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

Regulations 2017
Curriculum and Syllabi

(Amendments updated upto June 2020)

B.Tech.
(Aeronautical Engineering)

B.S. Abdur Rahman Crescent Institute of Science & Technology

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

REGULATIONS 2017

CURRICULUM AND SYLLABI
(Amendments updated upto June 2020)

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 multidisciplinary areas of importance and to play a vital role in the Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To blossom into an internationally renowned Institute.
- To empower the youth through quality and value-based education.
- To promote professional leadership and entrepreneurship.
- To achieve excellence in all its endeavors to face global challenges.
- To provide excellent teaching and research ambience.
- To network with global Institutions of Excellence, Business, Industry and Research Organizations.
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation.

DEPARTMENT OF AEROSPACE ENGINEERING

VISION AND MISSION

VISION

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

MISSION

- To provide quality education and training in Aerospace Engineering to bring out motivated and capable aerospace engineers.
- To create stimulating environment and supportive infrastructure for knowledge development in Aerospace and related areas.
- To develop analytical skills and undertake collaborative research in Aerospace and related industries.
- To provide leadership qualities and team spirit through a balanced curriculum along with co-curricular, extra-curricular and professional society activities.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

B.TECH. (AERONAUTICAL)

PROGRAMME EDUCATIONAL OBJECTIVES

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

PROGRAMME OUTCOMES

The graduates will be able to

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Identify, formulate, research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- Use research –based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological

PROGRAMME SPECIFIC OUTCOMES

- Formulate and solve problems in Aeronautical Engineering using the knowledge acquired in core areas of aerodynamics, aircraft structures, propulsion, materials, flight dynamics and avionics.
- Design aircraft systems, components and processes to meet desired needs within realistic constraints.

REGULATIONS - 2017
B.TECH. DEGREE PROGRAMMES
(With Amendments incorporated up to June 2020)
(Under Choice Based Credit System)

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 theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in a semester like Mathematics, Physics, Engineering Graphics, Fluid Mechanics, 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. Mechanical Engineering
10. Polymer Engineering
11. Biotechnology
12. Artificial Intelligence and Data Science
13. Computer Science and Engineering(Cyber Security)
14. Computer Science and Engineering(Internet of Things)

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every Programme has 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 or 80 hours per semester.

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

4.4 For the award of the degree, a student has to earn a minimum total credits specified in the curriculum of the respective programme of study.

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 shall 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 shall 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) are 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 shall 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 is constituted branch wise and semester wise

8.1 The composition of class committees for first and second semester is 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 is 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 three times during the semester. The first meeting shall 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 shall be decided for the first and second assessment. The second meeting shall be held within a week after the date of first assessment report, to review the students' performance and for follow up action.

8.4 During these two meetings the student members, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi, etc.

8.5 The third 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 ENROLLMENT

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

9.2 For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous 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 continuous assessment test 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 continuous assessment test 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 shall 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 ENROLLMENT & 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:

Assessments	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 6	1.5 hours	25%
Assessment 2	7 to 12	1.5 hours	25%
Semester End Examination	Full course	3 hours	50%

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

13.3 Every practical course shall 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 for the award of pass grade.

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 shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research organisation. The weightage for Industry internship 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, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the Viva Voce examination.

13.8 Assessment of seminars and comprehension shall 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 shall 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 is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. 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 Head of the Department / Dean of School for that purpose. However there is no substitute examination for semester end examination.

14.2 A student 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 assessment test. However the substitute examination will be conducted only after the last working day of the semester and before the 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 shall 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 redo a core course wherein “I” or “W” grade is awarded. If the student is awarded, “I” or “W” grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of Head of the Department / Dean of School.

15.5 A student who is awarded “U” grade in a course shall 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 shall be considered as internal mark for further appearance of arrear examination.

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

16.0 REDO COURSES

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

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

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

17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

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

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

"W" denotes withdrawal from the course.

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

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester end examination.

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

17.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department / Dean of the School 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 contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

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

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

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

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

“I” and "W" grades are excluded for calculating GPA.

"U", “I”, "AB" and **"W"** grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks shall be as follows:

Percentage Equivalent of Marks = CGPA X 10

17.6 After successful completion of the programme, the Degree shall 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 is not counted. The students who do not satisfy the above two conditions shall be classified as second class. For the purpose of classification, the CGPA shall 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 courses under SWAYAM up to 20% of credits of courses in a semester excluding project semester 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. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

19.0 SUPPLEMENTARY EXAMINATION

Students of final year can apply for supplementary examination for a maximum of three courses thus providing an opportunity to complete their degree programme. Likewise students with less credits can also apply for supplementary examination for a maximum of three 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 in both Odd and Even Semester.

20.0 PERSONALITY AND CHARACTER DEVELOPMENT

20.1 All students shall enroll, on admission, in any of the personality and character development programmes such as NCC, NSS, NSO, YRC, Rotaract, etc., and undergo related activities during the period of study.

21.0 DISCIPLINE

21.1 Every student is expected to observe disciplined and decorous behaviour both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

21.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean shall be referred to a Discipline and Welfare Committee constituted by the Registrar 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, etc.

iii) no disciplinary action pending against him/her.

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

23.0 MINOR DEGREES OFFERED FOR STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2020- 21

23.1 The students admitted in the following B.Tech. Programmes from the academic year 2020 – 21 can graduate with a minor degree, which is optional, along with a major degree:

• Civil Engineering	• Mechanical Engineering
• Electronics and Communication Engineering	• Electrical and Electronics Engineering
• Automobile Engineering	• Aeronautical Engineering
• Polymer Engineering	• Biotechnology Engineering
• Electronics and Instrumentation Engineering	• Computer Science and Engineering
• Information Technology	• Artificial Intelligence and Data Science
• Computer Science and Engineering (IoT)	• Computer Science and Engineering (Cyber Security)

23.2 The eligibility for choosing the minor degree is given as below:

Sl. No.	Minor Degree (Optional)	Eligible Major Degree Programmes (from other Departments)
1.	Artificial Intelligence and Machine Learning	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg.
2.	Block Chain	
3.	Cyber Security	
4.	Data Science	
5.	Internet of Things (IoT)	
6.	Virtual and Augmented Reality	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engineering Electronics & Instrumentation Engg. Electronics & Communication Engg.
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engg.
8.	Robotics	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT)

		Computer Science & Engineering Information and Technology Civil Engineering Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg.
9.	3D Printing	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Civil Engineering Biotechnology Electronics & Communication Engg.
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electronics & Communication Engg.
12.	GIS and Remote Sensing	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT)

		Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.
13.	Computational Biology	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.

23.3 A student shall earn an additional 18 to 20 credits for the award of minor degree.

23.4 A student shall be awarded a minor degree only when he / she completes the requirements for the award of major degree stipulated in the respective programme.

24.0 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.

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

B.TECH. AERONAUTICAL ENGINEERING

CURRICULUM & SYLLABUS, REGULATIONS 2017

SEMESTER I

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

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 1281	Advanced Calculus	3	1	0	4
2.	BS	-	Physics Elective	2	0	2	3
3.	BS	-	Chemistry Elective	2	0	2	3
4.	ESF	GEC 1211	Basic Engineering Mechanics	3	1	0	4
5.	BS	GEC 1212	Environmental Studies	2	0	0	2
6.	ESF	GEC 1213	Computer Programming II	1	0	2	2
7.	EC	AEC 1211	Introduction to Aeronautical Engineering	3	0	0	3

8.	EC	AEC 1212	Aircraft Component Modeling & Drafting Laboratory	0	0	3	1	
9.	EC	AEC 1213	Aircraft Structure Repair Laboratory	0	0	3	1	**23**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC 2181	Partial Differential Equations and Transforms	3	1	0	4	
2.	HS	-	Humanities Elective I	2	0	0	2	
3.	HS	ENC 2181	Oral Communication	0	0	2	1	
4.	EC	AEC 2101	Solid Mechanics	3	0	0	3	
5.	EC	AEC 2102	Engineering Thermodynamics	3	1	0	4	
6.	EC	AEC 2103	Fluid Mechanics	3	0	0	3	
7.	EC	EIC 2181	Basic Electrical and Electronics Engineering	3	0	0	3	
8.	EC	AEC 2104	Thermodynamics Laboratory	0	0	3	1	
9.	EC	AEC 2105	Fluid Mechanics Laboratory	0	0	3	1	
10.	EC	EIC 2182	Electrical and Electronics Engg Laboratory	0	0	3	1	**23**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	-	Mathematics Elective I	3	1	0	4
2.	HS	-	Humanities Elective II	2	0	0	2
3.	HS	ENC 2282	Written Communication	0	0	2	1
4.	EC	AEC 2211	Low Speed Aerodynamics	3	0	0	3
5.	EC	AEC 2212	Aircraft Structural Mechanics	3	1	0	4
6.	EC	AEC 2213	Air Breathing Propulsion	3	0	0	3

7.	EC	AEC 2214	Aircraft Systems and Instruments	3	0	0	3	
8.	EC	AEC 2215	Solid Mechanics Laboratory	0	0	3	1	
9.	EC	AEC 2216	Aircraft Systems and Instruments Laboratory	0	0	3	1	
10.	EC	AEC 2217	Propulsion Laboratory	0	0	3	1	**23**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	MS	MSC 3181/ MSC 3182	Leadership and CEO training / Social Entrepreneurship	3	0	0	3	
2.	GE	-	General Elective I	3	0	0	3	
3.	HS	ENC 3181	Communication & Soft Skill I Career Choice	0	0	2	1	
4.	EC	AEC 3101	Compressors and Turbines	2	0	0	2	
5.	EC	AEC 3102	Aircraft Structural Design and Analysis	3	1	0	4	
6.	EC	AEC 3103	High Speed Aerodynamics	3	1	0	4	
7.	EC	-	Electives	6	0	0	6	
8.	EC	AEC 3104	Aerodynamics Laboratory	0	0	3	1	
9.	EC	AEC 3105	Aircraft Structural Analysis Laboratory	0	0	3	1	**25**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	MS	MSC 3181/ MSC 3182	Leadership and CEO training / Social Entrepreneurship	3	0	0	3
2.	BS	-	Mathematics Elective II	2	0	0	2

3.	HS	ENC 3281	Communication and Soft skill II Confidence Building	0	0	2	1	
4.	EC	AEC 3211	Rocket Propulsion	3	0	0	3	
5.	EC	AEC 3212	Flight Dynamics	3	0	0	3	
6.	EC	AEC 3213	Aircraft Materials and Processes	3	0	0	3	
7.	EC	-	Electives	6	0	0	6	
8.	EC	AEC 3214	Aircraft Design Project - I	1	0	3	2	**23**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	GE	-	General Elective II	3	0	0	3	
2.	EC	AEC 4101	Avionics	3	0	3	4	
3.	EC	AEC 4102	Finite Element Method	3	0	0	3	
4.	EC	AEC 4103	UAV and MAV Systems	2	0	0	2	
5.	EC	-	Electives	7	0	0	7	
6.	EC	AEC 4104	Aircraft Design Project – II	1	0	3	2	
7.	EC	AEC 4105	CFD-Structural Analysis Laboratory	0	0	3	1	
8.	EC	AEC 4106	Internship	0	0	*	1**	**23**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	AEC 4211	Project Work	0	0	24	12	**12**

Total credits – 175

* 15 days

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

PROGRAMME ELECTIVES

ODD SEMESTER ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	PE	AECX 01	Optical Flow Diagnostics	2	0	0	2
2	PE	AECX 02	Hypersonic Aerodynamics	3	0	0	3
3	PE	AECX 03	Industrial Aerodynamics	3	0	0	3
4	PE	AECX 04	Grid Generation	2	0	0	2
5	PE	AECX 05	Wind Tunnel Model Design	1	0	0	1
6	PE	AECX 06	Theory of Elasticity	3	0	0	3
7	PE	AECX 07	Fatigue and Fracture Mechanics	3	0	0	3
8	PE	AECX 08	Structural Analysis Tools (NASTRAN and PATRAN)	2	0	0	2
9	PE	AECX 09	Smart Structures	1	0	0	1
10	PE	AECX 10	Aircraft Structural Testing and Qualification	1	0	0	1
11	PE	AECX 11	Measurement Systems	3	0	0	3
12	PE	AECX 12	NDT techniques for Aircraft Structures	1	0	0	1
13	PE	AECX 13	Airframe Repair and Maintenance	3	0	0	3
14	PE	AECX 14	Behavior of Materials at High Temperatures	3	0	0	3
15	PE	AECX 15	Heat Transfer	3	0	0	3
16	PE	AECX 16	Advanced Propulsion Systems	3	0	0	3
17	PE	AECX 17	Micro Propulsion	1	0	0	1
18	PE	AECX 18	Cryogenics	2	0	0	2
19	PE	AECX 19	Air Traffic Control and Aerodrome Design	3	0	0	3
20	PE	AECX 20	Aviation Rules and Regulation	3	0	0	3

EVEN SEMESTER ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	PE	AECX 21	Experimental Aerodynamics	3	0	0	3
2	PE	AECX 22	Computational Fluid Dynamics	3	0	0	3
3	PE	AECX 23	Viscous Flows	3	0	0	3
4	PE	AECX 24	Aero-acoustics	1	0	0	1
5	PE	AECX 25	Wind Engineering	3	0	0	3
6	PE	AECX 26	Composite Materials and Structures\	3	0	0	3
7	PE	AECX 27	Experimental Techniques For Aircraft Structures	2	0	0	2
8	PE	AECX 28	Vibration and Aero Elasticity	3	0	0	3
9	PE	AECX 29	Hyper Mesh	2	0	0	2
10	PE	AECX 30	Combustion	3	0	0	3
11	PE	AECX 31	Rockets and Missiles	3	0	0	3
12	PE	AECX 33	Aircraft Cooling Systems	1	0	0	1
13	PE	AECX 34	Aircraft General Engineering and Maintenance	3	0	0	3
14	PE	AECX 35	Product Development and 3D Printing Technologies	2	0	0	2
15	PE	AECX 36	Advanced Manufacturing Technologies	2	0	0	2
16	PE	AECX 37	Aircraft Navigation and Guidance	3	0	0	3
17	PE	AECX 38	Control Engineering	3	0	0	3

18	PE	AECX 39	Microprocessor and Microcontroller for Aircraft Systems	2	0	0	2
19	PE	AECX 40	Mathematical Modeling and Simulation (MATLAB)	2	0	0	2

Physics Elective Courses
(To be offered in II Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	PHCX 01	Fundamentals of Engineering Materials	2	0	2	3
2.	PHCX 02	Heat and Thermodynamics	2	0	2	3
3.	PHCX 03	Introduction to Nanoscience and Technology	2	0	2	3
4.	PHCX 04	Lasers and their applications	2	0	2	3
5.	PHCX 05	Materials Science	2	0	2	3
6.	PHCX 06	Non-Destructive Testing	2	0	2	3
7.	PHCX 07	Properties of Matter and Acoustics	2	0	2	3
8.	PHCX 08	Properties of Matter and Nondestructive Testing	2	0	2	3
9.	PHCX 09	Semiconductor Physics and Optoelectronics	2	0	2	3

Chemistry Elective Courses
(To be offered in II Semester)

Sl. No.	Course code	Name of the Courses	L	T	P	C
1.	CHCX 01	Analytical instrumentation	2	0	2	3
2.	CHCX 02	Corrosion and its control	2	0	2	3
3.	CHCX 03	Electrical materials and batteries	2	0	2	3
4.	CHCX 04	Engineering materials	2	0	2	3
5.	CHCX 05	Fuels and combustion	2	0	2	3
6.	CHCX 06	Fundamentals of physical chemistry	2	0	2	3
7.	CHCX 07	Green technology	2	0	2	3
8.	CHCX 08	Organic chemistry of biomolecules	2	0	2	3
9.	CHCX 09	Polymer science and technology	2	0	2	3

Maths Elective Courses
(To be offered in IV Semester)

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

Maths Elective Courses
(To be offered in VI Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 05	Mathematical Programming	2	0	0	2
2.	MACX 06	Statistical Methods for Data Analysis	2	0	0	2
3.	MACX 07	Numerical Methods for Integral and Differential Equations	2	0	0	2

4.	MACX 08	Mathematical Modelling	2	0	0	2
5.	MACX 09	Graph Theory	2	0	0	2

Humanities Elective I
(To be offered in III Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX 01	Fundamentals of Economics	2	0	0	2
2.	SSCX 02	Principles of Sociology	2	0	0	2
3.	SSCX 03	Sociology of Indian Society	2	0	0	2

Humanities Elective II
(To be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX 04	Economics of Sustainable Development	2	0	0	2
2.	SSCX 05	Industrial Sociology	2	0	0	2
3.	SSCX 06	Law for Engineers	2	0	0	2

