                 | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To have a fair knowledge in automotive pollution control.
- To understand the concept of formation and control techniques of pollutants like UBHC, CO, NOx, particulate matter and smoke for both SI and CI engine will be taught to the students.
- To know about the instruments for measurement of pollutants
- To get introduced about emission standards

**MODULE I        EMISSION FROM AUTOMOBILES          8**

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of ollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

**MODULE II        SI ENGINE EMISSIONS AND CONTROL          9**

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, Positive Crank case ventilation system, Secondary air injection, thermal reactor

**MODULE III        CI ENGINE EMISSION AND CONTROL          8**

Formation of White, Blue, and Black Smokes, NOx, soot, Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

**MODULE IV        NOISE POLLUTION FROM AUTOMOBILES          8**

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aerodynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction —Silencer Design.

**MODULE V        TEST PROCEDURES                              6**

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dynamometers - Seven mode and thirteen mode cycles for Emission Sampling.

**MODULE VI        EMISSION MEASUREMENTS                       6**

Emission analysers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

**L – 45; Total Hours –45**

**TEXT BOOKS:**

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint,   2005.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company., Newyork 1993.

**REFERENCES:**

1.  G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York. 1986.
2.  D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.
3.  L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
4.  C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.
5.  A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise', Applied science publisher ltd., London,1987.

**OUTCOMES:**

On completion of the course student should be able to
- Identify the sources of emission from vehicles.
- Analyse the causes and effects of emissions.
- Analyse causes and effects of noise pollution
- Bring out solutions for control of emissions.
- Demonstrate the test procedures and emission norms.
- Select suitable instruments for measurement of emissions.

**GECX215**  **MOTOR VEHICLE ACT, INSURANCE &**  **L  T  P  C**
**POLICY**  **3  0  0  3**

**OBJECTIVES:**

- To learn about basic act and regulation followed for road vehicle
- To learn about systematic steps involved to get licence and registration of motor vehicle
- To learn arbour various types of motor vehicle polices and insurances

**MODULE  I**  **BASIC RULES FOR ROAD VEHICLE**  **8**

Display and Use of Number Plates- Attachment of number plates- Number plates in horizontal position- Removal of number plates on transfer- Hours prescribed for lighted lamps- Mounting of lamps and reflectors- Multiple beam headlamps- Daytime running lamps- Auxiliary driving lamps- Parking lamps- Brakes- Stopping distances- Emergency or parking brakes- Horn- Muffler- Mirrors- Inspection of motor vehicles- Standards of safety and repair

**MODULE  II**  **LICENSING OF DRIVERS OF MOTOR VEHICLES**  **8**

Necessity of driving licence- Age limit in connection with driving of motor vehicle-Responsibility of owners of motor vehicles-Restriction on the holding of driving licence-Grant of learner's licence-Grant of driving licence-Addition to driving licence- Renewal of driving licence-Revocation of driving licence on grounds of disease or disability-Driving licence to drive motor vehicle belonging to the central government- power of court to disqualify- suspension of  driving licence in certain cases- suspension or cancellation of driving licence on convection- Endorsement.

**MODULE  III**  **REGISTRATION OF MOTOR VEHICLE**  **7**

Necessity for registration – Registration Where and how to be made- Special provision for registration of motor vehicle of diplomatic officers-Temporary registration- Production of vehicle at the time of registration- Refusal of registration- renewal of certificate of registration- effectiveness in India of registration- Change of residence or place of business-transfer of ownership- Suspension of registration – cancellation of registration suspended under section 53- certificate of fitness of transport vehicle-cancellation of registration.

## MODULE  IV        INSURANCE OF MOTOR VEHICLE                    8

Necessity for insurance against third party – Requirements of policies and limits of liability- - Duty of insurers to satisfy judgements and awards against person insured in respect of third party risks-Duty to give information as to insurance- Settlement between insurers and insured persons- transfer of certificate of insurance-production of certain certificates, licences and permit in certain cases-Special provisions as to compensation in case of hit and run motor accident – Types of motor polices

## MODULE  V        CONTROL OF TRANSPORT VEHICLES                 7

Power to State Government to control road transport- Transport authorities- General provision as to applications for permits- Application for stage carriage permit- Procedure of Regional Transport Authority in considering application for stage carriage permit- Scheme for renting of motor cabs- Application for private service vehicle permit- Procedure in applying for and granting permits- Duration and renewal of permits- Transfer of permit- Replacement of vehicles- Temporary permits

