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 center of excellence in Aerospace Engineering Education, Training and Research and contribute for the development of Aerospace Technology.

MISSION

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

• To create stimulating environment and supportive infrastructure for research and scholarly development in Aerospace and related areas.

• To undertake collaborative research with Aerospace and related industries to solve problems of interest.

• To provide analytical skills, leadership quality and team spirit through balanced curriculum and a judicious mix of 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

• 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.
B.Tech.  Aeronautical Engineering  Regulations 2017

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 Programme like Civil Engineering, Mechanical Engineering, etc.,

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

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

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

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

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

2.0 ADMISSION

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

2.1b) Candidates for admission to the third semester of the eight-semester B.Tech. programme under lateral entry scheme shall be required to have passed the Diploma examination in Engineering / Technology of the Department of Technical Education, Government of Tamil Nadu or any other examination of any other authority accepted by the Institution as equivalent thereto.
2.2 Notwithstanding the qualifying examination the candidate might have passed, the candidate shall also write an entrance examination prescribed by the Institution for admission. The entrance examination shall test the proficiency of the candidate in Mathematics, Physics and Chemistry on the standards prescribed for Ten plus Two academic stream.

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

3.0 BRANCHES OF STUDY

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

B.TECH. DEGREE PROGRAMMES:

1. Aeronautical Engineering
2. Automobile Engineering
3. Civil Engineering
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Technology
9. Manufacturing Engineering
10. Mechanical Engineering
11. Polymer Engineering
12. Biotechnology
13. Cancer Biotechnology
14. Food Biotechnology

4.0 STRUCTURE OF THE PROGRAMME

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

i) Basic Sciences (BS)
ii) Humanities & Social Sciences (HS)
iii) Management Sciences (MS)
iv) Engineering Sciences Fundamentals (ESF)  
v) Engineering Core Courses (EC)  
vi) Professional Electives (PE)  
vii) General Electives (GE)  
viii) Workshop practice, laboratory work, industrial training, seminar presentation, project work, etc.

4.2 Each course is normally assigned certain number of credits:
   - one credit per lecture period per week
   - one credit per tutorial period per week
   - one credit for two to three periods and two credits for four periods of laboratory or practical sessions
   - one credit for two periods of seminar / project work per week
   - one credit for two weeks of industrial training.

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

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

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

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

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

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

6.0 CLASS ADVISOR AND FACULTY ADVISOR
6.1 CLASS ADVISOR

A faculty member will be nominated by the HOD as Class Advisor for the class throughout the period of study except first year. The Class Advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study. However, for the first and second semester, the class advisors (First year class advisors) will be nominated by the first year coordinator.

6.2 FACULTY ADVISOR

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

7.0 COURSE COMMITTEE

7.1 Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers teaching the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

8.0 CLASS COMMITTEE

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

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

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

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

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

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

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

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

ii) Faculty members of all courses of the semester.

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

iv) All faculty advisors and the class advisors.

v) Head of the Department.

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

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

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

9.0 REGISTRATION AND ENROLMENT

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

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

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

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

10.0 COURSE CHANGE / WITHDRAWAL

10.1 CHANGE OF A COURSE

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

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

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

12.0 CREDIT LIMIT FOR ENROLMENT & MOVEMENT TO HIGHER SEMESTER
12.1 A student can enroll for a maximum of 32 credits during a semester including Redo /Pre do Courses
12.2 The minimum earned credit required to move to the higher semester shall be
   • Not less than 20 credits, to move to the 3rd semester
   • Not less than 40 credits, (20 for lateral entry) to move to the 5th semester
   • Not less than 60 credits, (40 for lateral entry) to move to the 7th semester

13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS
13.1 Every theory course shall have a total of three assessments during a
semester as given below:

<table>
<thead>
<tr>
<th>Assessment No.</th>
<th>Course Coverage in Weeks</th>
<th>Duration</th>
<th>Weightage of Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment 1</td>
<td>1 to 6</td>
<td>1.5 hours</td>
<td>25%</td>
</tr>
<tr>
<td>Assessment 2</td>
<td>7 to 12</td>
<td>1.5 hours</td>
<td>25%</td>
</tr>
<tr>
<td>Semester End Exam</td>
<td>Full course</td>
<td>3 hours</td>
<td>50%</td>
</tr>
</tbody>
</table>

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
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
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.

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.

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.

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.

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.

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:

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>10</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
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<tr>
<td>C</td>
<td>7</td>
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<tr>
<td>D</td>
<td>6</td>
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<tr>
<td>E</td>
<td>5</td>
</tr>
<tr>
<td>U</td>
<td>0</td>
</tr>
<tr>
<td>W</td>
<td>0</td>
</tr>
<tr>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>AB</td>
<td>0</td>
</tr>
</tbody>
</table>

"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 \( C_i \) is the number of credits assigned for the \( i^{th} \) course and \( G_{Pi} \) is the Grade Point in the \( i^{th} \) course

\[
GPA = \frac{\sum_{i=1}^{n} (C_i)(G_{Pi})}{\sum_{i=1}^{n} C_i}
\]

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 \( \times \) 10

17.6 After successful completion of the programme, the Degree will be awarded with the following classifications based on CGPA. 
### Classification | CGPA
--- | ---
First Class with Distinction | 8.50 and above and passing all the courses in first appearance and completing the programme within the Prescribed period of 8 semester for normal entry and 6 semesters for lateral entry
First Class | 6.50 and above and completing the programme within a maximum of 10 semester for normal entry and 8 semesters for lateral entry
Second Class | Others

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

### 18.0 ELECTIVE CHOICE:

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

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

19.0 SUPPLEMENTARY EXAMINATION

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

20.0 PERSONALITY AND CHARACTER DEVELOPMENT

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

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

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

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.
# SEMESTER I

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Group</th>
<th>Course Code</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>BS</td>
<td>MAC 1181</td>
<td>Differential Calculus and Geometry</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
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<tr>
<td>2.</td>
<td>HS</td>
<td>ENC 1181/IS 1181/LNC 1181</td>
<td>English / Arabic / Mandarin / German / Japanese</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
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<td>CHC 1181</td>
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<td>ESF</td>
<td>GEC 1101</td>
<td>Engineering Graphics</td>
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<td>2</td>
<td>3</td>
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<td>6.</td>
<td>ESF</td>
<td>GEC 1102</td>
<td>Engineering Design</td>
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<td>0</td>
<td>2</td>
</tr>
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<td>7.</td>
<td>ESF</td>
<td>GEC 1103</td>
<td>Basic Engineering Practices Laboratory</td>
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### B.Tech. Aeronautical Engineering Regulations 2017

#### B.S. Abdur Rahman Crescent Institute of Science and Technology

### SEMESTER VII

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*Total credits – 174*

*15 days*

**Industrial training will be undertaken during third year summer vacation. The credit will be awarded in the 7th Semester.*
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### Physics Elective Courses
(To be offered in II Semester)

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<th>Sl. No.</th>
<th>Course Code</th>
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<tr>
<td>1.</td>
<td>PHCX 01</td>
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<td>Semiconductor Physics and Optoelectronics</td>
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### Chemistry Elective Courses
(To be offered in II Semester)

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Maths Elective Courses  
(To be offered in IV Semester)

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Maths Elective Courses  
(To be offered in VI Semester)

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

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<td>GECX102</td>
<td>Total Quality Management</td>
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<td>GECX103</td>
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<td>14.</td>
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<td>Physics / Chemistry</td>
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## Group II Courses
(To be offered in VII semester)

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<td>Green Design and Sustainability</td>
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<td>GECX202</td>
<td>Appropriate Technology</td>
<td>Civil / Mechanical</td>
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<td>GECX203</td>
<td>Engineering System Modelling and Simulation</td>
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<td>National Service Scheme</td>
<td>School of Humanities</td>
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<td>Automotive Pollution and Control</td>
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<td>Motor Vehicle Act, Insurance and Policy</td>
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<td>Principles of Communication Systems</td>
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<td>GECX217</td>
<td>Lean Management</td>
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<td>18</td>
<td>GECX218</td>
<td>Spatial Data Modeling &amp; Analysis</td>
<td>Civil</td>
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</table>
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
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:

REFERENCES:
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
- 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
- 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
- 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

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

L : Understanding Non- Verbal Communications while listening to narration of incidents.
S: Narrating an experience
R: Inferential Reading
Language Focus: Interchange of Active & passive voice, Impersonal Passive voice.