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

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX 101	Disaster Management	Civil
2.	GECX 102	Total Quality Management	Mechanical
3.	GECX 103	Energy Studies	Mechanical

4.	GECX 104	Robotics	Mechanical
5.	GECX 105	Transport Management	Automobile
6.	GECX 106	Control Systems	EEE
7.	GECX 107	Introduction to VLSI Design	ECE
8.	GECX 108	Plant Engineering	EIE
9.	GECX 109	Network Security	CSE
10.	GECX 110	Knowledge management	CSE
11.	GECX 111	Cyber security	IT
12.	GECX 112	Genetic Engineering	LS
13.	GECX 113	Fundamentals of Project Management	CBS
14.	GECX 114	Operations Research	Mathematics
15.	GECX 115	Nano Technology	Physics / Chemistry
16.	GECX 116	Vehicle Maintenance	Automobile
17.	GECX 117	Fundamentals of Digital Image Processing	ECE

Group II Courses
(To be offered in VII semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX 201	Green Design and Sustainability	Civil
2.	GECX 202	Appropriate Technology	Civil / Mechanical
3.	GECX 203	Engineering System Modelling and Simulation	Mechanical
4.	GECX 204	Value Analysis and Engineering	Mechanical

Sl. No.	Course Code	Course Title	Offering Department
5.	GECX 205	Industrial Safety	Mechanical
6.	GECX 206	Advanced Optimization Techniques	Mechanical
7.	GECX 207	Matlab Simulation	EEE
8.	GECX 208	Embedded Systems and its Applications	ECE
9.	GECX 209	Usability Engineering	CSE
10.	GECX 210	Supply Chain Management	CBS
11.	GECX 211	System Analysis and Design	CA
12.	GECX 212	Advanced Materials	Physics & Chemistry
13.	GECX 213	National Service Scheme	School of Humanities
14.	GECX 214	Automotive Pollution and Control	Automobile
15.	GECX 215	Motor Vehicle Act, Insurance and Policy	Automobile
16.	GECX 216	Principles of Communication Systems	ECE
17.	GECX 217	Lean Management	Civil
18.	GECX 218	Spatial Data Modeling & Analysis	Civil
19.	GECX 219	Advanced Entreprenuership	MBA
20.	GECX 220	Electric Vehicles	EEE
21.	GECX 221	Artificial Intelligence and Evolutionary Computing using Matlab	EEE

SEMESTER I

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

OBJECTIVES:

The aims of this course are to

Introduce eigen values and eigenvectors of matrix algebra.

Make the student knowledgeable in the area of Three Dimensional Analytical Geometry.

Demonstrate the application of Differential Calculus.

Familiarize the student with the functions of several variables.

Develop the use of ODE solvable techniques necessary for engineering applications.

Motivate the students with some basic engineering application problems in ODE.

MODULE I MATRICES 8+2

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

MODULE II THREE DIMENSIONAL ANALYTICAL GEOMETRY 7+3

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

MODULE III DIFFERENTIAL GEOMETRY 7+3

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

MODULE IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 8+2

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

MODULE V ORDINARY DIFFERENTIAL EQUATIONS 8+2

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

MODULE VI APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS 7+3

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

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

After completing the course, student will be able to

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

ENC 1181	**ENGLISH**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

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

MODULE I **8**

L: Listening for general information

S : Self Introduction, Introducing one another.

R: Predicting the content

W: Paragraph Writing

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

MODULE II **8**

L: Listening for specific information (from dialogues)

S:Exchanging opinion.

R: Skimming technical Passages

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

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

MODULE III **7**

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

S: Making Presentations using visuals.

R : Scanning short texts for gist of information

W: Letter of Invitation, Expository Writing

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

MODULE IV **7**

L: Understanding prepared presentation techniques through videos

S: Short Presentations.

R: Reading for coherence and cohesion

W: Letter seeking permission for Industrial Visit

Language Focus: S-V agreement, Euphemism

MODULE V **8**

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

S: Narrating an expereince

R: Inferential Reading

W: Process Description – Transcoding a Flow chart.

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

MODULE VI **7**

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

S: Discussion in groups

R: Reading for critical appreciation

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

Language Focus: If clause and phrasal verbs.

TOTAL HOURS :45

REFERENCES:

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

Course for EAP. Cambridge University Press, Cambridge.

OUTCOMES:

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

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

ISC 1181	ARABIC	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I PREPARATORY ARABIC 7

Introducing Arabic Alphabets.
Listening and Reading.
Audio & Video aided listening, Tajweed listening,
Writing Arabic Alphabets (connected & unconnected).
Introducing words.
Reading simple sentences.
Learning names of the things in and around the class room.
Exercises.

MODULE II FUNCTIONAL ARABIC 7

Listening Arabic texts, stories and action verbs
Communicating Simple sentences.
Jumla' Ismiyya and Jumla' Fi'liyya
Situational Conversation:
Greetings, Introduction.
Classroom, College, Picnic.
Dining and Kitchen.
Reading skills.
Exercises

MODULE III FUNCTIONAL ARABIC 8

Implication of effective listening.
Audio aids.
Writing Simple sentences.
Communicating ordinal and cardinal numbers.
Situational communication:
Playground, library.
Forms of plural – Sample sentences.
Introduction to tenses.

Exercises.

MODULE IV FUNCTIONAL ARABIC 8

Communication:

Family, travel

Market, Prayer hall

Writing skills:

Note making.

Sequencing of sentences.

Developing answers from the questions.

Exercises.

MODULE V TECHNICAL ARABIC 8

Importance of technical communication.

Reading and writing skills.

Audio & Video aided listening.

Introduction to Arabic terms related to administration.

Situation communication:

Air travel, Office administration, passport, visa.

Exercises

MODULE VI TECHNICAL ARABIC 7

Situation communication:

Contractual work, machineries and equipments..

Computer, internet browsing.

Banking,

Exercises.

TOTAL HOURS :45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

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

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

LNC 1181	MANDARIN	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I **8**

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

MODULE II **8**

· Chinese names and related culture · Chinese family structures and values · Greetings

· Introducing Yourself · Family members · Occupations

MODULE III **7**

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

MODULE IV **7**

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

MODULE V **8**

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

MODULE VI **7**

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

TOTAL HOURS : 45

TEXT BOOKS:

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

OUTCOMES:

On completion of the course, students will be able to

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

LNC 1182	GERMAN	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I **8**

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

MODULE II **8**

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

MODULE III **7**

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

MODULE IV **7**

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

MODULE V **8**

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

MODULE VI **7**

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

TOTAL HOURS :45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

On completion of the course, students will be able to

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

LNC 1183 **JAPANESE**

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I **7**

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

MODULE II **8**

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

MODULE III **7**

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

MODULE IV **8**

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

MODULE V **7**

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

MODULE VI **8**

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

TOTAL HOURS :45

REFERENCES:

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

OUTCOMES:

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

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

PHC 1182	PHYSICS I	L	T	P	C
		3	0	2	4

OBJECTIVES

To make students conversant with the

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

MODULE I CRYSTAL PHYSICS 8

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

MODULE II ULTRASONICS AND THERMAL PHYSICS 8

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

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

MODULE III APPLIED OPTICS 8

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

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism –

Laser Action – Types of Laser: He-Ne laser, CO_2 laser and Nd:YAG laser - Applications : Laser Materials Processing .

MODULE IV FIBRE OPTICS 7

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

MODULE V QUANTUM MECHANICS 7

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

MODULE VI MODERN ENGINEERING AND BIOMATERIALS 7

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

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

L:45 periods

PRACTICALS

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

8. Determination of Acceptance angle and Numerical Aperture using fiber optic cable.
9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Determination of thermal conductivity of a bad conductor by Lee's disc method.
11. Determination of solar cell characteristics.

P: 30 periods
Total: 75 periods

REFERENCES:

1. Gaur R.K. and Gupta S.L., "Engineering Physics'', 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.
3. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co., 2010.
4. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics", W.H. Freeman, 2007.
5. Markert J.T., Ohanian. H. and Ohanian, M. "Physics for Engineers and Scientists". W.W. Norton & Co. 2007.
6. Godfrey Boyle, "Renewable Energy: Power for sustainable future", 2nd edition, Oxford University Press, UK, 2009.

OUTCOMES:

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

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

CHC 1181 CHEMISTRY

L	T	P	C
3	0	2	4

OBJECTIVES

To make the students conversant with

- the basic problems like hardness, alkalinity, dissolved oxygen associated with the water and treatment processes involved.
- types of electrodes, determination of pH, emf measurement, conductometric and potentiometric titration.
- the basic analytical techniques like colorimetry, UV-Visible, flame photometry and AAS.
- concepts of photochemistry related to physical processes and chemical reactions induced by photon absorption and their applications.
- the non-renewable sources such as thermal and nuclear energy, importance of renewable energy sources like solar, wind, biogas, biomass, geothermal, ocean with their advantages and limitations.
- the synthesis, properties and applications of nanomaterials.

MODULE I WATER TECHNOLOGY 9

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

MODULE II ELECTROCHEMISTRY 8

Types of electrodes (principle and working) : gas (SHE), metal/metal ion electrode, metal-metal insoluble salt (calomel electrode), ion-selective (glass electrode) – pH determination using glass electrode – concentration cells (problems) – standard cell (Weston-cadmium) – EMF measurement (problems) – conductometric titrations – potentiometric titrations.

MODULE III ANALYTICAL TECHNIQUES 7

Spectroscopy: (relation between interaction of electromagnetic radiation with matter and type of spectroscopy), electromagnetic spectrum – types of transitions – types of spectra (atomic and molecular) – Beer-Lamberts law (problems) – principles, instrumentation (block diagram only) and applications of: colorimetry (includes estimation of concentration of a solution) – UV-Vis spectrophotometer – atomic absorption spectroscopy – flame photometry (includes estimation of concentration of alkali metal).

MODULE IV PHOTOCHEMISTRY 7

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

MODULE V ENERGY SOURCES 8

Renewable and non-renewable energy: comparison, advantages and limitations – non-renewable energy : thermal energy (principle only) – nuclear reactor (components and functions) – nuclear energy (problems) – renewable energy: needs of renewable energy – solar energy : solar photovoltaic, advantages and limitations – wind energy: wind resources, wind turbines, advantages and limitations – bioenergy: biogas generation, factors affecting biogas generation, biomass gasifier, advantages and limitations – geothermal energy: principle, types of geothermal resources, advantages, limitations and applications – ocean energy: tidal and ocean thermal energy (principle, advantages and limitations).

MODULE VI NANOCHEMISTRY 6

Introduction – distinction between molecules, bulk materials and nanoparticles – classification based on dimension with examples – synthesis :– top-down approach: chemical vapour deposition, laser ablation, electrodeposition – bottom-up approach: precipitation, thermolysis (hydrothermal and solvothermal) – properties and applications of nanomaterials.

L:45 periods

PRACTICALS

1. Estimation of hardness in the given water sample.
2. Estimation of the alkalinity of the given water sample.
3. Estimation of dissolved oxygen in the given water sample.
4. Determination of EMF of the cell.
5. Estimation of a strong acid by conductometry.
6. Estimation of Fe^{2+} present in the given sample by potentiometry.
7. Verification of Beer-Lamberts law and estimation of metal ion concentration of the given sample.

8. Estimation of sodium and potassium present in the given sample by flame photometry (demonstration).

P:30 periods

Total: 75 periods

REFERENCES

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

OUTCOMES

The students will be able to

- solve problems related to hardness, alkalinity, dissolved oxygen associated with the water and describe the treatment processes.
- describe the various types of electrodes, determine pH, measure EMF, explain and determine the concentration of acid and ions using conductometric and potentiometric titrations.
- verify and derive Beer-Lambert's law, state the principle and illustrate the instrumentation of various analytical techniques.
- apply the concepts of photochemistry to elaborate various photo-physical and photochemical reactions.
- describe the various components and functions of nuclear reactor, explain the principle and enumerate the advantages and limitations of various renewable energy sources.
- classify nanomaterials and discuss their properties & applications; and apply nanochemistry approach to synthesize the nanomaterials.

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

OBJECTIVES:

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

MODULE I BASICS AND ENGINEERING CURVES 10

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

Conic sections: ellipse, parabola, hyperbola.

Special curves: cycloid, epicycloid, hypocycloid and involutes.

MODULE II ORTHOGRAPHIC PROJECTION 8

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

MODULE III PROJECTION OF STRAIGHT LINES AND PLANES 10

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

Projection of plane lamina in first quadrant and its traces

MODULE IV PROJECTION OF SOLIDS 10

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

MODULE V SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

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

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

MODULE VI PICTORIAL PROJECTIONS 10

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

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

L – 30; P – 30; TOTAL HOURS – 60

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

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

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

OBJECTIVES:

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

MODULE I DESIGN AS A CENTRAL ACTIVITY IN ENGINEERING 08

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

MODULE II NEED ANALYSIS AND CONCEPT DEVELOPMENT 07

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

MODULE III CASE STUDIES IN ENGINEERING DESIGN 08

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

MODULE IV INNOVATION AND DESIGN 07

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

TOTAL HOURS – 30

REFERENCES:

1. Clive L. Dym and David C. Brown,“Engineering Design: Representation and Reasoning”, 2nd Edition, Cambridge University Press, New Delhi, 2011.
2. Daniel G. Dorner, G. E. Gorman and Philip J. Calvert, “Information Needs Analysis: Principles and practice in information organizations”, Published by Faced Publishing, London. 2015.
3. Cliff Matthews, “Case Studies in Engineering Design”, John Wiley & Sons Pvt. Ltd, New York, 1998.
4. Bengt-Arne Vedin, “The Design-Inspired Innovation Workbook”, World Scientific, 2011.
5. Navi Radjou, Jaideep Prabhu and Simone Ahuja, “Jugaad Innovation”, Published by Random House India, 2012.

OUTCOMES:

The students will be able to

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

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

OBJECTIVES:

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

CIVIL ENGINEERING PRACTICE

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

MECHANICAL ENGINEERING PRACTICE

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

ELECTRICAL ENGINEERING PRACTICE

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

ELECTRONICS ENGINEERING PRACTICE

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

TOTAL HOURS – 30

OUTCOMES:

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

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

GEC 1104	COMPUTER PROGRAMMING I	L	T	P	C
		1	0	2	2

OBJECTIVES:

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

MODULE I COMPUTER FUNDAMENTALS 7

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

MODULE II PROGRAMMING IN C 8

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

LIST OF EXPERIMENTS:

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

L – 15; P – 30; TOTAL HOURS – 45

REFERENCES:

1. Ashok N Kamthane, “Computer Programming”, Pearson Education, 2nd

Edition, ISBN 13: 9788131704370, 2012
2. Paul J. Deitel, Deitel & Associates, “C How to Program”, Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012

OUTCOMES:

Students who complete this course will be able to

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

SEMESTER II

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

OBJECTIVES:

The aims of this course are to

- train the students in solving problems using multiple integration.
- provide knowledge in using special functions to find out the area and volume of a region.
- acquire knowledge in tangent and normal vectors.
- gain knowledge in finding the areas of a curve and surface using vector integration.
- learn about the analytic functions and their properties along with bilinear transformation.
- know complex integration using Cauchy's theorems.