## MODULE  VI        OFFENCES AND PUNISHMENT                       7

Driving without holding an effective driving licence- Driving by an under-aged person (Minor driving vehicle)- Holding of a driving licence permitting it to be used                                      by                                      other person.- Driving a vehicle at an excessive speed- Driving or permitting to drive a vehicle carrying excess load- Driving dangerously / its Abetment Driving an uninsured vehicle
Rider and pillion rider failing to wear protective head gear (Helmet) -Violation of Mandatory Signs -.e-challan and spot challan

**L – 45; Total Hours –45**

**TEXT BOOKS:**
1. The motor vehicle act 1988, Universal law publishing co.cpvt ltd. Newdelhi 2011
2. A Commentary On The Motor Vehicles Act, 1988 by SUKHDEV AGGARWAL The Bright Law House, New Delhi

**REFERENCES:**
1. The Motor Vehicles Act, 1988 Along with Latest Case Law, Notifications

& Table of Offences and Punishments Asia Law House; 15th edition (2014)

2. Assessment of Compensation in Accidents under Motor Vehicles Act by Karkara Delhi Law House (2013)

**OUTCOMES:**

On completion of the course students should be able to

- Explain the analysis of  rules and regulations for road vehicles
- Analyze the procedure for getting driving license for vehicles at national and international level
- Analyze the procedure for registration of vehicles.
- Analyze the procedure for Insurance of vehicles and claims.
- Analyze  the procedure for  obtaining Government Permits and renewal
- Analyze the consequences of not following the rules and regulations

| GECX216 | PRINCIPLES OF COMMUNICATION | L | T | P | C |
| | SYSTEMS | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To introduce the analog and digital modulation techniques.

To elaborate the working of communication receivers in the presence of noise.

To give an overview of various communication systems.

**MODULE  I  LINEAR MODULATION  8**

Baseband signals, Amplitude Modulation – Modulation Index, Power Transmitted, Double Side Band and Single Side Band AM, AM Modulators and AM Receivers, AM Radio systems, Frequency Division Multiplexing.

**MODULE  II  ANGLE MODULATION  8**

Frequency Modulation and Phase Modulation, Frequency deviation and modulation index, Bandwidth of FM, FM Modulators and FM receivers, FM Radio and FM Stereo Systems

**MODULE  III  SAMPLING AND PULSE MODULATION  7**

Sampling, Nyquist's Sampling Theorem, Pulse Modulations - PAM, PPM and PWM, Time Division Multiplexing, Bandwidth of TDM systems.

**MODULE  IV  DIGITAL COMMUNICATION  7**

Digital baseband data,Digital Modulations – ASK, FSK, PSK and QPSK. Digital Communication Transmitters and Receivers.

**MODULE  V  NOISE  8**

Sources of Noise, Thermal Noise, shot noise, White noise, Narrow band Noise, Effect of noise in communication, SNR, Receiver Noise Temperature and Noise Equivalent Bandwidth.

**MODULE  VI  COMMUNICATION SYSTEMS & NETWORK  7**

FM Radio Systems, Cellular Mobile network, Satellite Communications, Optical Fiber Communication.

**L – 45; T – 0; Total Hours – 45**

**TEXT BOOKS:**

1. A. Bruce Carlson, Paul B. Crilly, "Communication Systems", 5th Edition,

McGraw Hill Int., 2011.

2. B.P. Lathi, Zhi Ding, Hari M. Gupta, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2017.

**REFERENCES:**

1. Herbert Taub, Donald L. Schilling, Goutam Saha, "Principles of Communication Systems" 4th Edition, McGraw Hill Int. 2013.
2. Simon Haykin, "An Introduction To Analog And Digital Communications", 1st Edition, Wiley India, 2010.
3. Simon Haykin , "Communications Systems" 4th Edition, Wiley India, 2006.
4. Hwei P. Hsu, "Analog and Digital Communications" 3rd Edition,

**OUTCOMES:**

On completion of the course students will be able to

1. Identify various communication systems and the corresponding modulation schemes.
2. Predict the characteristics of various analog and digital modulation schemes.
3. Interpret the effect of noise and bandwidth in a communication systems
4. Apply the Nyquist criteria for a given baseband signals.
5. Evaluate the performance of communication receivers.
6. Demonstrate the applications of common communication systems.

| GECX217 | **LEAN MANAGEMENT** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **1** | **0** | **4** |

**OBJECTIVES:**

The objective of the Course to make the student know about

☐thebasics oflean productionmanagement,

☐ howLeanprinciplesare appliedtotheConstructionindustrytoimprove the operationmanagement and productdevelopment.