MODULE VI

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:


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.
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.
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:

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:

REFERENCES:

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.
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

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

MODULE II

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

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

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

MODULE V

MODULE VI

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

TOTAL HOURS :45

REFERENCES:
1. Nihongo I, Kokusaigakuyukai, and other supplementary material
2. Exersice book 1of Nihongo 1, and other supplementary material
3. Nippon, the Land and its People & Encyclopedia of Contemporary Japanese
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

MODULE III  APPLIED OPTICS  8
Interference – Air Wedge – Michelson’s Interferometer – Determination of wavelength of light and thickness of thin transparent sheet.
MODULE IV  FIBRE OPTICS
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
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

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.
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.
REFERENCES:

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.
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

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 ENERGIES 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

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.

L – 45; P – 30; TOTAL HOURS – 75

REFERENCES:


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.
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


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:

REFERENCES:

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.
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:

5. Navi Radjou, Jaideep Prabhu and Simone Ahuja, “Jugaad Innovation”, Published
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.
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
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

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

MODULE II  PROGRAMMING IN C

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
8. Arrays – Operation with arrays
9. Sorting and searching.

L – 15; P – 30; TOTAL HOURS – 45
REFERENCES:

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.
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:

REFERENCES:

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.
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 an 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


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
 MODULE V  
**FRICITION**  
08

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

 MODULE VI  
**LAWS OF MOTION**  
10


L – 45; T – 15; TOTAL HOURS – 60

REFERENCES:


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
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.
MODULE III ENVIRONMENTAL POLLUTION AND NATURAL 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 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.

Case studies related to current situation

TOTAL HOURS – 30

TEXT BOOKS:
6. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering,
REFERENCES:

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.
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


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.
10. Inheritance

L – 15; P – 30; TOTAL HOURS – 45
REFERENCES:

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

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

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

### MODULE IV  AIRPLANE PERFORMANCE, STABILITY & CONTROL  
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  
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  
Air data instruments, Gyro instruments, Fly-by-wire system, ILS, Auto-Pilot, CVR,
Flight data recorder.

**TOTAL HOURS – 45**

**TEXT BOOKS:**

**REFERENCES:**

**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.
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.
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:

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.
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.
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:

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

MODULE III FOURIER TRANSFORMS
Fourier integral theorem (without proof) - Fourier transform pair - Fourier Inverse Transform – Properties - Convolution theorem - Parseval’s identity.

MODULE IV APPLICATIONS OF FOURIER SERIES AND FOURIER TRANSFORMS
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
MODULE VI Z–TRANSFORM


L – 45; T – 15; Total Hours –60

TEXT BOOKS:

REFERENCES:

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
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
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
Making Poster presentations on current issues
Understanding nuances of making effective presentations (TED Videos)

MODULE IV
Deliberation on social and scientific issues – Debates (focus on rebuttal skills and deconstructing arguments)
Viewing videos on debates (NDTV Discussions)

MODULE V
Discussing social issues or current affairs in groups
Viewing group discussions and listening for specific information

MODULE VI
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:


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

MODULE II BEAMS
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
Double integration method, Macauly’s methods, Moment Area Method, Conjugate Beam Method, principle of superposition.

MODULE IV TORSION –SPRINGS – COLUMNS
Torsion of solid and hollow circular shaft, Shear Stress variation, Power transmissions in shaft, open and closed coil helical springs, Stresses in helical springs, Euler’s Column curve, Columns with different end conditions.

MODULE V PRINCIPAL STRESSES
Principle Stress and Strains, Mohr’s circle.

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

Total Hours : 45
TEXT BOOKS:


REFERENCES:


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.
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

MODULE IV  GAS AND VAPOUR POWER CYCLES  12

MODULE V  REFRIGERATION AND AIR-CONDITIONING  10

**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:**

**REFERENCES:**

**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.
OBJECTIVES:

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

MODULE I  FLUID PROPERTIES AND CLASSIFICATION  7
Introduction - Definitions, 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, Thermodynamics properties of fluid, Types of fluid.

MODULE II  FLUID STATICS AND PRESSURE MEASURING DEVICES  7
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 FLUID AND GOVERNING EQUATIONS  8
Lagrangian and Eulerian approaches- Acceleration field, material derivative, concept of control volume, control surface, fundamentals of flow visualization, and types of flow. Governing equations; mass momentum and energy conservation.

MODULE IV  INTERNAL FLOWS  7
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, and minor losses in pipe system, fluid meters.

MODULE V  DIMENSIONAL ANALYSIS AND FLOW PAST IMMERSED BODIES  7
Dimensional homogeneity, dimensional analysis and similarity Buckingham pi theorem. Reynolds number and geometry effects, momentum integral estimation, the
boundary layer equations, the flat-plate boundary layer, flow separation, external flows.

**MODULE VI TURBOMACHINERY**

Introduction and classification; The centrifugal pumps—performance curve and matching pump to piping system, pump cavitations and net positive suction head, pump in series and parallel, dynamic pump centrifugal pump and axial pump. Turbine; positive- displacement turbine, dynamic turbine, impulse turbine, Reaction turbine, turbine scaling laws.

**Total Hours : 45**

**TEXT BOOKS:**


**REFERENCES:**


**LEARNING OUTCOMES:**

Students will be able to:

- Understand the properties of fluid flows and the governing equations.
- Understand the various types of flows and basics of fluid machinery.
- Understand the importance of dimensional analysis.
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 & MEASUREMENTS  7

MODULE II  ELECTRICAL MACHINES  8

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 - Demultiplexers - 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 colour display formats - PAL, NTSC, SECAM.

MODULE VI     FUNDAMENTALS OF DIGITAL COMPUTER     7
Digital computer – Memories- Microprocessor basics- Intel 8085 microprocessor - Simple programs using 8085.

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Students will be able to

- Demonstrate the ability to design a system using various electrical and semiconductor 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
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
OBJECTIVES:
This course introduces fluid mechanics applications and measurements.

LIST OF EXPERIMENTS:
1. Comparison of coefficients of discharge of given Orifice meter and Venturimeter.
2. Calibration of Rotameter
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.
OBJECTIVES:
• 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. Static characteristics of PN junction diode
2. Static characteristics of zener diode
3. Design of full wave, half wave rectifiers.
4. Study of logic gates
5. Design of half adder and full adder.
6. Design of SR and JK flipflop using gates
7. Design of T and D flipflop using gates.
8. Introduction to Arithmetic and logical programs using 8085 microprocessor
9. Saw tooth wave generation using oscilloscope
10. Triangular wave generation using oscilloscope

Total Hours : 60

REFERENCES:

OUTCOMES:
Students will be able to
• 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

- Apply the programming techniques in developing the assembly language program for microprocessor application.
ENC 2282
WRITTEN COMMUNICATION

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

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

MODULE II

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

MODULE III

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

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

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

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:

**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.
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

MODULE II  FUNDAMENTALS OF INVISCID INCOMPRESSIBLE FLOW  8
Bernoulli’s equation, incompressible flow in a duct, pitot tube, pressure coefficient, governing equation for irrotational incompressible flow, elementary flow, ideal Flow over a circular cylinder, D’Alembert’s Paradox, lifting flow over a cylinder, Kutta Jonkowski Theorem, Real flow over smooth and rough cylinder, method of source panels.