MODULE I MULTIPLE INTEGRATION AND ITS APPLICATIONS 8+2

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

MODULE II TRANSFORMATION OF COORDINATES AND SPECIAL FUNCTIONS 7+3

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

MODULE III VECTOR DIFFERENTIATION 7+3

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

MODULE IV VECTOR INTEGRATION 8+2

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

MODULE V ANALYTIC FUNCTION 8+2

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

MODULE VI COMPLEX INTEGRATION 7+3

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

L – 45; T – 15; TOTAL HOURS – 60

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

After completing the course, student will be able to

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

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

OBJECTIVES:

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

MODULE I VECTOR APPROACH TO MECHANICS 07

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

MODULE II EQUILIBRIUM OF PARTICLE 06

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

MODULE III EQUILIBRIUM OF RIGID BODY 06

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

MODULE IV PROPERTIES OF SURFACES 08

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

Mass moment of Area

MODULE V FRICTION 08

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

MODULE VI LAWS OF MOTION 10

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

L – 45; T – 15; TOTAL HOURS – 60

REFERENCES:

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

OUTCOMES:

On completion of this course students should be able

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

GEC 1212 ENVIRONMENTAL STUDIES L T P C

2 0 0 2

OBJECTIVES

To make the student conversant with the

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

MODULE I NATURAL RESOURCES 8

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

MODULE II ECOSYSTEM AND BIODIVERSITY 8

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

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

MODULE III ENVIRONMENTAL POLLUTION AND NATURAL DISASTER 8

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

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6

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

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

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

Case studies related to current situation

L:30 periods

Total: 30 periods

TEXT BOOKS

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

REFERENCES

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

OUTCOMES

The student will be able to

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

GEC 1213 COMPUTER PROGRAMMING II

L	T	P	C
1	0	2	2

OBJECTIVES:

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

MODULE I PROGRAMMING IN C 7

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

MODULE II PROGRAMMING IN C++ 8

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

LIST OF EXPERIMENTS:

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

L – 15; P – 30; TOTAL HOURS – 45

REFERENCES:

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

OUTCOMES:

Students who complete this course will be able to

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

AEC 1211 INTRODUCTION TO AERONAUTICAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I AVIATION HISTORY AND AIRPLANE ANATOMY 8

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

MODULE II BASIC AERODYNAMICS 10

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

MODULE III PROPULSION 7

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

MODULE IV AIRPLANE PERFORMANCE, STABILITY & CONTROL 7

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

MODULE V AIRCRAFT MATERIALS AND STRUCTURES 7

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

MODULE VI AIRCRAFT INSTRUMENTS AND SYSTEMS 6

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

TOTAL HOURS – 45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will be able to

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

AEC 1212	AIRCRAFT COMPONENT MODELING & DRAFTING LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

LIST OF EXPERIMENTS

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

TOTAL HOURS –45

REFERENCES:

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

OUTCOMES:

Students will be able to,

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

AEC 1213	AIRCRAFT STRUCTURE REPAIR LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVE:

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

LIST OF EXPERIMENTS

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

TOTAL HOURS – 45

REFERENCES:

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

OUTCOMES:

Students will be able to,

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

SEMESTER III

		L	T	P	C
MAC 2181	**PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS**	**3**	**1**	**0**	**4**

OBJECTIVES:

The aims of this course are to

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

MODULE I PARTIAL DIFFERENTIAL EQUATIONS 8 + 2

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

MODULE II FOURIER SERIES 8+2

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

MODULE III FOURIER TRANSFORMS 7+3

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

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

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

MODULE V LAPLACE TRANSFORM 8+2

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

MODULE VI Z – TRANSFORM 7+3

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

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

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

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics", 5th edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. **Error! Hyperlink reference not valid.**, "Advanced Engineering Mathematics**"**, 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.

OUTCOMES:

After completing the course, student will be able to

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

ENC 2181	**ORAL COMMUNICATION**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES:

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

MODULE I **4**

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

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

MODULE II **4**

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

Understanding Negotiation, persuasion and marketing skills through Podcasts

Listening to short conversations and monologues for understanding real life conversations

MODULE III **4**

Making Poster presentations on current issues

Understanding nuances of making effective presentations (TED Videos)

MODULE IV **6**

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

Viewing videos on debates (NDTV Discussions)

MODULE V **6**

Discussing social issues or current affairs in groups

Viewing group discussions and listening for specific information

MODULE VI **6**

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

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

P – 30; Total Hours –30

REFERENCES:

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

OUTCOMES:

On completion of the course, students will be able to

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

AEC 2101	SOLID MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I AXIAL LOADING 7

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

MODULE II BEAMS 10

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

MODULE III DEFLECTION OF BEAMS 8

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

MODULE IV TORSION –SPRINGS – COLUMNS 6

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

MODULE V PRINCIPAL STRESSES 7

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

MODULE VI BIAXIAL STRESSES 7

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

Total Hours : 45

TEXT BOOKS:

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

2. R. K. Rajput, “Strength of Materials: Mechanics of Solid”, Fourth edition, S. Chand Limited, 2007.

REFERENCES:

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

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.

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

OBJECTIVES:

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

MODULE I FUNDAMENTAL CONCEPT 10

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

MODULE II FIRST LAW OF THERMODYNAMICS 10

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

MODULE III SECOND LAW OF THERMODYNAMICS 10

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

MODULE IV GAS AND VAPOUR POWER CYCLES 12

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

MODULE V REFRIGERATION AND AIR-CONDITIONING 10

Principle of Refrigeration – Vapour compression & Vapour absorption types – Coefficient of performance, Properties of refrigerants, Psychrometrics – Relative Humidity – WBT/DBT - Principle of Air conditioning – Types.

MODULE VI AIR COMPRESSOR 8

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

Total Hours : 60

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will able to

- Identify and relate various properties and thermodynamic system.
- Apply an appropriate formulation of the first law to relate energy, heat and work.
- Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.
- Employ temperature-entropy diagrams to analyze the gas and vapour power cycles.
- Calculate cooling load for refrigeration and air-conditioning systems.
- Determine work input for an air compressor with a given set of operating parameters.

AEC 2103 FLUID MECHANICS

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I BASIC CONCEPTS AND FLUID PROPERTIES 7

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

MODULE II FLUID STATICS AND PRESSURE MEASURING 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 FLUIDS AND GOVERNING EQUATIONS OF FLOW 8

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

MODULE IV INTERNAL FLOWS & DIMENSIONAL ANALYSIS 10

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

MODULE V BOUNDARY LAYER CONCEPTS 6

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

MODULE VI TURBOMACHINERY 7

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

Total Hours : 45

TEXT BOOKS:

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

REFERENCES:

1. Frank M. White, "Fluid mechanics", Tata McGraw Hill 2015.
2. Ira M. Cohen, Pijush. K. Kundu, David. R. Dowling "Fluid Mechanics", Fifth edition, 2015

OUTCOMES:

Students will be able to

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

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

OBJECTIVES:

- To gain the basic knowledge on electrical circuits and machines.
- To acquaint the students to semiconductor devices and their applications.
- To introduce some knowledge about the display system and its applications.
- To introduce the basic knowledge of microprocessor and its application in digital computing.

MODULE I ELECTRICAL CIRCUITS & MEASURMENTS 7

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

MODULE II ELECTRICAL MACHINES 8

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

MODULE III SEMI CONDUCTOR DEVICES AND APPLICATIONS 8

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

MODULE IV LINEAR AND DIGITAL ICS 8

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

MODULE V FUNDAMENTALS OF DISPLAYS TECHNOLOGIES 7

Display technologies: Construction, Working and principle of CRT - LED - LCD - EL - Plasma panel Display - Types of Display generations - Raster and strokes -

Aspect Ratio -Standard of definition SD, HD, ULD & 3D - Touch panel principles - Types of color display formats - PAL, NTSC, SECAM.

MODULE VI FUNDAMENTALS OF DIGITAL COMPUTER 7

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

Total Hours : 45

TEXT BOOKS:

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

REFERENCES:

1. Mehta V K, "Principles of Electronics", S. Chand & Company Ltd, (1994).
2. Mahmood Nahvi and Joseph A. Ed minister, "Electric Circuits", Schaum' Outline Series, Mc Graw Hill, (2002).
3. Jacob Millman & Christos C. Halkias, "Electronic Devices and Circuits" TMH, 1991

OUTCOMES:

Students will be able to

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

AEC 2104	THERMODYNAMICS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

LIST OF EXPERIMENTS:

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

Total Hours : 45

OUTCOMES:

Student will be able to

- Understand the thermodynamic cycles involved in 2 and 4 stroke engines.
- Evaluate the performance of refrigeration and air- conditioning systems.
- Evaluate the effectiveness of a parallel flow & counter flow heat exchangers.
- Evaluate the performance of a 4-stroke petrol & diesel engine.

AEC 2105	FLUID MECHANICS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- This course introduces fluid mechanics applications and measurements.

LIST OF EXPERIMENTS:

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

Total Hours : 45

OUTCOMES:

On completing this course the student will be able to:

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

		L	T	P	C
EIC 2182	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING LABORATORY**	**0**	**0**	**3**	**1**

OBJECTIVES:

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

LIST OF EXPERIMENTS

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

Total Hours : 60

REFERENCES:

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

OUTCOMES:

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

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

SEMESTER – IV

ENC 2282 WRITTEN COMMUNICATION

L	T	P	C
0	0	2	1

OBJECTIVES:

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

MODULE I **4**

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

MODULE II **4**

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

MODULE III **6**

Understanding format and conventions of writing email, memo, fax, agenda and minutes of the meeting. Writing email, memo, fax, agenda and minutes of the meeting for various purposes (industry specific)

MODULE IV **6**

Viewing letter of application and Résumé, letter calling for an interview, letter of inquiry and Promotional letter. Writing Functional résumé and letter of application using Edmodo,

MODULE V **6**

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

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

MODULE VI **4**

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

P- 30; Total Hours –30

REFERENCES:

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

OUTCOMES:

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

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

AEC 2211	LOW SPEED AERODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I FUNDAMENTAL EQUATIONS OF AERODYNAMICS 6

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

MODULE II FUNDAMENTALS OF INVISCID INCOMPRESSIBLE FLOW 8

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

MODULE III AIRFOIL THEORY 9

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

MODULE IV THEORY OF FINITE WINGS 10

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

MODULE V INTRODUCTION TO LAMINAR BOUNDARY LAYER 6

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

MODULE VI INTRODUCTION TO TURBULENT BOUNDARY LAYER 6

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

Total Hours –45

TEXT BOOKS:

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

REFERENCES:

1. Houghton, E.L., and Caruthers, N.B., Aerodynamics for Engineering students,
   Edward Arnold Publishers Ltd., London, 1989.
2. Katz and Plotkin, Low Speed Aerodynamics, Cambridge Univ. Press, 2002
3. Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 1985
4. John J Bertin., Aerodynamics for Engineers, Pearson Education Inc, 2002

OUTCOMES:

Students shall be able to

- Understand the capability and limitations of potential flow theory
- Mathematically express the fundamental equations of fluid flow and elementary flow concepts.
- Perform simple calculations for the estimation of the lift characteristics of airfoils using circulation theory/ thin airfoil theory.
- Estimate the induced drag characteristics and lift characteristics of finite wings.
- Perform simple laminar boundary layer calculations.
- Perform simple calculations in wall bounded turbulent boundary layer/ free shear layers.

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

OBJECTIVES:

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

MODULE I LOADS AND STRUCTURAL COMPONENTS OF AIRCRAFT 6

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

MODULE II STATICALLY DETERMINATE STRUCTURES 13

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

MODULE III STATICALLY IN DETERMINATE STRUCTURES 13

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

MODULE IV COLUMNS 8

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

MODULE V ENERGY METHODS 12

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

MODULE VI FAILURE THEORY 8

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

Total Hours –60

TEXT BOOKS:

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

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

REFERENCES:

1. James M Gere & Barry J. Goodno, Mechanics of Materials, Cenage Learning, 9th Edition, 2018.
2. R.C. Hibbeler, “Structural Analysis”, Fifth Edition, Prentice-Hall, 2002.
3. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, “Mechanics of Materials”, Firewall media, 2002.
4. Craig, R.R., 1996, Mechanics of Materials, John Wiley & Sons, New York.
5. R.S. Khurmi, “Strength of Materials”, Twenty third Edition, S. Chand Limited, 2007
6. R.K. Rajput, “ Strength of Materials: Mechanics of Solid”, Fourth edition, S. Chand Limited, 2007

OUTCOMES:

Students will be able to

- Identify and relate different kinds of load factors experienced in aircraft flight.
- Estimate the load bearing capability of different structural members used in the construction of aircraft.
- Extend the concepts of solid mechanics to in-determinate structural problems.
- Give a theoretical design ofcolumns subjected to various loads.
- Obtain theoretical predictions of structural behavior using energy methods.
- Acquire knowledge on failure theories and to predict the values of the stress at which the structure fails.

		L	T	P	C
AEC 2213	**AIR BREATHING PROPULSION**	**3**	**0**	**0**	**3**

OBJECTIVES:

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

MODULE I FUNDAMENTALS OF AERO ENGINES 9

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

MODULE II PISTON ENGINES & PROPELLER THEORY 6

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

MODULE III SUBSONIC &SUPERSONIC INTAKES 9

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

MODULE IV COMBUSTION SYSTEMS 7

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

MODULE V NOZZLES 7

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

MODULE VI RAMJET& SCRAMJET PROPULSION 7

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

Total Hours –45

TEXT BOOKS:

1. Saravanamuttoo, H.I. H., Rogers, G.F.C., CohenH., PaulStraznicky, “Gas
2. TurbineTheory”,6th Edition,PearsonEducationCanada,2008.
3. Hill Philip, Peterson Carl, “Mechanics and Thermodynamics of Propulsion”, Addison Wesly, 1992.

REFERENCES:

1. KroesMichaelJ,WildThomasW,“AircraftPowerplants”,7th Edition, Tata Mc Graw Hill, 2010.
2. MattinglyJ.D.,“ElementsofGasTurbinePropulsion”,TataMcGrawHill,2005.
3. El Sayed Ahmed, “Aircraft Propulsion and gas turbine engines”, Taylor and Francis (CRCpress),2008.
4. Rolls Royce Jet Engine”, 3rd Edition, 1983.
5. Roy Bhaskar,“ Aircraft Propulsion”, Elsevier(India),2008.

OUTCOMES:

Students will be able to

- Get perspective of different types of jet engines used in aircraft.
- Apply design concepts in propeller blade design.
- Learn engineering features of subsonic and supersonic intakes of jet engines.
- Acquire basic knowledge on combustion systems used in jet engines.
- Apply the basic design features of exhaust nozzles.
- Acquire knowledge of ramjet & scramjet propulsion systems.

		L	T	P	C
AEC 2214	**AIRCRAFT SYSTEMS AND INSTRUMENTS**	**3**	**0**	**0**	**3**

OBJECTIVES:

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

MODULE I AIRCRAFT SYSTEMS 8

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

MODULE II AIRPLANE CONTROL SYSTEMS 7

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

MODULE III ENGINE SYSTEMS 8

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

MODULE IV AIR CONDITIONING AND PRESSURIZING SYSTEM 7

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

MODULE V AIRCRAFT INSTRUMENTS 8

Flight instruments and navigation instruments – accelerometers, air speed indicators – mach meters – altimeters – gyroscopic instruments– principles and operation – study of various types of engine instruments – tachometers – temperature gauges – pressure gauge – operation and principles.

MODULE VI MODERN AIRCRAFT SYSTEMS 7

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

Total Hours –45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will be able to

- Demonstrate the ability to design a various system using pneumatic and hydraulic components.
- Keep abreast knowledge on various flight control system and its recent advancements.
- Demonstrate the fundamental understanding of the operation of engine auxiliary systems.
- To understand the various cabin comfort system used in aircraft modern display systems.
- Describe principle behind the operation of various vital parameter displays and its uses in effective conduct of the flight.
- To get basic knowledge of modern aircraft system which helps in understanding the aircraft navigation system better

AEC 2215	SOLID MECHANICS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

LIST OF EXPERIMENTS:

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

Total Hours –45

OUTCOMES:

Student will be able to

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

AEC 2216	**AIRCRAFT SYSTEMS AND INSTRUMENTS LABORATORY**	**L T P C**
		0 0 3 1

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Aircraft “Jacking Up” procedure.
2. Aircraft “Leveling” procedure.
3. Control system “Rigging check” procedure.
4. Aircraft “Symmetry Check” procedure.
5. “Flow test” to assess of filter element clogging.
6. Pressure test” to assess hydraulic External/Internal Leakage.
7. “Test of Brake System” and “Bleeding of Brake System”.
8. “Pressure test” procedure on fuel system component.
9. “Break Torque Load Test” on wheel brake units.
10. Maintenance and rectification of snags in hydraulic and fuel systems.

Total Hours – 45

OUTCOMES:

Students will able to

- Understand the procedure required to handle an aircraft before testing its systems.
- Identify the snags in aircraft hydraulic and fuel systems and their rectifications.
- Understand the working of various aircraft systems.

AEC 2217 **PROPULSION LABORATORY**

L	T	P	C
0	0	3	1

OBJECTIVES:

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

LIST OF EXPERIMENTS:

1. Study of an aircraft piston engine. (Includes study of assembly of sub systems, various Components, their functions and operating principles)
2. Study of an aircraft jet engine (Includes study of assembly of sub systems, various Components, their functions and operating principles)
3. Study of forced convective heat transfer over a flat plate.
4. Study of free convective heat transfer over a flat plate.
5. Study of performance of a propeller.
6. Study of free jet.
7. Study of wall jet.
8. Determination of spray characteristics of injector.
9. Study of propellant mixing and casting process.
10. Determination of calorific value of fuels

Total Hours – 45

OUTCOMES:

Students will able to

- Understand the principles of heat transfer.
- Evaluate the performance of a typical propeller.
- Evaluate the heat of combustion of typical aviation fuels.
- Evaluate the spray characteristics of injector.