**MODULE I**           **8**

lean production? – Introduction, background, and lean thinking. Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production System.

**MODULE II**           **8**

Manufacturing systems – an overview of manufacturing strategies. Job shops, batch flow, and flexible manufacturing systems Flow production and lean production systems

**MODULE III**           **7**

Value stream mapping in process design and product development Waste reduction - lead time reduction

Process cycle time and value-added vs. non-value added activities Optimum lot sizing

**MODULE IV**           **8**

Lean production processes, approaches and techniques.—Importance of focusing upon flow. Tools -. Workplace organization – 5S. - Stability. - Just-In-Time – One piece flow – Pull. - . Cellular systems. - . Quick change and set-up reduction methods. f. Total productive maintenance. -. Poka-Yoke – mistake proofing, quality improvement. Standards. - . Leveling. - . Visual management. Just-in-time techniques – SMED and Takt Times - Standard work processes and line balancing Poka-yoke and pull systems material handling reduction and facilities planning

**MODULE V**           **8**

Managing change in the lean organization Human resource management and the lean enterprise Employee involvement – Teams – Training – Supporting and encouraging involvement – Involving people in the change process -- communication -- Importance of culture. Startup of lean processes and examples of applications.

Sustaining improvement and change, auditing, follow-up actions.

**7**

## MODULE  VI

The lean enterprise and supply chain management Costs and risks of lean initiatives - Measuring lean initiatives

**L – 45;  Total Hours –45**

**TEXT BOOKS:**

1. The Toyota Way Fieldbook, Jeffrey Liker and David Meier, McGraw-Hill, 2006. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.
2. Womack, James P., and Daniel T. Jones. Lean Thinking. New York, NY: Simon and Schuster, 2003. ISBN: 0743249275.
3. Murman, Earll. Lean Enterprise Value. New York, NY: Palgrave Macmillan, 2002. ISBN: 0333976975.

**REFERENCES:**

1. Readings athttp://www.leanconstruction.org/readings.htm
2. Hopp,W.J.,andSpearman,M.L.(2011).FactoryPhysics,ThirdEdition, WavelandPress,LongGrove,Il. 720pp.

**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          8
                     LANDFORMS**

Methods for flow routing and flow accumulation – Extraction of stream networks   – Extraction of watershed boundaries and building watershed hierarchies – feature extraction, types of landforms.


**MODULE  VI          MODELING OF GEOSPATIAL PROCESSES          7**

Model formulation, input data processing – introduction to GIS-based hydrologic, erosion and environmental modeling – Geocomputational methods, including agent-based modeling, artificial neural networks and evolutionary computing.


**L – 45; T – 0; Total Hours –45**

**TEXT BOOKS:**

*1.* Hassan A, Karimi (2017), *Geospatial Data Science Techniques and Applications*, CRS Press & Co.

*2.* Sudipto Banerjee, Bradley P, Carlin, Alan E. Gelfand (2014),   *Hierarchical Modeling and Analysis for Spatial Data*, CRS Press & Co.


**REFERENCES:**

1. Maguire, D., M. Batty, and M. Goodchild. 2015. GIS, Spatial analysis, and modeling. ESRI  Press (G70.212 .G584 2005)

2. Zeiler, M. 2010. Modeling Our World: The ESRI Guide to Geodatabase Design. Second Ed.  ESRI Press, Redlands, California

**OUTCOMES:**

On successful completion of this course,

- Students will be able to apply the basic concepts of Conceptualize models as representations of real life systems with inputs, outputs, and processes.

- Students will have gained knowledge in spatial tools to make simulations and predictions of real life phenomena.

- Students will have synthesized knowledge about Apply, integrate, and develop models with geospatial data through a GIS.

- Students will have an overview of Evaluate models in terms of accuracy, sensitivity, and uncertainty.

- Students will have Use of a system-based approach for problem solving, with an emphasis on sustainability.

| **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

**L – 45; T – 0; 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