MODULE III  INCOMPRESSIBLE FLOW OVER AIRFOILS  9
Airfoil nomenclature, airfoil characteristics, Kutta condition, circulation and vorticity, circulation and lift, Kutta-Joukowski transformation and its applications, Karman Trefftz Profiles, Thin Airfoil theory and its applications, vortex panel method.

MODULE IV  INCOMPRESSIBLE FLOW OVER 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, effect of aspect ratio, non-
linear lifting-line method, lifting surface theory, vortex lattice method.

**MODULE V  INCOMPRESSIBLE 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, Karman Integral relation, laminar separation.

**MODULE VI  TURBULENT BOUNDARY LAYER  6**
Turbulent boundary layer on a flat plate, effect of pressure gradient, Prandtl's mixing length hypothesis, free shear layers.

**TEXT BOOKS:**
1. Turbulent boundary layer on a flat plate, effect of pressure gradient, Prandtl's mixing length hypothesis, free shear layers.
2. 

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

**OUTCOMES:**
Students shall be able to

- Understand the capability and limitations of potential flow theory
- Estimate the force coefficients of airfoils and wings
- Perform simple viscous flow calculations.
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  12
Plane truss analysis, method of joints, method of sections, 3D trusses.

MODULE III  Statically in determinate structures  12
Propped Cantilever beams, Fixed-Fixed beams, Clapeyron’s 3 moment theorem, moment distribution method, Maxwell’s reciprocal theorem.

MODULE IV  COLUMNS  10
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  10
Strain energy due to gradual loading (axial, bending, torsion, Shear), impact loading, Castiglione’s theorems, Unit load and Dummy load methods, application of energy methods to frames, beams, trusses and rings.

MODULE VI  FAILURE  10
Maximum principle Stress theory, Maximum principle Strain theory, shear stress theory, distortion energy theory, octahedral shear stress theory.

Total Hours –60
TEXT BOOKS:

REFERENCES:

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 of columns 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.
OBJECTIVES:
To introduce the fundamentals of air breathing propulsion and the working principles of air breathing engine components.

MODULE I  FUNDAMENTALS OF AERO ENGINES  9

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
Internal flow and stall in 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 - Modes of inlet operation.

MODULE IV  COMBUSTION SYSTEMS  7

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**


**Total Hours –45**

**TEXT BOOKS:**


**REFERENCES:**


**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.
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

MODULE II AIRPLANE CONTROL SYSTEMS

MODULE III ENGINE SYSTEMS

MODULE IV AIR CONDITIONING AND PRESSURIZING SYSTEM
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
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.

**TEXT BOOKS:**


**REFERENCES:**


**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.
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
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.
OBJECTIVES:

- To train the students to assess the Aircraft Systems and carry out 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.
3. Control system “Rigging check” procedure.
4. Aircraft “Symmetry Check” procedure.
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

LEARNING 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.
OBJECTIVES:
To carry out 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 be 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.
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:
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)

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

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

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

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

Total Hours – 30

REFERENCES:

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.
OBJECTIVES:
To introduce the fundamentals of aircraft compressors & turbine and analysis their design aspects

MODULE I \ COMPRESSORS
Centrifugal Compressors - Principle of operation – work done and pressure rise - slip factor, velocity diagrams, diffuser vane design considerations, Concept of Surging, choking, prewhirl, rotating stall, Performance characteristics.


MODULE II \ AIRCRAFT ENGINE TURBINES

MODULE III \ AIRCRAFT ENGINE SIZING & MATCHING

Total Hours : 30

TEXT BOOKS:
REFERENCES:


OUTCOMES:

Students will be able to

- Design aircraft compressor blades for single and multi-stage compressors.
- Design aircraft turbine blade profiles for gas turbines
- Interpret the performance characteristics of both compressor and turbines
- Understand the matching of components and the parameters characterizing the engine performance.
OBJECTIVES:
To introduce the analysis of various structural components under different loading conditions and the fundamentals of elasticity.

MODULE I  UNSYMMETRICAL BENDING OF BEAMS  8
(CROSS SECTIONS)
Bending Stresses in beams of unsymmetrical sections, bending of sections with skew loads, Structural Idealization, bending stress in the wing box.

MODULE II  SHEAR FLOW IN OPEN SECTIONS  10
Thin walled beams, 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 & multicell structures under torsion, Shear flow in single and multicell 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
TEXT BOOKS:

REFERENCES:

OUTCOMES:
Students will be able to

- Analyze the structural members of aircraft under different loading conditions.
- Carry out stress analysis on thin walled Structures such as wing and fuselage under different loading conditions.
- Obtain analytical solutions for the Buckling of finite plates.
- Differentiate between theory of elasticity and solid mechanics approaches in solving aircraft structural problems.
AEC 3103 HIGH SPEED AERODYNAMICS

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
Energy, momentum, continuity and 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
Prandtl equation and Rankine – Hugoniot relation, normal shock equations, pitot static tube, corrections for subsonic and supersonic flows

MODULE III OBLIQUE SHOCKS AND EXPANSION WAVES
Oblique shocks and corresponding equations, hodograph and pressure turning angle, shock polars, 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, methods of characteristics, two dimensional supersonic nozzle contours.

MODULE IV DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY 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 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 area rule, tip effects.

MODULE VI  HIGH SPEED WIND TUNNELS  12
Blow down, in draft and induction tunnel layouts and their design features, transonic, supersonic and hypersonic tunnels and their peculiarities, helium and gun tunnels, shock tubes, optical methods of flow visualization.

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Students will be able to

- Apply airfoil theory to predict airfoil performance.
- Analyse wing performance at high speed flight.
- Model 2-D supersonic flows.
- Gain understanding on high speed wind tunnel facilities and testing.
OBJECTIVES:

- To introduce the basics of Wind Tunnels and their Applications for the study of flow around different configurations and evaluation of aerodynamic forces and moments.

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 & thin airfoils
5. Force measurement using wind tunnel balance.
6. Flow over a flat plate at different angles of incidence
7. Flow visualization studies in low speed flows over cylinders
8. Flow visualization studies in low speed flows over airfoil with different angle of incidence
10. Supersonic flow visualization with Schlieren system.

Total Hours – 45

OUTCOMES:

Students will be able to

- Measure flow velocity, lift and drag coefficients using wind tunnels.
- Understand the dependence of airfoil pressure distribution on the lift coefficient.
- Use the flow visualization techniques to visualize compressible and incompressible flows.
AEC 3105  AIRCRAFT STRUCTURAL ANALYSIS LAB  L  T  P  C  
0  0  3  1

OBJECTIVES:
  • To carry out experiments to study the load-deflection characteristics of beams and the response 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.
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.
10. Wagner’s beam.

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.

Total Hours – 45
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


MODULE II
SOCIAL ENTREPRENEURSHIP: DRIVERS AND CHALLENGES


MODULE III
SOCIAL ENTREPRENEURSHIP: OPPORTUNITY RECOGNITION


MODULE IV
RESOURCE MOBILIZATION FOR SOCIAL VENTURE

MODULE V BUSINESS MODELS AND BUSINESS PLAN FOR SOCIAL ENTERPRISES


MODULE VI THE IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETIES AND CASES


Case Study of Social Entrepreneurs

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

2. The Process of social value creation : A multiple case study on Social Entrepreneurship in India , Archana Singh Springer 2016

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

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

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

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

MODULE V
Team building skills-- group discussions pertaining to industries-- presenting career goals.  -- preparing for interviews- interpersonal skills

Total Hours – 30

REFERENCES:
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.
OBJECTIVES:
• To introduce different types of propellants for rocket propulsion and the study of system performance.