SEMESTER - V

MSC 3181	LEADERSHIP AND CEO TRAINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims at

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

MODULE I Introduction to Leadership 12

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

MODULE II Leadership Style and Communication 08

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

MODULE III Leadership Roles 08

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

MODULE IV Leadership Challenges and Strategies 09

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

MODULE V Leadership and CEO Training 08

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

MODULE VI Teaching Pedagogy:

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

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

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

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Andrew J DuBrin. "Leadership: Research Findings, Practice, and Skills", 8th Edition, South-Western College Pub, 2015.
2. Yukl G , "Leadership in Organisations", 8th Edition, Pearson Education, 2013.
3. Richard L Daft , "Leadership", 5th Edition, South Western Cengage Learning

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

REFERENCES:

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

OUTCOMES:

The students will be able to

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

MSC 3182 SOCIAL ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fit between individual and their entrepreneurial ambitions.
- To identify the customers and find a problem worth solving.
- To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas
- To develop a solution for customers' problem and analyze the problem solution fit & product market fit.
- To build and demonstrate a Minimum Viable Product (MVP) for startup.
- To analyze and understand the impact of social entrepreneurship on society and cases.

MODULE I SELF & OPPORTUNITY DISCOVERY 9

Finding the flow, Effectuation, Entrepreneurial Style, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study.

MODULE II CUSTOMER , SOLUTION AND BUSINESS MODEL 9

Customers and Markets, Identification of Customer Segment, Niche Segment, Customers Jobs, Pain and Gain, Early Adopters, Value Proposition Canvas, Basics of Business Model and Lean Canvas, Risk and Assumptions.

MODULE III VALIDATION AND MONEY 9

Blue Ocean Strategy, Solution Demo, Problem – Solution Fit, Minimum Viable Product- Product Market Fit, Prototype – Case Study. Cost, Revenues, Pricing, Profitability Checks, Bootstrapping, Initial Financing and Pitching.

MODULE IV TEAM BUILDING AND MARKETING 7

Shared Leadership, Hiring, Fitment , Team Role and Responsibilities , Collaboration Tools and Techniques, Positioning and Branding, Channels

MODULE V SALES & SUPPORT 6

Sales Planning, Selling Skills, Project Management, Project Tracking, Basic of Business Regulation, Startup.

MODULE VI IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETIES AND CASES **5**

Impact of Social Entrepreneurship, NGO vs For-Profit Companies vs. Social Entrepreneurship. Procedures for registration of small scale industry, Overview of venture capital and angel investment, Social entrepreneurship report preparation by students. Case Study of Social Entrepreneurs.

Total Periods- 45

TEXT BOOKS

1. Entrepreneurship Rajeev Roy oxford, 2012.
2. Learn wise platform - Wadhwani Foundation, 2018
3. “Social Entrepreneurship and Social Business” Christine K Volkmann, Springer Gabler 2012.
4. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.

REFERENCES

1. Social Entrepreneurship” Manuel London, Routlege, 2012.
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.
3. Running Lean: Iterate From Plan A To a Plan That Works, Ash Maurya, "O'Reilly Media, Inc.", 28-Feb-2012.

OUTCOMES:

On completion of the course, students will be able to

- Build an entrepreneurial mindset and reach out the customer to identify the problem using design thinking process
- Craft solution to the problem through value proposition canvas and develop a business model using lean canvas
- Provide product solution demo and deliver a minimum viable product
- Work as a team and create brand strategy marketing for product/service
- Prepare, make an outstanding sale pitch for startup.
- Showcase the impact of Social Entrepreneurship on society and cases.

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

OBJECTIVES:

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

MODULE I **6**

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

MODULE II **6**

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

MODULE III **4**

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

MODULE IV **6**

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

MODULE V **8**

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

Total Hours – 30

REFERENCES:

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

OUTCOMES:

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

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

AEC 3101	COMPRESSORS AND TURBINES	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To Study and analyze design aspects and performance characteristics of axial type compressor.
- To analyze design aspects and performance characteristics of axial and radial type turbines.
- To study matching characteristics of jet engines' compressor and turbine.

MODULE I COMPRESSORS 14

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.

Axial Compressors - Basic operation - Elementary theory – Velocity triangles – Work and compression, Design parameters - Flow coefficient – loading coefficient - Degree of reaction - diffusion factor. Single and multi-stage axial compressor performance characteristics. Free vortex theory (Basics – importance). Cascade Analysis - nomenclature - Loss and Blade performance estimation, Axial Fans Introduction - Noise problem in Axial Compressors and Fans.

MODULE II AIRCRAFT ENGINE TURBINES 12

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

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

MODULE III MATCHING OF COMPRESSOR –TURBINE 4

Introduction to engine component sizing - Dimensional analysis for component matching, Engine Design Point operations, Engine Off Design operations - Aircraft Engine Component matching: Intake-Compressor Matching, Turbine Nozzle matching, Compressor – Turbine matching: Single and multi-spool. Free turbine and unducted Fan/Propeller Matching.

Total Hours : 30

TEXT BOOKS:

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

REFERENCES:

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion", Pearson Education Inc., 2010.
2. Mattingly J. D., "Elements of Gas Turbine Propulsion", Tata McGraw Hill, 2005
3. Roy Bhaskar, "Aircraft Propulsion", Elsevier (India), 2008.
4. S.M. Yahya, Turbines, Compressors and Fans, McGraw Hill Education (India) Private Limited, Fourth Edition, 2011.

OUTCOMES:

Students will be able to

- Analyze axial type compressor and fan design aspects and performance characteristics.
- Analyze axial and radial type turbines design aspects and performance characteristics.
- Do matching of jet engines' compressor and turbine.

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

OBJECTIVES:

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

MODULE I UNSYMMETRICAL BENDING OF BEAMS 8

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

MODULE II SHEAR FLOW IN OPEN SECTIONS 10

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

MODULE III SHEAR FLOW IN CLOSED SECTIONS 10

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

MODULE IV BUCKLING OF PLATES 12

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

MODULE V STRESS ANALYSIS IN WING AND FUSELAGE 10

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

MODULE VI BASICS OF ELASTICITY 10

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

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will be able to

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

		L	T	P	C
AEC 3103	**HIGH SPEED AERODYNAMICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the effect of compressibility at high speed flows.
- To understand the basics of shock and expansion waves at supersonic flows.
- To introduce the compressible flow theories to assess the flow over airfoils and wings.

MODULE I ONE DIMENSIONAL COMPRESSIBLE FLOW 8

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

MODULE II NORMAL SHOCK WAVES 7

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

MODULE III OBLIQUE SHOCKS AND EXPANSION WAVES 8

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

MODULE IV DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY COMPRESSIBLE FLOWS 8

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

MODULE V AIRFOIL CHARACTERISTICS IN HIGH SPEED FLOWS 7

Lower and upper critical Mach numbers, lift and drag divergence, shock induced separation, characteristics of swept wings, effects of thickness, camber and aspect ratio of wings, Transonic flow, transonic area rule, tip effects.

MODULE VI HYPERSONIC FLOWS 7

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

Total Hours –45

TEXT BOOKS:

1. John D. Anderson, Jr., ”Fundamentals of Aerodynamics”, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007.
2. Liepmann, H. W and Roshko, A., “Elements of Gas dynamics”, Dover Publication, 2002.
3. Pope, A. and Goin, L., “High Speed Wind Tunnel Testing”, John Wiley, 1985

REFERENCES:

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

OUTCOMES:

Students will be able to

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

AEC 3104	AERODYNAMICS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

LIST OF EXPERIMENTS:

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

Total Hours – 45

OUTCOMES:

Students will be able to

- Understand process of calibration of subsonic wind tunnel.
- Understand the airfoil pressure distribution form and its influence on the lift value.
- Visually recognize the location and formation of vortices and flow separation point by flow visualization techniques.
- Calculate the co efficient of Lift of an given Airfoil.
- Calculate the coefficient of Drag of an given Airfoil
- Know the importance of the geometry to obtain better aerodynamic characteristics by using flow visualization techniques.

AEC 3105	**AIRCRAFT STRUCTURAL ANALYSIS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1**

OBJECTIVES:

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

LIST OF EXPERIMENTS:

1. Determination of Young's Modulus for the given material (statically determinate beam) and verify Maxwell's reciprocal theorem for the same using extensometers
2. Determination of Young's Modulus for the given material (statically indeterminate beam) and verify Maxwell's reciprocal theorem for the same using extensometers.
3. Determine the Critical Load for a column (South well -plot).
4. Unsymmetrical bending of beams.
5. Determination of Shear center for Closed and Open Section.
6. Constant Strength Beam.
7. Beam with combined loading.
8. Calibration of photo-elastic material and determination of Stresses in circular discs and beams.
9. Vibrations of beams
10. Wagner's beam.

Total Hours – 45

OUTCOMES:

Students will be able to

- Evaluate the material properties of aircraft structural members.
- Obtain experimental results of static and dynamic structural responses and compare with that of theoretical values.
- Determine the stress pattern for different cross sections using photo-elastic apparatus.

SEMESTER – VI

MSC 3181 LEADERSHIP AND CEO TRAINING

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims at

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

MODULE I Introduction to Leadership 12

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

MODULE II Leadership Style and Communication 08

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

MODULE III Leadership Roles 08

Facets of leadership-Leader as an individual – personality and leadership, values, attitudes and ethics of a leader. **Leader as a relationship builder**-

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

MODULE IV Leadership Challenges and Strategies 09

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

MODULE V Leadership and CEO Training 08

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

MODULE VI Teaching Pedagogy:

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

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

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

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Andrew J DuBrin. "Leadership: Research Findings, Practice, and Skills", 8th Edition, South-Western College Pub, 2015.
2. Yukl G , "Leadership in Organisations", 8th Edition, Pearson Education,

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

REFERENCES:

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

OUTCOMES:

The students will be able to

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

MSC 3182 SOCIAL ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fit between individual and their entrepreneurial ambitions.
- To identify the customers and find a problem worth solving.
- To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas
- To develop a solution for customers' problem and analyze the problem solution fit & product market fit.
- To build and demonstrate a Minimum Viable Product (MVP) for startup.
- To analyze and understand the impact of social entrepreneurship on society and cases.

MODULE I SELF & OPPORTUNITY DISCOVERY 9

Finding the flow, Effectuation, Entrepreneurial Style, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study.

MODULE II CUSTOMER , SOLUTION AND BUSINESS MODEL 9

Customers and Markets, Identification of Customer Segment, Niche Segment, Customers Jobs, Pain and Gain, Early Adopters, Value Proposition Canvas, Basics of Business Model and Lean Canvas, Risk and Assumptions.

MODULE III VALIDATION AND MONEY 9

Blue Ocean Strategy, Solution Demo, Problem – Solution Fit, Minimum Viable Product- Product Market Fit, Prototype – Case Study. Cost, Revenues, Pricing, Profitability Checks, Bootstrapping, Initial Financing and Pitching.

MODULE IV TEAM BUILDING AND MARKETING 7

Shared Leadership, Hiring, Fitment , Team Role and Responsibilities , Collaboration Tools and Techniques, Positioning and Branding, Channels

MODULE V SALES & SUPPORT 6

Sales Planning, Selling Skills, Project Management, Project Tracking, Basic of Business Regulation, Startup.

MODULE VI IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETIES AND CASES 5

Impact of Social Entrepreneurship, NGO vs For-Profit Companies vs. Social Entrepreneurship. Procedures for registration of small scale industry, Overview of venture capital and angel investment, Social entrepreneurship report preparation by students. Case Study of Social Entrepreneurs.

Total Periods- 45

TEXT BOOKS

5. Entrepreneurship Rajeev Roy oxford, 2012.
6. Learn wise platform - Wadhwani Foundation, 2018
7. “Social Entrepreneurship and Social Business” Christine K Volkmann, Springer Gabler 2012.
8. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.

REFERENCES

4. Social Entrepreneurship” Manuel London, Routlege, 2012.
5. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.
6. Running Lean: Iterate From Plan A To a Plan That Works, Ash Maurya, "O'Reilly Media, Inc.", 28-Feb-2012.

OUTCOMES:

On completion of the course, students will be able to

- Build an entrepreneurial mindset and reach out the customer to identify the problem using design thinking process
- Craft solution to the problem through value proposition canvas and develop a business model using lean canvas
- Provide product solution demo and deliver a minimum viable product
- Work as a team and create brand strategy marketing for product/service
- Prepare, make an outstanding sale pitch for startup.
- Showcase the impact of Social Entrepreneurship on society and cases.

ENC 3281 COMMUNICATION AND SOFT SKILLS - II CONFIDENCE BUILDING

L	T	P	C
0	0	2	1

OBJECTIVES:

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

MODULE I **6**

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

MODULE II **6**

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

MODULE III **4**

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

MODULE IV **6**

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

MODULE V **8**

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

Total Hours – 30

REFERENCES:

1. Covey, S.R. (2004). The 7Habits of Highly Effective People: Powerful Lessons in Personal Change. Free Press.UK

2. Fine, P.M.& Alice Olin's. (2016).Step up: Confidence, Success and Your Stellar Career in 10 Minutes a Day. Vermilion.UK
3. Pai, A. (1993).How to Develop Self-Confidence. Amazon.com
4. Wentz, F.H.(2012). Soft skills training: A Workbook to Develop Skills for Employment. Amazon.com

OUTCOMES:

After completing the course students would be able to

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

AEC 3211	**ROCKET PROPULSION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

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

MODULE I FUNDAMENTALS OF ROCKET PROPULSION 7

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

MODULE II PROPELLANTS 9

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

MODULE III SOLID ROCKET MOTORS 8

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

MODULE IV LIQUID PROPELLANT ROCKET ENGINES 7

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

MODULE V HYBRID ROCKET ENGINE 7

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

MODULE VI ADVANCED PROPULSION 7

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

Total Hours –45

TEXT BOOKS:

1. George P. Sutton, Oscar Biblarz, “Rocket Propulsion Elements”, 7th Edition, John-Wiley & Sons, Ltd., 2001.

REFERENCES:

1. R. Humble, G. Henry, and W. Larson, “Space Propulsion Analysis and Design”, McGraw-Hill, New York, 1995.
2. Hill, Philip and Carl Peterson, “Mechanics and Thermodynamics of Propulsion”, Prentice Hall, 1991

OUTCOMES:

Students will be able to

- Evaluate performance parameters for rocket engines and nozzles.
- Acquire knowledge about combustion properties of solid & liquid propellants.
- Analyze solid rocket motor performance parameters and propellant grain structure.
- Acquire knowledge about different feed systems of liquid propellant rocket engine.
- Evaluate performance parameters for hybrid rocket engine.
- Acquire knowledge about advanced propulsion systems.

AEC 3212	FLIGHT DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I FORCES ON THE AIRPLANE 7

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 9

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

MODULE III STATIC LONGITUDINAL STABILITY AND CONTROL 9

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 7

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 6

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 7

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.

Total Hours –45

TEXT BOOKS:

1. Anderson, J.D., "Aircraft performance and design", McGraw Hill, 1995.
2. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son, Inc, New York, 2011.

REFERENCES:

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

OUTCOMES:

Students will be able to

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

AEC 3213 AIRCRAFT MATERIALS AND PROCESSES

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I ELEMENTS OF MATERIAL SCIENCE 7

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

MODULE II MECHANICAL BEHAVIOR OF MATERIALS & CORROSION 9

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

MODULE III AIRCRAFT METAL ALLOYS & HEAT TREATMENT 8

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

MODULE IV CERAMICS AND COMPOSITES 8

Introduction – powder metallurgy - modern ceramic materials – cermets - cutting tools – glass ceramic –production of semi fabricated forms - plastics and rubber – Graphene - carbon/carbon composites, fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design, open and close mould processes.

MODULE V METAL WORKING PROCESSES AND WELDING 8

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

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

MODULE VI SELECTION OF MATERIALS FOR AIRCRAFTS 5

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

Total Hours – 45

TEXT BOOKS:

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

REFERENCES:

1. F.C Campbell," Manufacturing technology for aerospace structural materials", Elsevier publication.
2. Martin, J.W., "Engineering Materials, Their properties and Applications", Wykedham Publications (London) Ltd., 1987.
3. Van Vlack. L.H., "Materials Science for Engineers", Addison Wesley, 1985.
4. Kenneth. G. Budinski & Michael .K. Budinski, "Engineering material properties and selection", Prentice Hall publications, 2010.

OUTCOMES:

Students will be able to

- Understand atomic structure, crystal structure of solids.