MODULE I CLASSIFICATION AND FUNDAMENTAL OF ROCKET PROPULSION

MODULE II LIQUID PROPELLANT ROCKET ENGINE FUNDAMENTALS
Propellants, Propellant Feed Systems, Gas Pressure Feed Systems, Propellant Tanks, Tank Pressurization, Turbopump Feed Systems and Engine Cycles, Flow and Pressure Balance

MODULE III LIQUID PROPELLANTS AND COMBUSTION

MODULE IV SOLID PROPELLANT ROCKET FUNDAMENTALS
Propellant Burning Rate, Basic Performance Relations, Propellant Grain and Grain Configuration, Propellant Grain Stress and Strain.

MODULE V SOLID PROPELLANTS AND COMBUSTION
Classification, Propellant Characteristics, Hazards, Propellant Ingredients, Other Propellant Categories Liners, Insulators, and Inhibitors, Combustion of Solid Propellants,
Physical and Chemical Processes, Ignition Process, Extinction or Thrust Termination, Combustion Instability

MODULE VI THRUST VECTOR CONTROL
TVC Mechanisms with a Single Nozzle, TVC with Multiple Thrust Chambers or Nozzles Testing Integration with Vehicle, Attitude Control and Side Maneuvers with Solid Propellant Rocket Motors

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Students will be able to

• Apply thermodynamic relations for rocket engines and nozzles for the evaluation of engine performance
• Understand the ballistics properties of propellants and combustion kinetics.
• Understand the mechanisms involved in thrust vector control.
OBJECTIVES:

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

MODULE I DRAG ON THE AIRPLANE

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

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 and load factor.

MODULE III STATIC LONGITUDINAL STABILITY AND CONTROL

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

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

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

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 – 45

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Students will be able to

• Have a broad understanding of the performance of aircraft during climb, cruise, descent and landing.
• Evaluate and understand the V-n diagram.
• Calculate the basic design parameters such as range and endurance
• Analyze the static and dynamic stability of aircraft.
OBJECTIVES:
• To introduce types of materials used in aircraft, their characteristics and applications.

MODULE I  INTRODUCTION TO AIRCRAFT MATERIALS  7
General properties of materials, definition of terms, requirements of aircraft materials, testing of aircraft materials, inspection methods, application and trends in usage in aircraft structures and engines, introduction to smart materials and nanomaterials; selection of materials for use in aircraft.

MODULE II  AIRCRAFT METAL ALLOYS  6
Aluminum alloys, magnesium alloys, titanium alloys, plain carbon and low carbon steels, corrosion and heat resistant steels, maraging steels, copper alloys, Producibility and surface treatments aspects for each of the above.

MODULE III  AIRCRAFT SUPERALLOYS AND CORROSION  7
General introduction to superalloys, nickel based superalloys, cobalt based superalloys, and iron based superalloys, manufacturing processes associated with superalloys, heat treatment and surface treatment of superalloys. Knowledge of the various methods used for removal of corrosion from common aircraft metals and methods employed to prevent corrosion.

MODULE IV  COMPOSITE MATERIALS  8
Definition and comparison of composites with conventional monolithic materials, reinforcing fibers and matrix materials, carbon-carbon composites production, intermetallic matrix composites, ablative composites based on polymers, ceramic matrix, metal matrix composites based on aluminum, magnesium, titanium and nickel based composites for engines.

MODULE V  POLYMERIC MATERIALS, CERAMICS&GLASS  9
Knowledge and identification of physical characteristics of commonly used polymeric
material: plastics and its categories, properties and applications; commonly used
ceramic, glass and transparent plastics, properties and applications, adhesives and
sealants and their applications in aircraft.

MODULE VI AIRED WOOD, RUBBER, FABRICS & DOPE AND
PAINT
Classification and properties of wood, seasoning of wood, aircraft woods, their
properties and applications, joining processes for wood, plywood; characteristics and
definition of terminologies pertaining to aircraft fabrics and their applications, purpose
of doping and commonly used dopes; purpose of painting, types of aircraft paints,
aircraft painting process.

L – 45; T – 15; Total Hours – 45

TEXT BOOKS:

REFERENCES:
1. F.C Campbell,” Manufacturing technology for aerospace structural materials”,
   Elsevier publication.

OUTCOMES:
Students will be able to

- Understand the properties of materials used in various parts of aircraft.
- Classify the materials based on the structures and its properties.
- Understand the importance of surface treatment/coating and its process.
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.

- Learn to work as a team to achieve the goal.
- Apply cognitive design skills to generic design problems.
OBJECTIVES:
• To introduce the basic concepts of avionics systems utilized in Aircraft.

MODULE I  INTRODUCTION
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
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:

MODULE IV  FLIGHT DECKS AND COCKPITS:
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 & 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 & NAVIGATION INSTRUMENTS )
Communications systems- Navigation systems – flight control systems – radar –
electronic warfare – utility systems reliability and maintainability –certification.

Total Hours – 45

TEXT BOOKS:


REFERENCES:


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.
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:
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.
AEC 4104  AIRCRAFT DESIGN PROJECT - II

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
7. Balancing and maneuvering loads on tail plane, aileron and rudder loads.
8. Detailed structural layouts
9. Design of some components of wings, fuselage

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.
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

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.
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 inviscid hypersonic flows.

MODULE II  SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS  8
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  EXPERIMENTAL FACILITIES FOR HYPersonic 8 FLOWS

Impulse facilities, hypersonic wind tunnels, shock tunnels, gun tunnels, and heat transfer measurements.

Total Hours – 45

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Students will be able to:

• Understand the procedure to solve inviscid and viscous hypersonic flow problems.
• Understand high temperature effects in hypersonic aerodynamics.
• Familiar with the experimental setups used for simulating hypersonic flows.
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:**

**REFERENCES:**

**OUTCOMES:**
Students will be able to

- Evaluate the state of stress and strain.
- Solve theory of elasticity problems using numerical methods.
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

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
Safe life and fail safe design philosophies, Importance of Fracture Mechanics in aerospace structures – Application to composite materials and structures.
TEXT BOOKS:

REFERENCES:

OUTCOMES:
Students will be able to

• Understand the fundamental principles and assumptions involved in the basic analysis of Fatigue and Fracture of Structures.
• Evaluate the structures from the view of fatigue and fracture mechanics.
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, Bedworth ratio, kinetic laws of oxidation, defect structure and control of oxidation by alloy additions,

MODULE IV  HOT 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.

**TEXT BOOKS:**

**REFERENCES:**

**OUTCOMES:**
Students will be able to

- Understand the failure mechanisms and the cause of surface defects of materials under high temperatures.
- Gain knowledge on Super alloys and their need in high temperature areas.
- Acquire knowledge about ablation and their importance in aeronautical applications.
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  FUNDAMENTALS AND HEAT CONDUCTION  10

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  6
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-overall heat transfer coefficient- LMTD- NTU method of heat exchanger analysis.

MODULE VI  HEAT TRANSFER PROBLEMS IN AEROSPACE  8
Heat transfer problems in gas turbine combustion chambers - rocket thrust chambers - aerodynamic heating - ablative heat transfer.