- Gain knowledge on engineering behaviour of materials and effects of corrosion on materials.
- Identify the need for different alloying materials and heat treatment processes involved.
- Acquire knowledge on types and applications of different ceramic and composite materials.
- Employ different metal working processes and welding methods used in aerospace industries.
- Select and suggest suitable materials for different parts of aircraft based on their characteristics and properties

AEC 3214 AIRCRAFT DESIGN PROJECT - I

L	T	P	C
1	0	3	2

OBJECTIVES:

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

1. Comparative configuration study of different types of airplanes
2. Comparative study on specification and performance details of aircraft
3. Preparation of comparative data sheets
4. Work sheet layout procedures
5. Comparative graphs preparation and selection of main parameters for the design
6. Preliminary weight estimations, selection of main parameters,
7. Power plant selection, Aerofoil selection, Wing tail and control surfaces
8. Preparation of layouts of balance diagram and three view drawings
9. Drag estimation
10. Detailed performance calculations and stability estimates

Total Hours – 45

TEXTBOOKS

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

REFERENCES

- Janes “ All the World’s Aircraft 2010 – 2011” Edited by Paul Jackson FRAeS
- Perkins Hage“ Airplane performance stability and control” , Wiley publications, 2005.

OUTCOMES:

Students will be able to

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

- Apply the fundamental principles of Aerodynamics, Flight performance & stability and propulsion to evolve the configuration of an aircraft.
- Develop skills in design of aircraft components using computer aided tools.
- Learn to work as a team to achieve the goal.
- Apply cognitive design skills to generic design problems.
- Learn project management and time management skills.

SEMESTER – VII

AEC 4101	**AVIONICS**	**L**	**T**	**P**	**C**
		3	**0**	**3**	**4**

OBJECTIVES:

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

MODULE I INTRODUCTION 7

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

MODULE II PRINCIPLE OF DIGITAL SYSTEMS 7

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

MODULE III DIGITAL AVIONICS ARCHITECTURE 8

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

MODULE IV FLIGHT DECKS AND COCKPITS 7

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 AIR DATA INSTRUMENTS & GYROSCOPICINSTRUMENTS 8

Introduction to Accelerometer and Gyroscope – Turn and bank Indicator, Air data instruments- Airspeed, altitude, vertical speed indicators- Angle of attack measurements.

MODULE VI COMMUNICATION & NAVIGATION INSTRUMENTS 8

Communications systems - Navigation systems – flight control systems – radar – Electronic warfare – utility systems reliability and maintainability – certification.

PRACTICALS:

DIGITAL ELECTRONICS

- Addition/subtraction of binary numbers.
- Multiplexer/de multiplexer circuits.
- Encoder/decoder circuits.
- Timer circuits, shift registers, binary comparator circuits.

MICROPROCESSORS

- Addition and subtraction of 8-bit and 16-bit numbers.
- Sorting of data in ascending & descending order.
- Sum of a given series with and without carry.
- Greatest in a given series & multi-byte addition in BCD mode.
- Interface programming with 4 digit 7 segment display & switches & LED's.
- 16 channel analog to digital converter & generation of ramp, square, triangular wave by digital to analog converter.

AVIONICS DATA BUSES

- Study of different avionics data buses.
- MIL-Std – 1553 data buses configuration with message transfer.
- MIL-Std – 1553 remote terminal configuration.

L – 45 + P - 30 Total Hours – 75

TEXT BOOKS:

1. Spitzer, C.R. "Digital Avionics Systems", McGraw Hill, 1
2. Gaokar, R.S., "Microprocessors Architecture-Programming and Applications", Wiley and Sons Ltd., New Delhi, 199
3. Pallet, E.H.J., "Aircraft Instruments & integrated systems", Longman Scientific and Technical, McGraw Hill, 1992.

REFERENCES:

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

OUTCOMES:

Students will be able to

- Identify the use of various avionics systems and their advantages over the conventional system.
- Gain knowledge of the operation of the microprocessor.
- Acquire knowledge of the communication protocol and architecture of avionics systems.
- Keep abreast of the basic principles, theory and operation of modern cockpit display systems.
- Differentiate between air data instruments and gyroscopic instruments and their functioning for both civil and military aircraft.
- Acquire knowledge about the principles of various avionics systems like navigation, communication and electronic warfare.

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

OBJECTIVES:

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

MODULE I INTRODUCTION 6

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

MODULE II DISCRETE ELEMENTS 8

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

MODULE III CONTINUUM ELEMENTS 10

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

MODULE IV ISOPARAMETRIC ELEMENTS 7

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

MODULE V FIELD PROBLEMS 6

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

MODULE VI VIBRATION ANALYSIS 8

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

Total Hours –45

TEXT BOOKS:

1. J.N. Reddy, “An Introduction to Finite Element Method”, 3rd Edition, Tata McGraw Hill, 2006.
2. Chandrupatla and Belegundu, “Introduction to Finite Elements in

Engineering”, 4th Edition(revised), Pearson Education, 2011.

REFERENCES:

1. Seshu. P., “Textbook of Finite Element Analysis”, Illustrated Reprint, Prentice Hall of India Learning Pvt Ltd., 2003.
2. R. D. Cook., “Concepts and Applications of Finite Element Analysis”, 2nd Edition, Wiley, 1981.
3. David V. Hutton., “Fundamentals of Finite Element Analysis”, Tata McGraw Hill, 2005.
4. S.S. Rao, “Finite Element Analysis”, 4th Edition, Elsevier Butterworth Heinemann, 2011
5. O. C. Zienkiewicz and Y.K. Cheung., “The Finite Element Method: Its Basis and Fundamentals”, 6th Edition (Reprint), Butterworth Heinemann, 2005.
6. G Lakshmi Narasiah., “Finite Element Analysis”, Illustrated Edition, B S publications, 2009.

OUTCOMES:

Students will be able to

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

AEC4103	UAV AND MAV SYSTEMS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To gain the basic knowledge on UAV/MAV design.
- To acquaint the students to various airframe structures and their applications
- To introduce the basic methods of designing the communication and payload for UAV/MAV.
- To introduce some knowledge about the Autopilot system and flight path planning.

MODULE I INTRODUCTION TO UAV/MAV 6

History of UAV –classification –basic terminology-models and prototypes – applications.

MODULE II BASICS OF AIRFRAME 8

Airframe –dynamics –modeling- structures –wing design- engines types-equipment maintenance and management-control surfaces-specifications. Autopilot – AGL-pressure sensors-servos –accelerometer – gyros –actuators - power supply processor, integration, installation, configuration, and testing.

MODULE III AUTOPILOT SYSTEMS 8

Autopilot – Types, Feedback signal, LVDT, RVDT, Potentiometer, Connection and Calibration of Autopilot - APM Mission Planner.

MODULE IV COMMUNICATION PAYLOADS AND PATH PLANNING 8

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range – Waypoints navigation-ground control software-Recent trends in UAV-Case Studies.

Total Hours:30

REFERENCES:

1. Jane’s Unmanned Aerial Vehicles and Targets, Jane’s Information Group;

ASIN: 0710612575, 1999.
2. R. Said and H. Chayeb, “Power supply system for UAV”, KTH, 2002.
3. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
4. Skafidas, “Microcontroller Systems for a UAV”, KTH, TRITA-FYS 2002:51 ISSN 0280-31634, 2002.

OUTCOMES:

Upon completion of this course, students will understand

- The advanced concepts of UAV System Design to the engineers and to provide the necessary mathematical knowledge that are needed in modeling and analyzing an unmanned system.
- an exposure on various topics such as Design and development of UAVs, payloads and design standards, concluding with case studies of different such unmanned systems and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

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

OBJECTIVES:

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

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

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

Total Hours –45

OUTCOMES:

Students ill be able to

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

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

OBJECTIVES:

- To familiarize the students with the application of CFD/ CSM codes and their applications in aeronautics.
- To train the students to compute the flow features and stress distributions over aircraft components.

LIST OF EXPERIMENTS

CFD Analysis of

1. Flow over an airfoil
2. Flow over a cone cylinder fuselage configuration
3. Free jet flow

Computational Structural Analysis of

1. Wing spar
2. Fuselage bulkhead

Total Hours –45

OUTCOMES:

Students will be able to

- Identify suitable computational domains, boundary conditions for simple flow problems
- Select the appropriate meshing techniques and suitable solver for the flow problems
- Simulate the flow around various configurations and interpret the results obtained
- Analyze the structural response of different Aircraft structural components for various loads.

AEC 4106 **INTERNSHIP** **L T P C**
0 0 0 1

OBJECTIVES:

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

SEMESTER VIII

AEC4211	PROJECT WORK	L T P C
		0 0 24 12

OBJECTIVES:

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

Students should do a project which involves themselves with innovative ideas of design, fabrication, analysis, Industrial problem solving, new development. Frequently, progress in the project work is evaluated by conducting reviews. At end semester students should appear for their project viva-voce and submit the reports.

OUTCOMES:

Student can able to

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

PROFESSIONAL ELECTIVES

AECX 01 OPTICAL FLOW DIAGNOSTICS

L	T	P	C
2	0	0	2

OBJECTIVES:

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

MODULE I INTRODUCTION TO OPTICAL DIAGNOSTICS 8

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

MODULE II VECTOR MEASUREMENTS 7

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

MODULE III SCALAR MEASUREMENTS 8

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

MODULE IV METHOD OF SELECTION & INSTRUMENTATION 7

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

Total Hours – 30

REFERENCES:

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

OUTCOMES:

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

AECX02	HYPERSONIC AERODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 7

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

MODULE II SIMPLE SOLUTION METHODS FOR HYPERSONIC 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 HYPERSONIC WIND TUNNELS 8

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

Total Hours – 45

TEXT BOOKS:

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

REFERENCES:

- John. D. Anderson. Jr ., “Modern compressible flow with historical perspective”.McGraw Hill Publishing Company, New York, 1996.
- John. T Bertin, “Hypersonic Aerothermodynamics”, published by AIAAInc., Washington.D .C., 1994.

OUTCOMES:

Students will be able to:

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

AECX03 INDUSTRIAL AERODYNAMICS

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I ATMOSPHERIC BOUNDARY LAYER 7

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

MODULE II VEHICLE AERODYNAMICS 8

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

MODULE III WIND ENERGY COLLECTORS 7

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

MODULE IV BUILDING AERODYNAMICS 8

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

MODULE V FLOW INDUCED VIBRATIONS 8

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

MODULE VI AIR POLLUTANT DISPERSION 7

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

Total Hours – 45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will be able to

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

AECX 04	GRID GENERATION	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To familiarize the students with mesh generation for various geometries, techniques in mesh generation using commercial software and to learn about commercial software tools.

MODULE I INTRODUCTION TO GRID GENERATION 7

General transformation of the equations, Matrices and Jacobians, Stretched (Compressed) grids, Boundary- Fitted Coordinate System- elliptic grid.

MODULE II DEVELOPMENTS IN GRID GENERATION 8

Adoptive grids, modern development in grid generation, Structured Meshes, finite volume grid generation; unstructured meshes.

MODULE III MESH CONTROL TECHNIQUES 8

Inflation, Match control, Pinch, Node to Node Connectivity, Tetra Mesh, Hexa Mesh, Prism Mesh, Mapped Face Meshing, Projections, Meshing in Proximity & Curvatures.

MODULE IV INTRODUCTION TO MESHING IN COMMERCIAL SOFTWARE 7

Grid Generation in commercial software, Hyper mesh, GAMBIT, ANSYS Mesh, ICEM CFD, Turbo Grid.

Total Hours – 30

TEXT BOOKS:

1. Numerical Grid Generation by Dr. Joe. F. Thompson, 2009, Thomas & Reuters
2. Grid Generation Methods by Vladimir. D. Liseikin, 2009, Google Books

REFERENCES:

1. Handbook of Grid Generation by Nigel P. Weatherill, N. P. Weatherill, Joe F. Thompson, 1998.

OUTCOMES:

Students will be able to:

- Identify the type of grid required for an engineering solution
- Be aware of recent developments in grid generation techniques
- Identify techniques involved in meshing complex geometries
- Apply the meshing techniques in commercial software

AECX 05	WIND TUNNEL MODEL DESIGN	L	T	P	C
		1	0	0	1

OBJECTIVES:

- The overall importance of model making, Inspection, Servicing and quality assurance steps to be cover to ensure the proper mounting of a model in wind tunnel.

MODULE I APPLICABILITY AND IMPLEMENTATION 8

Introduction of applicability and implementation of model, basic definition of various models and mountings additional requirement for wind tunnel model , design and analysis standard, material selection ,structural analysis and mechanical connections study of models, metallic materials allowable stress limits, nonmetallic materials allowable stress limits, stability of a model based on pressurized systems rotating systems.

MODULE II SERVICEAND INSPECTIONS OF MODELS 7

Need of service and requirements of Inspection of model, procedure for removing models front wind tunnel, identification of software and hardware of existing equipment, general periodic in-service inspections of other model hardwareassembly, installation and configuration change procedures quality assurance.

Total Hours – 15

REFERENCES:

1. Pope, A., and Goin, L., “High Speed Wind Tunnel Testing”, John Wiley, 1985.
2. Rae, W.H., and Pope, A., “Low Speed Wind Tunnel Testing”, John Wiley Publication, 1984

TEXT BOOKS:

1. Rathakrishnan. E “Instrumentation, Measurement and Experiments in Fluids”,CRCPress, London, 2007
2. Wind-Tunnel Model Systems Criteria NASA report dated January 28, 2014

OUTCOMES:

A the end of the course students will be able to

- Understand the requirements and basic standards for selecting the materials for wind tunnel model.
- Familiar with procedure to be followed in periodic servicing and inspection methods of model mounted in wind tunnel.

AECX06	THEORY OF ELASTICITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I ANALYSIS OF STRESS 7

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

MODULE II ANALYSIS OF STRAIN 7

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

MODULE III PLANE STRESS AND PLANE STRAIN PROBLEMS 9

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

MODULE IV POLAR COORDINATES 7

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

MODULE V STRESS CONCENTRATION 7

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

MODULE VI TORSION 8

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

Total Hours – 45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will be able to

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

		L	T	P	C
AECX07	**FATIGUE AND FRACTURE MECHANICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

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

MODULE I INTRODUCTION TO FATIGUE 6

Fatigue, maximum stress, minimum stress, mean stress, stress amplitude, R ratio, constant amplitude fatigue loading, variable amplitude fatigue loading.

MODULE II PHYSICAL ASPECTS OF FATIGUE 5

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

MODULE III FATIGUE OF STRUCTURES 10

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

MODULE IV STATISTICAL ASPECTS OF FATIGUE BEHAVIOR 8

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

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- Introduction to composite failure theory, fatigue in composite materials and repair of composite material, Application to composite materials and structures.

Total Hours –45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will be able to

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

AECX 08	STRUCTURAL ANALYSIS TOOLS (NASTRAN and PATRAN)	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To familiarize the students with rudimentary knowledge of structural analysis and linear & non-linear FEA, its applications and modeling techniques.

MODULE I INTRODUCTION TO STRUCTURAL ANALYSIS 7

Static Structural Analysis, Dynamic Analysis, Rigid body dynamics, Kinetics and Kinematics of Mechanisms involved in mechanical systems.

MODULE II TOOLS IN STRUCTURAL ANALYSIS 8

Linear and non-linear FEA, its applications and modeling techniques, Buckling Analysis1D, 2D and 3D Meshing, Assembly FEM.

MODULE III INTRODUCTION TO NX NASTRAN 8

Linear Static Analysis, Normal modes analysis, Buckling Analysis, Heat Transfer Analysis, Spot Weld Analysis.

MODULE IV INTRODUCTION TO PATRAN 7

Explicit Dynamics in Patran, Engine Analysis in Patran, Non linear Rigid body dynamics and Heat Transfer problems.

Total Hours –30

TEXT BOOKS:

1. NX Nastran 9.0 for Design Engineers, by Sham Ticko 2009
2. FEA in PATRAN by P. Dechaumphai & S. Sucharitpwatskul, 2007

REFERENCES:

1. MSC NASTRAN & PATRAN Reference Guide by NASA, Users Colloq: 1985 Latest Edition: 2018.

OUTCOMES:

Students will be able to:

- Identify the type of analysis required for a structural problem
- Be aware of recent developments in structural analysis techniques
- Identify techniques involved in NASTRAN tools
- Identify the techniques in PATRAN software.

AECX 09	SMART STRUCTURES	L	T	P	C
		1	0	0	1

OBJECTIVES:

- This course is designed to give an insight into the latest developments regarding smart materials and their use in structures. Further, this also deals with structures which can self adjust their stiffness with load.

MODULE I OVERVIEW OF SMART MATERIALS 8

Introduction to Smart Materials, Principles of Piezoelectricty, Perovskyte Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, Principles of Magnet ostriction, Rare earth Magnet ostrictive materials, Giant Magnet ostriction and Magneto-resistance Effect, Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rhelological Fluids.