Total Hours – 45

TEXT BOOKS:

REFERENCES:

OUTCOMES:

Students will be able to

• Understand the equations governing conduction, convection and radiation problems.
• Apply suitable governing equation to solve the heat transfer problems
• Apply the knowledge base gain to solve simple heat transfer problems experienced by flight vehicles.
OBJECTIVES:

• To introduce the concepts of advanced propulsion systems applied for propelling flight vehicles within and beyond atmosphere

MODULE I PROPELLION FUNDAMENTALS AND OVERVIEW OF GAS DYNAMICS

Operational Envelopes, standard atmosphere, Air-breathing Engines Overview, Aircraft performance, Rocket Engines, H-K diagram, Normal shock wave, Flow with heat addition, flow with friction

MODULE II RAMJET ENGINES AND AIR AUGMENTED ROCKETS

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 SYSTEMS


MODULE IV NUCLEAR PROPULSION SYSTEMS

Fission propulsion, Radioisotope Nuclear Rocket, Fusion propulsion, Antimatter propulsion

Nuclear rocket engine design and performance – nuclear rocket reactors – nuclear

MODULE V ELECTRIC PROPULSION SYSTEMS 8
Basic concepts in electric propulsion, Power requirements and rocket efficiency, Electrothermal thrusters – Resistojet, Arcjet, Solar/Laser/Microwave thermal propulsion, Electrostatic thrusters – Hall Thruster, Field emission thruster, Colloid thruster, Large accelerated plasma Propulsion – current and future trends, Fundamentals of ion propulsion – performance analysis – electrical thrust devices – Ion rocket engine, Electromagnetic thrusters – MPD thruster, PPT, VASIMR, Induced spacecraft Interactions

MODULE VI ADVANCED PROPULSION CONCEPTS 6
Concepts of Micropropulsion – chemical propulsion, electrical propulsion, Propellantless propulsion – Tethers, Propellantless electric/nuclear propulsion, Photon Rocket, Beamed Energy Earth-to-Orbit Propulsion, Solar sails, Magnetic sails, Breakthrough propulsion

Total Hours –60

TEXT BOOKS:


REFERENCES:
Propulsion”, Progress in Aeronautics and Astronautics, Volume 189, AIAA, 2001

OUTCOMES:
Students will be able to

• Understand the principle and working of ramjet and scramjet engines
• Understand the concepts and applications of electric and nuclear propulsion systems
• Gain knowledge about the future propulsion systems.
OBJECTIVES:
• To introduce the procedures of for air traffic services and navigations

MODULE I BASIC CONCEPTS

MODULE II AIR TRAFFIC SERVICES
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 FLIGHT INFORMATION ALERTING SERVICES, COORDINATION
Radar service, basic radar terminology – identification procedures using primary / secondary radar – performance checks use of radar in area and approach control services

MODULE IV EMERGENCY PROCEDURES AND RULES OF THE AIR
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 AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION
width of runways – minimum distance between parallel runways etc. – obstacles restriction.

MODULE VI VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES

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 – 60

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Students will be able to

• Understand various Air Traffic Services and the navigation aids for aircraft landing
• Plan layouts of Aerodromes.
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 WORTHINESS REQUIREMENTS 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, 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-flight 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:**

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 ENGINEERING LICENSING


MODULE V C.A.R. SERIES ‘T’ - FLIGHT TESTING OF AIRCRAFT

Flight testing of (series) aircraft for issue of C of A; flight 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 balance control 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 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:

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.

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.
PHC 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
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
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

MODULE IV  NANOMATERIALS
Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical,

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.
5. Determination of paramagnetic susceptibility of given liquid.
7. Analysis of size effect on the absorption spectrum of nanomaterials.

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

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.
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

MODULE III FUNDAMENTALS OF THERMODYNAMICS 10

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:

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.
INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY

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

MODULE II SYNTHESIS AND IMAGING TECHNIQUES
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
Photolithography - electron beam lithography - X-ray and Ion beam lithography - nanoimprint lithography - soft lithography - nanoelectromechanical systems (NEMS) - nanoindentation principles.

PRACTICALS
2. Synthesis of nanomaterials by hydrothermal method.
4. Synthesis of nanomaterials by chemical bath deposition method.
5. Synthesis of nanomaterials by co-precipitation 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:

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.
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


MODULE II  DIFFERENT LASER SYSTEMS  8


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)
7. Bandgap determination of a semiconductor diode.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:


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.
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  
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  

MODULE III   MAGNETIC MATERIALS  
Introduction to magnetic materials & origin of magnetic moment - Different types of

**MODULE IV OPTICAL MATERIALS**


**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.

**REFERENCES:**

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.
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

MODULE II  RADIOGRAPHIC INSPECTION METHOD  10

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.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

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.
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
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

MODULE III  ACOUSTICS OF BUILDING
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
Polarization - double refraction - Theory of Plane, Circularly and Elliptically polarized light - Quarter wave plate and half wave plate - photo elasticity - Theory of photoelasticity - 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.
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:

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.
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

MODULE III  NDT TECHNIQUES  6

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.
4. Inspection of welds by Magnetic Particle Testing.
5. Determination of moment of inertia of the disc by torsion pendulum method.
7. Demonstration of working of flywheel.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

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.
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

MODULE III OPTICAL MODULATORS  7

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:


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.
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  

MODULE II  CHROMATOGRAPHY  

MODULE III  SPECTROSCOPY  

MODULE IV  THERMAL ANALYSIS  
Principle, instrumentation and applications: Thermo gravimetric 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:

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.
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-

MODULE II FORMS OF CORROSION  7
Forms of corrosion-conditions for electrochemical corrosion –galvanic corrosion –

MODULE III CORROSION CONTROL AND ORGANIC COATINGS  8
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


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:


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
OBJECTIVES:
The students should be conversant with
- preparation, properties and applications of plastics used in electrical and electronic applications
- properties and uses of electrical engineering materials
- classification and description of different types of batteries.
- classification and types of fuel cells

MODULE I  POLYMERS FOR ELECTRICAL AND ELECTRONIC APPLICATIONS
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

MODULE III  BATTERIES

MODULE IV  FUEL CELLS
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.
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.

**REFERENCES:**


**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.
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

MODULE II  ADHESIVES AND BINDING MATERIALS  7

MODULE III  LUBRICANTS  7
MODULE IV  COMPOSITE MATERIALS


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:

3. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.

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.
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


MODULE II  LIQUID AND GASEOUS FUELS


MODULE III  COMBUSTION

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

Friction and wear – lubricants: definition, functions and mechanism of lubrication

**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:**

2. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
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, volatile 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.
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.
4. Phase rule experiments with organic compounds: (i) naphthalene and p-dichlorobenzene (ii) naphthalene and diphenyl (iii) m-dinitrobenzenzene and p-nitrotoluene.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:


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
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

MODULE II  WASTE & WASTE MINIMISATION  8

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

PRACTICALS
1. Synthesis of an ionic liquids (Ex: imidazolium) and testing the solubility of organic
2. Green bromination of stilbene (using pyridine hydrobromide).
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).

**REFERENCES:**


**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.
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

MODULE III  AMINO ACIDS, PEPTIDES AND PROTEINS  7

MODULE IV  NUCLEIC ACIDS  8

PRACTICALS
1. Qualitative tests to identify carbohydrates.
2. Quantitative estimation of carbohydrates.
3. Separation of sugars – TLC and/or paper chromatography.
5. Separation of amino acids – TLC and/or paper chromatography.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

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.
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

MODULE II THERMOPLASTICS AND BIODEGRADABLE POLYMERS  8
Preparation, properties and applications : LDPE, HDPE, polypropylene, PVC, PTFE, PET, polyamides (Nylon-6 and Nylon 6,6) and polycarbonates – polymer blends and alloys – basics of biodegradable polymers.