MODULE II SMART STRUCTURES AND APPLICATION 7

Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design. application of smart Structures used in aircraft.

Total Hours – 15

TEXT BOOKS:

1. Engineering Analysis of Smart Material Systems," by Donald J. Leo, Wiley, 2007.

REFERENCES:

1. "Self-Healing Materials: Fundamentals, Design Strategies, and Applications," by Swapan Kumar Ghosh, WileyVCH Verlag GmbH & Co. KGaA, 2009.
2. "Roark's Formulas for Stress and Strain," 8th ed., R. J. Roark, W. C. Young, R. G. Budynas, A. M. Sadegh, McGraw-Hill, 2012.

OUTCOMES:

Students will be able to:

- Analyze the behavior of smart materials such as piezoelectric ceramics, shape memory alloys and electro active polymers.
- Identify state-of-the-art approaches for making structures smarter (e.g. health assessment, self-heal and adapt to environment)

AECX 10	AIRCRAFT STRUCTURAL TESTING AND QUALIFICATION	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To study and understand the various aircraft structural Testing methods, theory and their industrial applications.

MODULE I INTRODUCTION 7

Certification for testing Civil & Military aircraft, FAR and MIL Standard Aircraft testing, Threats to Structural Integrity and the Role & Scope of Testing and Analysis, Experimental Characterization of Composites Used in Aerospace Applications, Data generation & Development Tests for Aircraft Structural Joints & Features, Structural Testing for Crashworthiness and Impact.

MODULE II AIRCRAFT TESTING METHODS 8

Strain Gauging & Measurement of Structural Loads on Aircraft & Components, Full Scale Static & Fatigue Testing of Aircraft Structures & Components, Understanding aircraft structural dynamics & development of associated test requirements, Aircraft Vibration Testing: Role, Scope, Methodology & Facilities, Structural Testing of Civil Aircraft Instrumentation, data acquisition & test controls in aircraft structural testing.

Total Hours – 15

TEXT BOOKS:

1. Full-Scale Structural Testing, John E. McCarty**,** ASM International, Volume 21, doi**:** doi.org/10.31399/asm.hb.v21.9781627081955, 2001.
2. MIL-STD-1540D report.
3. FAA-AC- 23-19A report.

REFERENCES:

1. Introduction of Nondestructive testing - A training guide, John Wiley & Sons
2. Handbook on structural testing Robert T. Reese, Wendell A. Kawahara, Fairmont Press, 1999.

OUTCOMES:

Students will be able to:

- Understand the role of structural testing application and procedures for aircraft structures.
- Identify the appropriate test method for the load applied on an aircraft.

AECX 11	MEASUREMENT SYSTEMS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To understand the principles employed in measurements in aircraft structures
- To understand the principles employed in measurements in aerodynamic stream
- To understand the techniques employed in measurements in space

MODULE I INTRODUCTION TO EXPERIMENTAL METHODS 5

Characteristics of Measuring systems - Readability, Sensitivity, Hysteresis, Accuracy, Precision- Calibration, Standards, Experiment planning, Causes and types of experimental errors, Statistical analysis of experimental data.

MODULE II FLOW MEASUREMENTS 7

Pressure Measurement: Manometer, Pressure transducers, Scanning valves; Temperature Measurement: Thermometers, Thermocouples, Thermopiles, Keil probes; Velocity Measurement: Pitot probes, Hot wires, 7 hole probes, Laser Doppler Velocimetry (LDV), Particle Image Velocimetry (PIV), Doppler Global Velocimetry(DGV) ; Turbulence Measurements: LDV, Hot wire anemometers, Root Mean Square(RMS), Spectrum- FLOW VISUALIZATION: Path- Streak- Stream- and Time lines, Direct visualization, Surface flow visualization, Flow field visualization, Data driven visualization.

MODULE III FORCES AND MOMENTS FROM WIND TUNNEL BALANCE MEASUREMENTS 7

Types of wind tunnels, Aeronautical wind tunnels, Wind tunnel data systems, Balances, Balance requirements and specifications, External balances and internal balances - STRESS AND STRAIN MEASUREMENTS: Stress and strain, Strain measurements, Strain gauge types, Basic characteristics of of a strain gage, Electrical resistance strain gauges, Rosette analysis, Strain gauge sensitivity, Stress gauges.

MODULE IV MOTION AND VIBRATION MEASUREMENT 7

Two simple vibration instruments, Principles of seismic instrument, Practical considerations for seismic instruments, Sound measurements -MOTION AND

INERTIAL MEASUREMENTS: Applications of accelerometer sensors, Acceleration sensing principles, Pendulous accelerometer (open and closed loop), Micro-machined accelerometer, Piezoelectric accelerometer, Rate gyroscope principles, Rate-integrating gyroscope principles, Micro-gyro sensors, Laser gyros.

MODULE V SPACECRAFT ATTITUDE DETERMINATION 4

Sensors: Infrared earth sensors-Horizon Crossing Sensors, Sun sensors, Star sensors, Rate and rate integrating gyros, Magnetometers.

Total Hours –30

TEXT BOOKS:

1. Experimental Methods for Engineers, Seventh Edition, J. P. Holman, Tata McGraw Hill, 2004.
2. Measurement Systems-Application and Design,5th Edition, Ernest O Doebelin, Dhanesh N Manik, Tata McGraw Hill, 2007
3. Low-Speed Wind Tunnel Testing, Jewel B Barlow, William H. Rae,Jr. , Alan Pope, John Wiley, Third Edition, 1999
4. Spacecraft Dynamics and Control-A Practical Engineering Approach, Marcel J. Sidi, Cambridge University Press, 1997

OUTCOMES:

- The students will have knowledge in fundamental in measurements of aircraft structures
- Understand the principles employed in measurements in wind tunnels
- Understand the techniques employed in measurements in space.

AECX 12	NDT TECHNIQUES FOR AIRCRAFT STRUCTURES	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To study and understand the various Non-Destructive Evaluation and Testing methods, theory and their industrial applications.

MODULE I OVERVIEW OF NDT 6

Importance of NDT in quality assurance. Different types of non-destructive techniques to obtain information regarding size, location and orientation of damage or cracks. Visual inspection techniques coin tapping technique for composite structures and adhesive bonds.

MODULE II NDT METHODS 9

Die penetration technique. Magnetic particle testing. Ultrasonic testing: Pulse echo technique, pitch-catch technique, through transmission technique, A-scan B-Scan, C-scan. Acoustic emission: Sources of acoustic emission in composites, peak amplitude rise time during events, ring-down counts duration of events. X-ray radiography for composite materials: Absorption spectra, short wave length, X-ray for detection of voids.

Total Hours – 15

TEXT BOOKS:

- Nondestructive Testing, Edword Arnold U.K.
- Introduction of Nondestructive testing - A training guide, John Wiley & Sons.

REFERENCES:

1. Donglas C Lalia, NDT for Aircraft, Jeppesen.
2. NDT and Ultrasonic Testing for Aircraft, FAA-AC 43-3

OUTCOMES:

Students will be able to:

- Identify the different types of flaws and defect in the aircraft
- Identify the appropriate technique for the flaw detection in aircraft structures

AECX13	AIRFRAME REPAIR AND MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS 7

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

MODULE II PLASTICS IN AIRCRAFT 7

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

MODULE III ADVANCED COMPOSITES IN AIRCRAFT 7

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

MODULE IV AIRCRAFT JACKING, ASSEMBLY AND RIGGING 9

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

MODULE V REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM 9

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

MODULE VI SAFETY PRACTICES 6

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

Total Hours –45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will be able to

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

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

OBJECTIVES:

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

MODULE I CREEP 12

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

MODULE II FRACTURE 9

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

MODULE III OXIDATION 5

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

MODULE IV CORROSION 7

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

MODULE V SUPERALLOYS 7

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

MODULE VI ABLATION 5

Ablative materials, Applications, Advantages and Disadvantages, Ablative heat transfer–case studies.

Total Hours –45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will be able to

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

AECX15	HEAT TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I HEAT CONDUCTION 10

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

MODULE II FREE CONVECTION 8

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

MODULE III FORCED CONVECTION 7

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

MODULE IV RADIATIVE HEAT TRANSFER 7

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

MODULE V HEAT EXCHANGERS 6

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

MODULE VI HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING 7

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

Total Hours –45

TEXT BOOKS:

1. YunusA.Cengel.,“HeatTransfer–Apracticalapproach”, 2nd Edition, Tata McGraw-Hill, 2002.
2. Incropera.F.P.andDewitt.D.P.,“IntroductiontoHeatTransfer”,JohnWiley andSons,2002..

REFERENCES:

1. Lienhard, J.H.,“AHeatTransferTextBook”,Doverpublication,2011.
2. Holman, J.P.“HeatTransfer”,6th Edition, McGraw-Hill Book Co., Inc., New York,1991.

OUTCOMES:

Students will be able to

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

AECX 16	ADVANCED PROPULSION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I ADVANCED CHEMICAL PROPULSION SYSTEM 7

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

MODULE II RAMJET ENGINES AND AIR AUGMENTED ROCKETS 7

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

MODULE III SCRAMJET PROPULSION 8

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

MODULE IV NUCLEAR PROPULSION SYSTEMS 7

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

MODULE V ELECTRIC PROPULSION SYSTEMS 8

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

MODULE VI MICRO-PROPULSION SYSTEM 8

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

Total Hours –45

TEXT BOOKS:

1. MartinTajmar, “Advancespace Propulsion systems”, 1st Edition, Springer; Softcover reprint of the original,2003.
2. WilliamH.HeiserandDavidT.Pratt, “Hypersonic Airbreathing propulsion”, AIAAEducation Series, 2001.
3. Corin Segal, “The scramjet engine–Processes and characteristics”, Cambridge University Press, 2009.

REFERENCES:

1. Sutton, G.P., “Rocket Propulsion Elements”, 8th Edition, John Wiley & Sons Inc., New York, 2010
2. Roy Bhaskar, “Aircraft Propulsion”, Elsevier (India), 2008
3. Gordon, C.O., “Aerothermodynamics of Gas Turbine and Rocket Propulsion”, 3rd Edition, AIAA Education Series, New York, 1998.
4. Paul, Z, Developments in High Speed Vehicle Propulsion System, Progress in Astronautics & Aeronautics, AIAA, Vol.165.
5. Paul, Z, Scramjet Propulsion, Progress in Astronautics & Aeronautics, AIAA, Vol. 189.
6. Paul, Z, Micro-propulsion for Small Spacecraft, Progress in Astronautics & Aeronautics, AIAA, Vol. 187.

OUTCOMES:

Students will able to

- Explain the different features and capabilities of advanced chemical rocket propulsion systems.
- Calculate the Performance parameters of Ramjet.
- Acquire the knowledge of hypersonic propulsion system and their design issues.
- Identify different Nuclear PropulsionSystem types and gain knowledge about their combustion phenomena.
- Acquire the knowledge of various Electric Propulsion System thrust generation techniques.
- Explain the Requirement of Micro-propulsion and their features

AECX 17	MICRO PROPULSION	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To identify importance of Micro propulsion and their types
- To explore recent advances in Micro propulsion systems.

MODULE I REQUIREMENTS AND TYPES 8

Recent Micro-spacecraft Developments; Micro propulsion Options; Primary Set of Micro propulsion Requirements; Chemical Propulsion Options; Review of Electric Propulsion Technologies for Micro and Nano- satellites.

MODULE II EMERGING TECHNOLOGIES 7

MEMS and MEMS - Hybrid Propulsion System - Fabrication Methods and Applications of MEMS - Integration and Packaging of Smart Microsystems.

Total Hours – 15

TEXT BOOKS:

1. Vijay K. Varadan., K. J. Vinoy, and S. Gopalakrishnan, Smart Material Systems and MEMS, John Wiley & Sons Ltd, England, 2006.

REFERENCES:

1. Paul, Z., Developments in High Speed- Vehicle Propulsion System – Progress in Astronautics & Aeronautics, Vol.165, AIAA.
2. Paul, Z., Micro propulsion for Small Spacecraft – Progress in Astronautics & Aeronautics, Vol. 187, AIAA.

OUTCOMES:

Students will be able to

- Identify different Micro propulsion options and their requirements
- Employ emerging techniques to fabricate micro systems

AECX 18	CRYOGENICS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To provide knowledge on the properties of materials at low temperature
- To familiarize with various gas liquefaction systems and to provide design aspects of cryogenic storage and transfer lines
- To provide the knowledge of evolution of low temperature science.

MODULE I Introduction to Cryogenic Systems 8

Introduction to Cryogenic Systems, Historical development, Low Temperature properties of Engineering Materials, Mechanical properties- Thermal properties-Electric and magnetic properties –Cryogenic fluids and their properties.

MODULE II Gas Liquefaction Systems & Cryogenic Fluid Storage and Transfer Systems 11

Liquification systems for Air Simple Linde –Hampson System, Claude System, Heylndt System, Dual pressure, Claude. Liquefaction cycle Kapitza System. Comparison of Liquefaction Cycles Liquefaction cycle for hydrogen, helium and Neon, Critical components of liquefaction systems.

Design of cryogenic fluid storage vessels, Inner vessel, Outer Insulation, Suspension system, Fill and drain lines. Cryogenic fluid transfer, External pressurization, Self pressurization, Transfer pump.

MODULE III Gas Cycle Cryogenic Refrigeration Systems 11

Classification of Cryo coolers, Cryo – refrigerators, Stirling cycle – working principle. Schmidt’s analysis of Stirling cycle Various configurations of Stirling cycle refrigerators, Stirling Cryo coolers, Gifford Mcmahon Cryo- refrigerator, Pulse tube refrigerator, Solvay cycle refrigerator, Vuillimier refrigerator, Cryogenic regenerators.

Total Hours – 30

TEXT BOOKS:

1. J. H. Boll Jr, Cryogenic Engineering
2. R. B. Scott, Cryogenic Engineering, Van Nostrand Co., 1959
3. Randal F.Barron, Cryogenic systems, McGraw Hill, 1986

REFERENCES:

1. Klaus D.Timmerhaus and Thomas M.Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989.

OUTCOMES:

Students will be able to

- Understand properties of material at cryogenic temperatures, Cryogenic fluids and their properties.
- Design Cryogenic Fluid Storage and Transfer Systems and know about various liquefaction systems.
- Get ideas on cryogenic refrigeration systems.

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

OBJECTIVES:

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

MODULE I AIR TRAFFIC CONTROL - INTRODUCTION 8

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

MODULE II AIR TRAFFIC SERVICES AND SEPARATION PROCEDURES 10

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

MODULE III RADAR IN AIRCRAFT SEPARATION AND IDENTIFICATION 6

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

MODULE IV RADAR IN EMERGENCY AND COORDINATION PROCEDURES 5

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

MODULE V PHYSICAL CHARACTERISTICS OF RUNWAY AND OBSTACLE RESTRICTION 8

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

MODULE VI VISUAL AIDS FOR NAVIGATION AND LANDING 8

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

Total Hours –45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Students will be able to

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

AECX20	AVIATION RULES AND REGULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

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

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 7

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

MODULE III C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS: 10

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

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

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

MODULE V C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT 6

Flight testing of (series) aircraft for issue of C of A; fight testing of aircraft for which C or A had been previously issued. C.A.R. SERIES 'X' – MISCELLANEOUS **REQUIREMENTS:** Registration Markings of aircraft; weight and balancecontrol of an aircraft; provision of first aid kits & physician's kit in an aircraft; use furnishing materials in an aircraft; concessions

MODULE VI AIRCRAFT DOCUMENTS PROCEDURE AND PERMITS 6

Aircraft log books; document to be carried on board on indian registered aircraft; procedure for issue of taxy permit; procedure for issue of type approval of aircraft components and equipment including instruments.

Total Hours –45

REFERENCES:

1. “Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus,New Delhi.
3. “Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA.
4. “Advisory Circulars ", form DGCA. as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Cod e of Conduct

OUTCOMES:

Students will be able to

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

AECX23	VISCOUS FLOWS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic idea of compressible and incompressible viscous flows and boundary layers.

MODULE I FUNDAMENTAL EQUATIONS OF VISCOUS FLOWS 8

Classifications of fundamental equations, The equation of continuity, the Navier stokes equation, the energy equation, boundary conditions for viscous heat conducting flow; orthogonal coordinates system, mathematical character of the basic equations.

MODULE II SOLUTIONS OF THE NEWTONIAN VISCOUS-FLOW EQUATIONS 8

Introduction and classifications of solutions, Couette flows, Poiseuille flow through ducts-circular pipes, combined Couette - Poiseuille flow non circular duct. Similarity solutions, low Reynolds number linearized motion.

MODULE III LAMINAR BOUNDARY LAYERS 8

The laminar-boundary layer equations, flow separation, Similarity solutions for steady two-dimensional flows- Blasius solutions: Falkner-skan wedge flow, Free- shear flows, approximate integral methods, flow in the inlet of ducts.

MODULE IV INCOMPRESSIBLE TURBULENT FLOW 7

Physical and mathematical description of turbulence, the Reynolds equations of turbulent motion, The two dimensional turbulent-boundary-layer equation, Velocity profiles: The inner, Outer, and overlap layers, Turbulent flow in pipes and channels, The turbulent boundary layer on a flat plate, Turbulence modeling.

MODULE V COMPRESSIBLE-BOUNDARY LAYER FLOW 7

Introduction steady viscous flow, similarity solutions for compressible laminar flow, solutions for laminar flat plate flow ,integral relation for the compressible boundary layer, compressible law of the wall, compressible law of the wake, flat plate theory of van driest.

MODULE VI TURBULENT FREE SHEAR FLOWS 7

Equations for plane free shear layers, plane free jets: Global balance, far field, near field, wall effects, mixing layer, plane wake, axisymmetric free shear flows: basic equations, free jet, wake, Buoyant jets: plane boundary jets, axisymmetric buoyant jet, plane wall jet.

Total Hours –45

TEXT BOOKS:

1. Frank M.White, “Viscous fluid flow”, Tata McGraw Hill Publications, 2006.

REFERENCES:

1. Schlichting .H, “Boundary layer theory”, McGraw Hill Publications, Newyork.

OUTCOMES:

Students will be able to

- Understand the basic equations involved for solving of viscous flow problems.
- Solve the fundamental problems related to Navier-stokes
- Understand the concept of laminar boundary layer
- Understand the concept of turbulent boundary layer.
- Formulate the integral relation of compressible boundary layer and its solution methods.
- Understand the concept of free shear layer and its application to jet flows.

		L	T	P	C
AECX 24	**AERO-ACOUSTICS**	**1**	**0**	**0**	**1**

OBJECTIVES:

- To provide an introduction to acoustics and aero-acoustics concept.
-

MODULE I INTRODUCTION 8

Conservation equations, wave equation. Acoustic energy, intensity, Fourier analysis, power spectrum. One-dimensional and three-dimensional sound propagation. Sources of sound: elementary sources, monopole, dipole and multipole sources. Generalized functions,Green's function for wave equation.

MODULE II INTERACTION 7

Acoustics of rigid solid boundaries: reciprocity theorem, Kirchhoff's formula. Sound generation by flow: Lighthill's acoustic analogy, its successors. Ffowcs Williams and Hawking's theory. Introduction to aero acoustics measurement methods.

Total Hours – 15

TEXT BOOKS:

1. Goldstein, M. E., Aeroacoustics, McGraw-Hill, 1976.
2. Aeroacoustics of Low Mach Number Flows: Fundamentals, Analysis, and Measurement by Stewart Glegg , William Devenport, Academic Press, 2017

REFERENCES:

1. Howe, M. S., Theory of vortex sound, Cambridge, 2003.
2. Pierce, A. D., Acoustics, Acoustical Society of America, 1989.
3. Crighton, D. G., Dowling, A. P., Ffowcs Williams, J. E., Heckl, M. and Leppington, F. G.,Modern methods in analytical acoustics, Springer, 1992.
4. Aeroacoustic Measurements by Thomas J. Mueller, Springer,2002.

OUTCOMES:

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

- Understand the basics of acoustics and aero-acoustics.
- Know the basic equations involved for acoustic related problems.
- Coupling between acoustic waves and fluid flow motion.

AECX 25	WIND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I ATMOSPHERIC BOUNDARY LAYER 7

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

MODULE II WIND ENERGY COLLECTORS 7

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

MODULE III WIND TURBINE BLADE DESIGN 8

CAD Modeling of Wind Turbine Blade, IEC61400-1, IEC61400-23 Standards for Blade Design, Bionic Blade Designs for Wind turbines, Nacelle and Tower Design standards and governing parameters.

MODULE IV BUILDING AERODYNAMICS 8

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

MODULE V FLOW INDUCED VIBRATIONS 8

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

MODULE VI AIR POLLUTANT DISPERSION 7

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

Total Hours – 45

TEXT BOOKS:

1. Scorer R.S "Environmental Aerodynamics", Ellis Harwood Ltd, England, 1978.
2. Sachs P "Wind Forces in Engineering", Pergamon Press, 1988
3. Blevins R.D "Flow Induced Vibrations", Van Nostrand, 1990

REFERENCES:

1. Rose Mccallen, Fred Browand, James Rose The aerodynamics of heavy vehicle- Trucks, buses and trains Springar Berlin Heidelperg Newyork,2004
2. Sovran, M(ed) "Aerodynamic drag mechanism of bluff bodies and road vehicles",Plenum Press, N.Y, 1978
3. Calvert N.G "Wind Power Principles", Charles Griffin & Co London, 1979.

OUTCOMES:

Students will be able to

- Understand the wind environment in the atmosphere and the structure of the atmospheric boundary layer
- Gain knowledge on applications of aerodynamics in stability of turbines.
- Understand wind turbine physics, various types of wind turbines and design constraints
- To apply the knowledge of Aerodynamics to building designs and learn about building codes.
- Understand the practical problems involved flow induced vibrations and wind loads
- Understand air pollutant dispersion influenced by natural winds.

AECX26	COMPOSITE MATERIALS AND STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the methods of fabrication and analysis of composite materials and structures.

MODULE I INTRODUCTION 7

Introduction – Advantages and applications of composite materials, reinforcements and matrices- type of resins properties and applications – generalized Hooke's law – elastic constants for anisotropic, orthotropic and isotropic materials.

MODULE II MICRO MECHANICS 8

Micromechanics – mechanics of material approach and elasticity approach to determine the material properties - fibre volume ratio - Mass Ratio - effects of voids and hygrothermal effects of lamina.

MODULE III MACRO MECHANICS 9

Macro mechanics – Stress Strain relations with respect to natural and arbitrary axis – Determination of material properties – Experimental characterization of lamina, Failure Theories.

MODULE IV LAMINATED PLATES 10

Governing differential equation for a unidirectional lamina and general laminate, angle ply, cross ply laminates – failure criteria for composites.

MODULE V SANDWICH CONSTRUCTIONS 5

Basic modes of sandwich construction – materials used for sandwich construction – failure modes of sandwich panels.

MODULE VI FABRICATION PROCESS 6

Various open and closed mould processes – Manufacture of fiber – netting analysis – autoclave – vacuum bag molding – filament winding – pultrusions – resin transfer molding.

Total Hours –45

TEXT BOOKS:

1. Jones, R.M., "Mechanics of Composite Materials", 2nd Edition, Taylos & Francis group, 1999.
2. Authar K Kaw., "Mechanics of Composite Materials", 2nd Edition, CRC press, 2010.

REFERENCES:

1. Madhuji Muhkapadhyay., "Mechanics of composite Materials and structures", Illustrated Edition, University press, 2004.
2. Calcote, L R., "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
3. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
4. Allen Baker., "Composite Materials for Aircraft Structures", 2nd Edition, AIAA series, 1999.

OUTCOMES:

Students will be able to

- Understand the properties of materials used in various parts of aircraft.
- Understand the importance of micro mechanics its process.
- Understand the importance of macro mechanics its process.
- Calculate the mechanical properties of laminated plates and apply suitable failure criteria.
- Understand the basic concepts involving sandwich construction.
- Understand the fabrication process involved in developing the composite structures.

AECX 27	EXPERIMENTAL TECHNIQUES FOR AIRCRAFT STRUCTURES	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To introduce the experimental methods of finding the responses of structural elements subjected to different types of loads.

MODULE I EXTENSOMETERS 10

Principles of measurement, Accuracy, Sensitivity and range of measurements Mechanical, Optical Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

MODULE II ELECTRICAL RESISTANCE STRAIN GAUGES 15

Principle of operation and requirements, Types and their uses, Materials for strain gauge, temperature compensation, cross sensitivity, Rosette analysis, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators. Design of Three Component Balance and Six Component Balance.

MODULE III BRITTLE COATINGS AND MOIRE METHODS 5

Introduction to Moire Techniques, Brittle coating methods and holography.

Total Hours –30

TEXT BOOKS:

1. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., andRamachandra, K., “Experimental Stress Analysis”, Tata McGraw-Hill, NewDelhi, 1984.
2. Dally, J.W., and Riley, W.F., “Experimental Stress Analysis”, 4th Edition,McGraw-Hill Inc., New York, 2005.

REFERENCES:

1. Hetyenyi, M., “Hand book of Experimental Stress Analysis”, John Wiley andSons Inc.,New York, 1972.
2. Sadhu Singh, “Experimental Stress Analysis”, 2nd Edition, Khanna, 1990.

OUTCOMES:

Students will be able to,

- Differentiate and use the type of strain gauges suitable for different applications.
- Evaluate the structural responses using different experimental stress analysis techniques and compare with that of the analytical data
- Identify the areas of stress concentration on different types of structural elements using the photo elastic methods.
- Gain knowledge of 3D photo elasticity and digital photo elasticity.
- Use the Moiré techniques, brittle coating methods and holography wherever traditional methods cannot be used.
- Apply NDT methods for detecting the structural defects.

AECX 28	VIBRATION AND AERO ELASTICITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide theoretical background to vibration of mechanical systems and analysis.

MODULE I INTRODUCTION 9

Free and forced vibrations, degrees of freedom, simple harmonic motion, spring mass system, torsional vibration, Equation of motion, D'Alembert's Principle, conservation of energy.

MODULE II SINGLE DEGREE OF FREEDOM SYSTEMS 8

Free vibrations, damped vibrations, forced Vibrations, with and without damping, support excitation, vibration measuring instruments.

MODULE III MULTI DEGREES OF FREEDOM SYSTEMS 7

Two degrees of freedom systems, static and dynamic couplings, principal co-ordinates, principal modes and orthogonal condition, Eigen value problems, Hamilton's principle, Lagrangean equations and application.

MODULE IV CONTINUOUS SYSTEMS 7

Vibration of elastic bodies, vibration of strings, longitudinal, lateral and torsional vibrations.

MODULE V APPROXIMATE METHODS 6

Approximate methods, Rayleigh's method, Dunkerlay's method, Rayleigh-Ritz method, matrix Iteration method.

MODULE VI ELEMENTS OF AEROELASTICITY 8

Vibration due to coupling of bending and torsion - aeroelastic problems - collars triangle - wing Divergence - aileron control reversal – flutter – buffeting.

Total Hours –45

TEXT BOOKS:

1. Timoshenko S., "Vibration Problems in Engineering", Wolfender press, New York, 2008.

2. Fung Y.C., “An Introduction to the Theory of Aero elasticity”, Dover Publications, 2008.

REFERENCES:

1. Bisplinghoff R.L., Ashely H and Hogman R.L., “Aeroelasticity”, Dover Publications, 1996.
2. Tse. F.S., Morse, I.F., Hunkle, R.T., “Mechanical Vibrations Theory and Applications”, Allyn and Bacon, 1978
3. Benson H.Tongue, “Principles of Vibration”, Oxford University Press, 2000.
4. Singiresu S. Rao, “Mechanical Vibrations”, Addison- Wesley Publishing Company, 1995.

OUTCOMES:

Student will be able to

- Calculate natural frequency and period of simple vibrating mechanical systems
- Construct simple vibration models of mechanical systems and perform time- and frequency-domain vibration analysis for SDOF
- Construct simple vibration models of mechanical systems and perform time- and frequency-domain vibration analysis for MDOF
- Estimate the vibrations of continuous systems: bars, beams and plate
- Apply approximate methods for vibrations of continuous systems
- Gain knowledge on various Aero elastic problems experienced by an aircraft.

		L	T	P	C
AECX 29	**HYPER MESH**	**2**	**0**	**0**	**2**

OBJECTIVES:

- To study and understand the Hyper Mesh software tools for Aerospace application

MODULE I INTRODUCTION TO HYPER MESH 06

Introduction to CAD & CAE, Application of CAE Software, Advantages and Introduction to geometry tools and creation of surface.

MODULE II MESHING 09

Introduction to Meshing, structured and unstructured mesh, 1D, 2D and 3D, Mesh quality and quality index, 1D and 2D size optimization.

MODULE III CREATING AN FEA MODEL 10

Deck preparation, Model Organization: Collectors, Material and properties assignment, Assign of loads and constraints, setup solver.

MODULE IV SOLVING AND EXPORTING 5

Post-processing: Viewing a Deformed Shape, Viewing a Contour Plot Exporting FE data to various Solvers like ANSYS, LS Dyna and Radioss.

Total Hours – 30

TEXT BOOKS:

1. Hyper Mesh Basic Training, Volume 1, 2003 Altair Engineering, Inc.

OUTCOMES:

Students will be able to:

- Understand the application of software in solving aerospace problems
- Identify the appropriate mesh type for solving the problem
- Create a collector to solve the FEA problem
- Capture the results and save the file in required formats.

AECX 30	COMBUSTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic principles of combustion thermodynamics in different types of aerospace power plants.

MODULE I COMBUSTION FUNDAMENTALS 7

Review of thermodynamics of combustion - Basic Reaction Kinetics, Elementary reactions, Multistep reactions, Global kinetics. Physics of Combustion - Fundamental laws of transport phenomena, Conservations Equations.

MODULE II PREMIXED FLAME 8

Modes of Combustion- Fameless combustion- deflagration - detonation - One dimensional combustion wave - Rankine-Hugoniot curves, Laminar premixed flame, Burning velocity measurement methods, Effects of chemical and physical variables on Burning velocity, Flame extinction, Ignition, Flame stabilizations - Turbulent Premixed flame.

MODULE III DIFFUSION FLAME 7

Introduction to Droplet Combustion - Liquid fuel combustion, Atomization, Spray Combustion, Gaseous Jet diffusion flame, Solid fuel combustion.

MODULE IV COMBUSTION IN JET ENGINES 7

Combustion in gas turbine combustion chambers - recirculation – combustion efficiency - factors affecting combustion efficiency - fuels used for gas turbine combustion chambers, combustion stability, ramjet combustion. Dual Mode Combustion.

MODULE V COMBUSTION IN SUPERSONIC ENGINES 8

Introduction to supersonic combustion – need for supersonic combustion for hypersonic air-breathing propulsion, supersonic combustion controlled by diffusion, mixing and heat convection – analysis of reactions and mixing processes, supersonic burning with detonation shocks, various types of supersonic combustors- Hydrogen based Combustion.

MODULE VI COMBUSTION IN ROCKET ENGINE 8

Solid propellant combustion - double and composite propellant combustion – various combustion models, combustion in liquid rocket engines – single fuel droplet combustion model, combustion in hybrid rockets.

Total Hours –45

TEXT BOOKS:

1. Sharma, S.P., and Chandra Mohan, “Fuels and Combustion”, Tata McGraw Hill, Publishing Co., Ltd., New Delhi, 1987.
2. Sutton, G.P., “Rocket Propulsion Elements”, 5th Edition, John Wiley & Sons Inc., New York, 1993.

REFERENCES:

1. Loh, W.H.T., “Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design”, Springer Verlag, New York, 1982.
2. Mathur, M.L., and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers and Distributors, Delhi, 1988.
3. Beer, J.M., and Chiger, N.A. “Combustion Aerodynamics”, Applied Science Publishers Ltd., London, 1981.
4. Turns, S. R., “An Introduction to Combustion Concepts and Applications”, 2nd Edition, McGraw Hill International Editions, New Delhi, 2000.

OUTCOMES:

Students will be able to

- Acquire the basics of chemical kinetics and physics of combustion.
- Explore premixed flame characteristics
- Explore diffusion flame characteristics and their application.
- Analyze combustion phenomena of jet engines.
- Acquire knowledge about supersonic combustion process.
- Comprehend all types of rocket engine combustion systems & Hybrid rockets.

AECX31 ROCKETS AND MISSILES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the principles of design, development, operation and flight of rockets and missiles.

MODULE I SOLID ROCKET SYSTEMS 7

Introduction - Rockets - purpose – classifications – components – functions, Solid-fuel rockets – basic concepts, design, solid propellants, Grain geometry, Casing, Nozzle, Performance. Ignition system in rockets – types of igniters and igniter design considerations.

MODULE II LIQUID ROCKET SYSTEMS 7

Injection system and propellant feed systems of liquid rockets and their design considerations – design considerations of liquid rocket thrust chambers– combustion mechanisms.

MODULE III AERODYNAMICS OF ROCKETS AND MISSILES 9

Airframe components of rockets and missiles – forces acting on a missile while passing through atmosphere – classification of missiles and Indian missile program – slender body aerodynamics- method of describing forces and moments – lift force and lateral moment –lateral aerodynamic damping moment – longitudinal moment – drag estimation – body up wash and body downwash in missiles – rocket dispersion.