MODULE III THERMOSET RESINS, ELASTOMERS AND FRP  7
MODULE IV MOULDING TECHNIQUES


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.
7. Synthesis of unsaturated polyester.
8. Preparation of FRP laminates.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:


OUTCOMES:

The student will be able to

- classify various polymers, name the polymers and types of polymerization
reactions, calculate molecular weight of polymers,
- summarise preparation, properties and applications of thermoplastics and give examples of biodegradable polymers
- elaborate the properties and applications of thermosets, elastomers and FRP
- select the appropriate moulding technique for a given polymer, based on the application
Maths Elective Courses
(to be offered in IV Semester)

MACX 01 DISCRETE MATHEMATICS AND GRAPH THEORY

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

MODULE II PREDICATE CALCULUS 7+3

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

TEXT BOOKS:

REFERENCES:

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.
OBJECTIVES:
The aims of this course are to impart the
- knowledge of the theory of probability and random variables
- techniques to carry out probability calculations and identifying probability distributions
- application of statistical inference in practical data analysis

MODULE I  BASICS OF PROBABILITY AND STATISTICS  8+2
Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye’s theorem - Descriptive Statistics.

MODULE II  ONE DIMENSIONAL RANDOM VARIABLE AND PROBABILITY DISTRIBUTION FUNCTIONS  7+3
Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III  TWO DIMENSIONAL RANDOM VARIABLES  8+2
Joint, marginal, conditional probability distributions –covariance, correlation - transformation of random variables.

MODULE IV  SAMPLING AND ESTIMATION  7+3
Sampling distributions – basic knowledge on Random, simple random, stratified and cluster samplings – Test of Hypotheses - concepts- Point estimation and Interval estimation.

MODULE V  THEORY OF INFERENCE  8+2
Large sample tests – test for single and difference on proportions, single mean, difference of means, difference of variances – confidence intervals. Small sample tests – Student’s t test, F test and Chi square test on theory of goodness of fit and analyses of independence of attributes.

MODULE VI  DESIGN OF EXPERIMENTS  7+3
Analysis of variance – one way classification – two way classification – Completely
Randomised Block Designs – Randomised Block Design – Latin square designs - Interpretations - case studies.

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

REFERENCES:

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.
OBJECTIVES:
The aims of the course are to
- acquire the knowledge of the theory of probability and random variables
- study discrete and continuous probability distributions.
- demonstrate the techniques of two-dimensional random variables and its distributions.
- introduce the random process, stationarity, Markov process and the study of correlation function and spectral analysis.

MODULE I Basics of Probability 7+3
Sample space, events - axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye’s theorem - Tchebychev’s inequality.

MODULE II One dimensional Random variable and Probability Distribution functions 7+3
Discrete random variable – continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III Two dimensional random variables 7+3
Joint, marginal, conditional probability distributions - covariance, correlation and regression lines - transformation of random variables.

MODULE IV RANDOM PROCESSES 8+2
Classification of Random process - Stationary process - WSS and SSS processes - Poisson process – Markov Chain and transition probabilities.

MODULE V CORRELATION FUNCTIONS 8+2
Autocorrelation function and its properties - Cross Correlation function and its properties - Linear system with random inputs – Ergodicity.

MODULE VI SPECTRAL DENSITY 8+2
Density Spectrum.

\[ L - 45; \ T - 15; \ \text{Total Hours} \ - 60 \]

**TEXT BOOKS:**


**REFERENCES:**


**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.
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

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

MODULE IV  INITIAL VALUE PROBLEMS FOR FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS  7+3
Numerical solutions by Taylor’s Series method, Euler’s method, Modified Euler’s Method - Runge – Kutta Method of fourth order – Milne’s and Adam’s Bashforth Predictor and Corrector methods

MODULE V  INITIAL AND BOUNDARY VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS  8+2
Numerical solutions by Taylor’s Series method - Runge – Kutta Method of fourth order of second order ODE. Finite difference methods.
MODULE VI  BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace equation.

TEXT BOOKS:

REFERENCES:

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

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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

MODULE II ADVANCED LINEAR PROGRAMMING PROBLEMS

MODULE III TRANSPORTATION PROBLEM
Transportation problems – Initial basic feasible solutions, MODI method, Unbalanced transportation problem, Degeneracy in transportation models.

MODULE IV ASSIGNMENT PROBLEM
Assignment problem – Minimization and Maximization type of problems by Hungarian method.

Total Hours – 30

TEXT BOOKS:

REFERENCES:


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.
OBJECTIVES:
The aim of the course is to
- introduce statistical quality control tools.

MODULE I 
TESTS OF HYPOTHESES AND STATISTICAL INFERENCE 
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

MODULE III 
STATISTICAL QUALITY CONTROL-I
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

Total Hours –30

TEXT BOOKS:

REFERENCES:
2. Chin Long chiang “Statistical Methods of Analysis “World Scientific Books,

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.
OBJECTIVES:
- This course aims to solve numerically integral and differential equations.

MODULE I  NUMERICAL INTEGRATION  8
Numerical integration by trapezoidal and Simpson’s 1/3 and 3/8 rules – Romberg’s method – Two Point and Three point Gaussian quadrature formulae.

MODULE II  NUMERICAL DOUBLE INTEGRATION  6
Double integrals using trapezoidal and Simpson’s 1/3 rules

MODULE III  NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS  8

MODULE IV  BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS  8
Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations

Total Hours –30

TEXT BOOKS:

REFERENCES:
**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.
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

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:

REFERENCES:
2. Alfio Quarteroni, “Mathematical models in science and engineering”, Notices of AMS
3. J.N. Kapur, “Mathematical models in Biology and Medicine”, Affiliated East-
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
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:

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.
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

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

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.
TEXT BOOKS:

REFERENCES:

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.
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

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

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

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

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

TEXT BOOKS:

REFERENCES:

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.
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:

REFERENCES:

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
B.Tech. Aeronautical Engineering Regulations 2017

Humanities Elective II
(To be offered in IV Semester)

SSCXO4 ECONOMICS OF SUSTAINABLE DEVELOPMENT L T P C 2 0 0 2

OBJECTIVES:

- To have an increased awareness on the concept and components of sustainable development.
- To develop the ability to demonstrate the need of sustainable development and international responses to environmental challenges.
- To have an insight into global environmental issues and sustainable globalization.
- To establish a clear understanding of the policy instruments of sustainable development.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 7

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 8
Need for sustainability – Global environmental challenges: population growth, resource depletion, pollution, energy use, climate change, pollution, growing water scarcity, other urban problems, loss of biodiversity, hazardous wastes disposal. International responses to environmental challenges - Global policy such as Kyoto Protocol, Montreal Protocol, Basel Convention.

MODULE III GLOBALIZATION AND ENVIRONMENT SUSTAINABILITY 8

MODULE IV POLICIES FOR ACHIEVING SUSTAINABLE DEVELOPMENT 7
Principles of environmental policy for achieving sustainable development: precautionary principle and polluter pays principle – Business Charter for Sustainable Development. Policy instruments for sustainable development: direct regulation – market based pollution control instruments such as pollution tax, subsidy, pollution permits.

L – 30; T – 0; Total Hours – 30

TEXT BOOKS:

REFERENCES:

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.
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

L – 30; T – 0; Total Hours –30
TEXT BOOKS:

REFERENCES:
1. Robbins, Stephen, Organizational Behaviour , Prentice Hall of India PVT Ltd new Delhi, 1985

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.
OBJECTIVES:

- To understand the Constitution and Governance of our country.
- To apprise the students of human rights - local and international anc 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

MODULE II HUMAN RIGHTS

MODULE III INDUSTRIAL, CORPORATE AND LABOUR LAWS

MODULE IV LAWS RELATED TO IPR

TEXT BOOKS:
2. H. D, Agarwal (2008), International Law and Human Rights, Central Law
Publications,

REFERENCES:

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

MODULE II NATURAL DISASTERS
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
Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion

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

MODULE V NATURAL DISASTER REDUCTION & MANAGEMENT
Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards
MODULE VI  ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA

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:


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.
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

MODULE III  TQM IMPROVEMENT PROCESS  8

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

MODULE VI  
QUALITY SYSTEMS

L – 45; Total Hours –45

TEXT BOOKS:

REFERENCES:

OUTCOMES:
The student should be able to
• apply the various statistical tools and approaches for Quality control.
• achieve continuous process improvement through TQM.
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

MODULE III  OTHER RENEWABLE ENERGY SOURCES  8
Power from wind – wind turbine working and types, solar thermal power plants – low medium and high power generation, power from wave, tidal, geothermal sources, OTEC system. MHD power plants – working, types, merits and demerits. Energy from biomass.

MODULE IV  COGENERATION, WASTE HEAT RECOVERY AND COMBINED CYCLE PLANTS  8
advantages, different combinations and practical scope.

**MODULE V  ENERGY CONSERVATION AND MANAGEMENT  7**


**MODULE VI  GLOBAL ENERGY ISSUES AND CARBON CREDITS  7**


L – 45; Total Hours –45

**TEXT BOOKS:**

**REFERENCES:**

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

MODULE I
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

MODULE III ROBOT SENSORS

MODULE IV ROBOT PROGRAMMING & AI TECHNIQUES
Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

MODULE V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS
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


L – 45; Total Hours – 45

REFERENCES:


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.
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

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  
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  
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:

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

MODULE I  BASIC CONCEPTS AND SYSTEM REPRESENTATION  8
Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

MODULE II  TIME RESPONSE ANALYSIS AND DESIGN  8

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

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:


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.
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

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:

REFERENCES:

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
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

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:

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
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

MODULE II  SYMMETRIC ENCRYPTION AND MESSAGE  CONFIDENTIALITY  7
Symmetric Encryption Principles - Symmetric Block Encryption Algorithms - Random and Pseudorandom Numbers - Stream Ciphers and RC4 - Cipher Block Modes of Operation

MODULE III  PUBLIC KEY CRYPTOGRAPHY AND MESSAGE  AUTHENTICATION  8

MODULE IV  KEY DISTRIBUTION, USER AUTHENTICATION AND TRANSPORT-LEVEL SECURITY  8
Symmetric Key Distribution Using Symmetric Encryption - Kerberos - Key Distribution Using Asymmetric Encryption - X.509 Certificates - Public-Key Infrastructure - Federated Identity Management - Web Security Considerations -
Secure Socket Layer and Transport Layer Security - Transport Layer Security

MODULE V WIRELESS NETWORK SECURITY, ELECTRONIC MAIL SECURITY AND IP SECURITY

MODULE VI SYSTEM SECURITY
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:

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.
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

MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9

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

L – 45; Total Hours – 45

TEXT BOOKS:


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
OBJECTIVES:

- To understand the basics of Cyber Security Standards and Policies.
- To know the legal, ethical and professional issues in Cyber security.
- To understand Cyber Frauds and Abuse and its Security Measures.
- To know the technological aspects of Cyber Security.

MODULE I  FUNDAMENTALS OF CYBER SECURITY  7
Security problem in computing – Cryptography Basics – History of Encryption –
Modern Methods – Legitimate versus Fraudulent Encryption methods –
Encryption used in Internet.

MODULE II  CYBERCRIME AND CYBEROFFENSES  8
Cybercrime and Information Security – Cybercriminals – Classifications of
Cybercrimes – Email Spoofing – Spamming – Cyber defamation – Internet Time
Theft – Forgery – Web jacking – Hacking – Online Frauds – Software Piracy –
Mail Bombs – Password Sniffing – Cyberoffenses – Categories – Planning the
attacks – Cyberstalking – Cybercafe and Cybercrimes – Botnets.

MODULE III  CYBERCRIME: MOBILE AND WIRELESS DEVICES  8
Proliferation of Mobile and Wireless Devices – Trends in Mobility – Credit card
frauds in Mobile and Wireless Computing – Security Challenges – Authentication
Service Security – Attacks on Mobile Phones.

MODULE IV  TOOLS AND METHODS USED IN CYBERCRIME  8
Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers
and Spywares – Virus and Worms – Trojan Horses and Backdoors –

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


L – 45; Total Hours –45

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Upon completion of this course, students will be able to
- Explain the general security issues.
- Discuss various cybercrimes and offenses.
- Outline the occurrence of Cybercrime in mobile and wireless environment.
- Use relevant tools and methods in cybercrime
- Apply security policies in cyber forensics.
- Outline the strategies adopted in computer forensics.
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 MENDELMISM 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**

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.

**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
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

MODULE II  PROJECT MANAGEMENT PROCESS, TOOLS AND TECHNIQUES  8
Project life cycle-Initiation, Planning, Execution, Monitoring and Closing Phase;  - Link between project management process, process groups and knowledge areas; Project management tools and techniques- Project Stakeholders description and mapping - Stakeholder Management Process

MODULE III  PROJECT QUALITY, COST AND SCHEDULE MANAGEMENT  10
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

L – 45; Total Hours –45

REFERENCES:

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.
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

MODULE II  ARTIFICIAL VARIABLE AND TWO PHASE METHOD, DUALITY  6

MODULE III  TRANSPORTATION PROBLEM & ASSIGNMENT PROBLE  8
Transportation problems – Initial basic feasible solutions, MODI method, Unbalance in transportation, Degeneracy in transportation models, Assignment problem – Minimization and Maximization type of problems by Hungarian method.

MODULE IV  NETWORK AND SEQUENCING PROBLEMS  8
PERT and CPM – Network diagram – Fulkerson's rule - CPM Probability of achieving completion date – Crash time – Cost analysis. Sequencing N jobs through 2 machines and 3 machines.

MODULE V  QUEUING THEORY & SIMULATION  7
Poisson arrivals and exponential service times – characteristics of Queuing models – single channel – Introduction to multi channel models – Random number generation – Monte Carlo Simulation.

MODULE VI  INVENTORY CONTROL, REPLACEMENT MODELS AND GAME THEORY  8
Types of inventory - Inventory cost - EOQ - Deterministic inventory problems – Introduction to probabilistic models & system level inventory control - Replacement models – Replacement of items that deteriorate with time – value of money changing with time – not changing with time – Individual and group replacement policy - Game theory – simple games.

L – 45; Total Hours –45

TEXT BOOKS:


REFERENCES:


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.
OBJECTIVES:

• To introduce the basic concepts of Nanoscience relevant to the field of engineering.
• To provide an exposure about the importance of various synthesis method.
• To enrich the knowledge of students in various characterisation techniques.

MODULE I

INTRODUCTION & CLASSIFICATION OF NANOMATERIALS
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
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
Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV

CARBON BASED NANOMATERIALS

MODULE V

NANOPHOTONICS
Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

MODULE VI

CHARACTERISATION TECHNIQUES
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:

REFERENCES:

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.
OBJECTIVES:

- To know about the various methods of maintaining procedure, vehicle insurance and basic problems in a vehicle.
- The student able to impart knowledge in maintaining of engine components and subsystems.
- The student able to impart knowledge in maintaining of transmission, driveline, steering, suspension, braking and wheels.
- The student able to impart carefully maintaining their vehicle and can increase driving safety.

MODULE I
MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS


MODULE II
ENGINE AND ENGINE SUBSYSTEM 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

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 CONDITIONING MAINTENANCE  
8
Maintenance of batteries, starting system, charging system and body electrical - Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

L – 45; Total Hours –45

**TEXT BOOKS:**

3. Vehicle Service Manuals of reputed manufacturers

**REFERENCES:**

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.
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

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

REFERENCES

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
B.Tech.  Aeronautical Engineering

Group II courses
(To be offered in VII Semester)

GECX201 GREEN DESIGN AND SUSTAINABILITY  L  T  P  C
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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

MODULE II  SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS  8

MODULE III  FRAMEWORK FOR ACHIEVING SUSTAINABILITY  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

MODULE V  ENERGY CONSERVATION AND EFFICIENCY  7
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:


REFERENCES:


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.
OBJECTIVES:

- To impart students knowledge about the basics and applications of various appropriate technologies in the field of civil engineering.

MODULE I    BASICS CONCEPTS

Background, Tools, Choices and Implications, Appropriate Technology Movement (an overview) - Basic design process, basic financial analysis - discounted cash flow, and energy fundamentals.

MODULE II    APPROPRIATE TECHNOLOGY WITH REFERENCE TO BUILDING DESIGN


MODULE III    WATER, HEALTH AND SANITATION MANAGEMENT


MODULE IV    WASTE MANAGEMENT

Types of Waste - Sources - Collections and On-Site Processing - Transferring Stations - Disposal Systems - Recycling.

MODULE V    ENERGY EFFICIENT TECHNIQUES


MODULE VI    TECHNOLOGY POLICY


L – 45; Total Hours – 45
TEXT BOOKS:

REFERENCES:

OUTCOMES:

• At the end of the course, the students will be able to use suitable technologies for various conditions for sustainable development.
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

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

REFERENCES:


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.
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

MODULE IV   FUNCTION ANALYSIS AND CREATIVE PHASES  9

MODULE V   EVALUATION, INVESTIGATION AND RECOMMENDATION  6
Paired comparison and Evaluation Matrix techniques - Criteria for selection of

**MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES**


**L – 45; Total Hours –45**

**TEXT BOOKS:**


**REFERENCES:**


**OUTCOMES:**

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.
OBJECTIVES:
• To understand the various safety measures to be taken in different industrial environments.

MODULE I SAFETY MANAGEMENT

MODULE II SAFETY IN MANUFACTURING
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

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

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
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


L – 45; Total Hours –45

REFERENCES:


OUTCOMES:

Students would be able to
- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.
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

MODULE III  GENETIC ALGORITHM  7

MODULE IV  ANT COLONY OPTIMIZATION  8

MODULE V  FUZZY LOGIC AND ANN  8
MODULE VI IMPLEMENTATIONS & APPLICATIONS


L – 45; Total Hours – 45

REFERENCES:


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
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GECX207 | MATLAB SIMULINK | L T P C
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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


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 REPRESENTATION OF NUMBERS 7

Linearization and solving non-linear systems of equations - The Newton-Raphson method - Integers and rational numbers in different bases - Floating point numbers - Round off and errors in basic arithmetic - Significant digits when reporting results

MODULE IV ORDINARY DIFFERENTIAL EQUATIONS 8

Numerical integration and solving 1st order, ordinary differential equations (Euler’s method and Runge-Kutta) - Use of ODE function in MATLAB

MODULE V NON-LINEAR DIFFERENTIAL EQUATIONS 8

Converting 2nd order and higher ODEs to systems of 1st order ODEs - Solving systems of ODEs via Euler’s method and Runge-Kutta - Solving single and systems of non-linear differential equations by linearization - Use of the function ODE in MATLAB to solve differential equations
MODULE VI  
INTRODUCTION OF SIMULINK

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:

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 Matlab 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.
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

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 and TOOLS  8
Development process of an embedded system-software modules and tools for implementation of an embedded system- Integrated development environment- Host and target machines-cross compiler-cross assembler-Choosing right platform.

MODULE V  PROGRAM MODELING IN EMBEDDED SYSTEMS  8
Program Models – Data Flow Graph model-control DFG model-Synchronous DFG model- Finite state machines- UML modeling – UML Diagrams.
MODULE VI  EMBEDDED SYSTEMS APPLICATION  5

Application specific embedded system – case study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card.

Total Hours – 45

TEXT BOOKS:


REFERENCES:


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.
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

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

MODULE IV  USABILITY TESTING  8

MODULE V  USABILITY ASSESSMENT METHODS  8
MODULE VI USER INTERFACES

L – 45; Total Hours –45

TEXT BOOKS:

REFERENCES:

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.
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 an 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
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
Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

MODULE III AGGREGATE PLANNING AND MANAGING SUPPLY, DEMAND AND INVENTORY

MODULE IV MANAGING INVENTORY IN SUPPLY CHAIN
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
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
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:


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.
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

MODULE II  AUTOMATED TOOLS FOR SYSTEMS DEVELOPMENT  7
What is requirements determination? Fact finding techniques, Tools for
documenting procedure and decision-CASE Tools-Need for CASE tools-
Reverse engineering and reengineering- phases of the software life cycle-
Ranking projects-Value Chain Analysis- Corporate Strategic Planning vs. Information Systems Planning.

MODULE III  SYSTEM ANALYSIS  8
Determining System Requirements – Traditional Methods - Modern Methods –
Radical Methods – Structuring System Requirements – Process Modeling –

MODULE IV  SYSTEM DESIGN  8
System Implementation – Software Application Testing – Installation –
MODULE V  USABILITY AND MEASURING USER SATISFACTION  7

Usability Testing-User satisfaction test- A tool for analyzing user satisfaction –

MODULE VI  SAD IN E-COMMERCE  7


L – 45; Total Hours –45

REFERENCES:

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.
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

MODULE III
8

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

MODULE VI

L – 45; Total Hours – 45

REFERENCES:
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 semiconductor devices
- applications of smart materials
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

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 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

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

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:

3. Social Problems in India, Ram Ahuja.

REFERENCES:


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
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  

MODULE II  
SI ENGINE EMISSIONS AND CONTROL  
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  
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  
MODULE V  TEST PROCEDURES  
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  
Emission analysers — NDIR, FID, Chemiluminescent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

L – 45; Total Hours –45

TEXT BOOKS:


REFERENCES:


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.
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 about various types of motor vehicle polices and insurances

MODULE I BASIC RULES FOR ROAD VEHICLE
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
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 conviction - Endorsement.

MODULE III REGISTRATION OF MOTOR VEHICLE
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

REFERENCES:
1. The Motor Vehicles Act, 1988 Along with Latest Case Law, Notifications
& Table of Offences and Punishments Asia Law House; 15th edition (2014)

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
### 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

### 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

**TEXT BOOKS:**

REFERENCES:
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.
OBJECTIVES:

The objective of the Course to make the student know about

- the basics of lean production management,
- how Lean principles are applied to the Construction industry to improve the operation management and product development.

MODULE I

lean production? – Introduction, background, and lean thinking. Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production System.

MODULE II


MODULE III

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


MODULE V

Managing change in the lean organization Human resource management and the lean enterprise Employee involvement – Teams – Training – Supporting and encouraging involvement – Involving people in the change process -- communication - - Importance of culture. Startup of lean processes and examples of applications.
Sustaining improvement and change, auditing, follow-up actions.

**MODULE VI**
The lean enterprise and supply chain management Costs and risks of lean initiatives - Measuring lean initiatives

**TEXT BOOKS:**


**REFERENCES:**

1. Readings at http://www.leanconstruction.org/readings.htm

**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 lean 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
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
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
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
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
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, viewshed analysis – solar irradiation, photovoltaic energy potential, time series of elevation data, analysis of coastal change.

MODULE V FLOW TRACING, WATERSHED ANALYSIS AND 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**

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.

**TEXT BOOKS:**


**REFERENCES:**


**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.