MODULE IV ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD 8

One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields – description of vertical, inclined and gravity turn trajectories – determination of range and altitude – simple approximations to burn out velocity and altitude – estimation of culmination time and altitude.

MODULE V STAGING AND CONTROL OF ROCKETS AND MISSILES 8

Design philosophy behind multi staging of launch vehicles and ballistic missiles –

multistage vehicle optimization – stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics – various types of thrust vector control methods including secondary injection thrust vector control – numerical problems on stage separation and multi staging.

MODULE VI MATERIALS FOR ROCKET AND MISSILE APPLICATIONS 6

Selection criteria of materials for rockets and missiles – materials for various airframe components and engine parts – materials for thrust control devices – various adverse conditions faced by aerospace vehicles and the requirement of materials to perform under these conditions.

Total Hours –45

TEXT BOOKS:

1. Cornelisse, J.W., Schoyer H.F.R., Wakker K.F., “Rocket Propulsion and SpaceDynamics”, Pitman Publishing, 1979.
2. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons, 2000.
3. Chin, S.S., “Missile configuration Design”, McGraw-Hill, 1961.
4. Parker, E.R., “Material for Missiles and Spacecraft”, McGraw Hill Book Co. nc., 1982.

REFERENCES:

1. Barrere et al, “Rocket propulsion”, Elsevier publisher Co., 1960.
2. Martin J. L. Turner, “Rocket and Spacecraft propulsion: Principles, Practice & New Developments”, Springer Praxis, 2004.
3. N. Nielsen, “Missile Aerodynamics”, Mountain View, Near, Inc., 1998.

OUTCOMES:

Students will be able to

- Identify the various parts of a solid rocket propellant and propellant grain geometry.
- Acquire knowledge of the ignition and feed systems of the liquid rocket and their design parameters.
- Apply the law of aerodynamics on the flight performance of the rockets and missiles.
- Solve the rocket performance related problems and find the range and altitude gained in the ideal conditions.
- Recognize various types of multi-staging in the rockets and distinguish their separation techniques.
- Differentiate the various materials used in the rockets and missiles.

AECX 33	AIRCRAFT COOLING SYSTEMS	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To introduce the basic knowledge of aircraft pressurization and cabin comfort system and its applications.
- To gain the basic knowledge of Air conditioning in aircrafts to the students.

MODULE I AIRCRAFT PRESSURISATION 7

Atmosphere : Description of a cabin pressure system -Structural Requirements for pressure cabins -Cabin pressure and rate of change controls - Safety - Recirculation systems - Humidification.

MODULE II AIR CONDITIONING & COOLING SYSTEMS 8

Air conditioning -types -Heating systems - Cooling systems: air evaporative-boot strap – regenerative air-Maintenance of the various components of the system.

Total Hours – 15

TEXT BOOKS:

1. Aircraft Maintenance & Repair - Kroes , Watkins , Delp
2. Handbooks of Airframe and Power plant Mechanics, US dept. of Transportation, Federal, Aviation Administration, The English Book Store, New Delhi, 1995.

REFERENCES:

1. A & P Technician Airframe Text book - Jeppesen : Boeing company
2. Civil Aircraft Inspection Procedure (CAIP), Civil Aviation Authority, Himalayan Books.

OUTCOMES:

Students will be able to

- To understand the aircraft pressurization & various cabin comfort system used in aircraft.
- To understand the various Air conditioning systems in aircrafts.

AECX34	AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of aircraft general engineering and maintenance practices.

MODULE I AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT 10

Mooring, jacking, leveling and towing operations – Preparation – Equipment – precautions – Engine starting procedures – Piston engine, turboprops and turbojets – Engine fire extinguishing – Ground power unit.

MODULE II GROUND SERVICING OF VARIOUS SUB SYSTEMS 08

Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.

MODULE III MAINTENANCE OF SAFETY 05

Shop safety – Environmental cleanliness – Precautions.

MODULE IV INSPECTION 10

Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data sheets – ATA Specifications.

MODULE V AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES 06

Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop – Identification terminology – Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws etc) – American and British systems of specifications – Threads, gears, bearings, etc – Drills, tapes and reamers – Identification of all types of fluid line fittings. Materials, metallic and non-metallic - Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging over splicing.

MODULE VI OTHER SPECIFICATIONS AND SERVICES 06

American and British system of specifications – Threads, gears, bearings, etc – Drills, tapes and reamers–Identification of all types of fluid line fittings. Materials, metallic and non-metallic Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging over splicing.

Total Hours –45

TEXT BOOKS:

1. Kroes Watkins Delp, “Aircraft Maintenance and Repair”, McGraw Hill, New York, 1993.

REFERENCES:

1. A&P Mechanics, “Aircraft Hand Book”, FAA Himalayan Book House, New Delhi, 1996.
2. A&P Mechanics, “General Hand Book”, FAA Himalayan Bok House, New Delhi, 1996.

OUTCOMES:

Students will be able to

- Keep abreast with procedure and standard maintenance practices.
- Gain knowledge on maintenance and flight safety aspects.
- Gain knowledge on theoretical aspects of ground servicing of aircraft.
- Acquire knowledge on importance of aircraft documentation and various inspection schedules.
- Identify and gain knowledge on special aircraft tools and equipments.
- Keep abreast with development of new generation aircraft and their system.

AECX 35	PRODUCT DEVELOPMENT AND 3D PRINTING TECHNOLOGIES	L	T	P	C
		2	0	0	2

OBJECTIVES:

At the end of this course the students would have developed a thorough understanding of the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping Technologies.

MODULE I INTRODUCTION TO PRODUCT DEVELOPMENT 7

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping and Tooling on Product Development – Benefits- Applications – Digital prototyping - Virtual prototyping.

MODULE II REVERSE ENGINEERING & CAD MODELING 8

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid

Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing.

MODULE III RAPID PROTOTYPING & TOOLING 7

Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

MODULE IV 3D PRINTING 8

Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.

Total Hours – 30

TEXT BOOKS:

1. Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
2. Rapid Tooling: Technologies and Industrial Applications, Peter D. Hilton, Hilton/Jacobs, PaulF .Jacobs, CRC press, 2000.

REFERENCES:

1. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
2. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006.

OUTCOMES:

- It helps the students to get familiarized with the various methods of rapid prototyping technologies and rapid tooling.
- Students will be able to identify 3D Printing techniques and apply various manufacturing methodologies to develop a specific product.

AECX 36 ADVANCED MANUFACTURING TECHNOLOGIES

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the principles of various nontraditional machining processes.
- To learn the features of various types of computer controlled machines.
- To study the different types of metal forming and welding processes.
- To know the various processes involved for making plastic and ceramic different components.

MODULE I NON TRADTIONAL MACHINING PROCESSES 9

Conventional machining process – Hard Milling - Hard Tuning – Hybrid Machining - Differences between conventional and non conventional machining process – Additive manufacturing - Electric Discharge Machining (EDM) - Ultrasonic Machining (USM) - Electro chemical machining (ECM) - Laser Beam Machining (LBM) - Electron Beam Machining (EBM) - Plasma arc Machining (PAM) - Ion beam Machining (IBM) - Abrasive Jet Machining (AJM) - Abrasive Water Jet Machining (AWJM).

MODULE II COMPUTER CONTROLLED MACHINES 7

Configuration and working of conventional machine tools – Cutting parameters – Machinability of materials - NC part programming - NC coordinate systems and axes - Computer aided part programming – CNC languages – APT language structure: geometry commands, motion - Direct Numerical Control (DNC) - Computer Integrated Manufacturing (CIM).

MODULE III FORMING AND JOINING PROCESSES 7

Rolling - Extrusion - Forging - Forming - Blanking and Piercing, Brake Forming, Deep Drawing, Stretch Forming - Rubber Pad Forming, Superplastic Forming - Joining - Gas Metal and Gas Tungsten Arc Welding, Plasma Arc Welding, Laser Welding, Resistance Welding, Friction Stir Welding, Diffusion bonding.

MODULE IV MANUFACTURING OF PLASTIC AND CERAMIC COMPONENTS 7

Types of Plastics: Thermosetting plastics and Thermo plastic – Injection Moulding:

Plunger and Screw machines- Blow moulding- Rotational moulding - Film blowing- Extrusion moulding- Compression moulding- Thermoforming Transfer moulding- Bonding of thermoplastics - Ceramics - Pressing -Uniaxial Pressing, Isostatic Pressing, Wet Bag Isostatic Pressing, Dry Bag Isostatic Pressing - Casting - Slip Casting, Vacuum Casting, Doctor Blade Process, Waterfall Technique, Paper Casting Process.

Total Hours – 30

TEXT BOOKS:

1. F.C. Campbell, Manufacturing Technology for Aerospace Structural Materials, Elsevier.
2. J. Paulo Davim, Nontraditional Machining Processes: Research Advances.
3. P.N. Rao, “CAD / CAM Principles and Applications”, 2nd Edition, Tata Mc Graw Hill, 2004.
4. Manufacturing Science, G.S. Sawhney, Vol I & II, I.K. International Publishing House Pvt. Ltd, New Delhi.

REFERENCES:

1. Hajra Choudhury , Elements of Workshop Technology, Vol I and Vol II, Media Promoters Pvt. Ltd, Mumbai 2007.
2. Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc.2006.
3. Manufacturing Technology, P.N. Rao, Tata McGraw- Hill Publishing Limited, II Edition, 2009.
4. Ibrahim Zeid, “CAD/CAM - Theory and Practice”, McGraw Hill, International Edition, 1998.
5. A text book of production technology, P.C. Sharma, S.Chand and Company, X Edition, 2000.

OUTCOMES:

Students will be able to

- Identify a suitable nontraditional process for making a component.
- Understand the computers involved in the manufacturing process.
- Select an appropriate forming and welding process of metals.
- Choose proper technique for making components by plastic and ceramic.

AECX37	AIRCRAFT NAVIGATION AND GUIDANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the concept of

- Different axis systems and co-ordinate transformation techniques
- Different radio navigation systems
- nertial sensors and inertial navigation
- Various approach and landing aids of aircraft
- Satellite navigation & Hybrid navigation

MODULE I NAVIGATION SYSTEMS & INERTIAL SENSORS 6

Introduction to navigation – Types – Introduction to Inertial Sensors - Mechanical - Ring Laser gyro- Fiber optic gyro – MEMS system.

MODULE II INERTIAL NAVIGATION SYSTEMS 8

INS components: transfer function and errors- Earth in inertial space - coriolis effect – INS Mechanization. Stable Platform and Strap down – Navigation algorithms - INS system block diagram.

MODULE III INERTIAL NAVIGATION ALGORITHM 8

Different co-ordinate systems – Transformation Techniques - Schuler Tuning - compensation errors - Gimbal lock – Initial calibration and Alignment Algorithms.

MODULE IV RADIO NAVIGATION 8

Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations -LORAN, DECCA and Omega – TACAN.

MODULE V APPROACH AND LANDING AIDS 6

ILS, MLS, GLS - Ground controlled approach system - surveillance systems-radio altimeter.

MODULE VI SATELLITE NAVIGATION&HYBRID NAVIGATION 9

Introduction to GPS -system description -basic principles -position and velocity determination signal structure-DGPS, Introduction to Kalman filtering -Estimation and mixed mode navigation- Integration of GPS and INS-utilization of navigation systems in aircraft.

TOTAL HOURS: 45

REFERENCES:

1. Myron Kyton, Walfred Fried, ‗Avionics Navigation Systems', John Wiley & Sons,2nd edition, 1997
2. Nagaraja, N.S. ―Elements of Electronic Navigation‖, Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.
3. George M Siouris, ‗Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.
4. Albert Helfrick, ‗Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995.
5. Albert D. Helfrick, ‗Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.

OUTCOMES:

Upon completion of the course,

- Students will explain the advanced concepts of Aircraft Navigation to the engineers and to provide the necessary mathematical knowledge that are needed in modeling the navigation process and methods.
- The students will have an exposure on various Navigation systems such as Inertial Measurement systems, Radio Navigation Systems, Satellite Navigation – GPS.
- Landing aids and will be able to deploy these skills effectively in the analysis and understanding of navigation systems in an aircraft.

AECX 38	CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To analyze the system modeling and various methods of representation.
- To provide adequate knowledge on time response analysis of systems and steady state error calculations.
- To educate the necessity for frequency domain analysis using numerous plots.
- To enhance knowledge on stability analysis of multivariable processes.

MODULE I SYSTEM REPRESENTATION AND ANALYSIS 8

Open loop and closed loop control systems – Transfer Function – Mechanical, Electrical and Electromechanical Systems – Block diagram representation – Block diagram reduction – Signal flow graphs.

MODULE II TIME DOMAIN ANALYSIS 7

Transient and Steady State response – Test Signals – Time domain specifications – First order system, Steady state error and error constants – P, PI, PID modes of feedback control.

MODULE III FREQUENCY DOMAIN ANALYSIS 8

Frequency domain specifications – Relation between time and frequency domain parameters – Analysis based on bode plot and polar plot – Gain and phase margin – Nichols chart.

MODULE IV COMPENSATOR DESIGN 7

Compensator design using bode plots: Lag, Lead, Lead-Lag Compensator. Realization of Lag, lead and Lead-Lag networks.

MODULE V SYSTEM STABILITY – I 7

Stability analysis by locating roots in s plane – Routh Hurwitz criterion– Root locus construction and performance analysis.

MODULE VI SYSTEM STABILITY - II 8

Stability analysis in frequency domain – Nyquist stability criterion- Case Study-Modelling and parameter analysis of a closed loop control system.

Total Hours –45

REFERENCES:

1. K. Ogata, 'Modern Control Engineering', 4th edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath& M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003.
3. Benjamin C Kuo, "Control Systems", Tata McGraw Hill, 2002 4. C.J.Chesmond.'Basic Control System Technology', Viva low priced student edition, 1998.
4. John S. Bay, "Fundamentals of Linear State Space Systems", McGraw-Hill 1999.

OUTCOMES:

At the end of the course, the student will have knowledge and achieve skills on the following:

- Ability to analyze complex systems using mathematical models.
- Get the time response of first and second order systems analytically and interpret the response.
- Perform frequency response analysis of physical systems and interpret the response.
- Design appropriate compensator for the given system to meet the desired specifications
- Implement state space approach for the process and obtain the solution.

AECX 39	**MICROPROCESSOR AND MICROCONTROLLER FOR AIRCRAFT SYSTEMS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

OBJECTIVES:

The student should be made to:

- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study about communication and bus interfacing.
- Study the Architecture of 8051 microcontroller.

MODULE I THE 8086 MICROPROCESSOR 8

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

MODULE II I/O INTERFACING 7

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

MODULE III MICROCONTROLLER 8

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

MODULE IV INTERFACING MICROCONTROLLER 7

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.

Total Hours – 30

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088

Family – Architecture, Programming and Design", Second Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.

OUTCOMES:

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

- Design and implement programs on 8086 microprocessor. x Design I/O circuits.
- Design Memory Interfacing circuits.
- Design and implement 8051 microcontroller based systems.

		L	T	P	C
AECX 40	**MATHEMATICAL MODELING AND SIMULATION (MATLAB)**	**2**	**0**	**0**	**2**

OBJECTIVES:

- Students will understand the advanced concepts of Mathematical Modeling and Simulation to the engineers and to provide the necessary mathematical knowledge that are needed in modeling physical processes.

MODULE I SYSTEM MODELS AND SIMULATION 9

Continuous and discrete systems, System modeling, Static models, Dynamic models, Principles used in modeling the techniques of simulation, Numerical computation techniques for models, Distributed lag models, Cobweb models.

MODULE II PROBABILITY, CONCEPTS IN SIMULATION 10

Stochastic Variables, Discrete probability functions, continuous probability function, Measure of probability functions, Continuous uniformly distributed random number, Congestion in systems, Arrival patterns, Various types of distribution.

MODULE III SYSTEM DYNAMICS AND MATHEMATICAL MODELS FOR FLIGHT SIMULATION 11

Historical background growth and decay models, System dynamics diagrams, Multi – segment models, Representation of time delays, The Dynamo Language Elements of Mathematical models, Equation of motion, Representation of aerodynamics data, Aircraft systems, Structure and cockpit systems, Motion system, Visual system, Instructor's facilities. Introduction, advantage of simulator, the effectiveness of Simulator, The user's role, Simulator Certification, Data sources, Validation, in- flight simulators.

Total Hours – 30

TEXT BOOKS:

1. Gordon. G., "System Simulation" , Prentice – Hall Inc., 1992.
2. Stables, K.J. and Rolfe, J.M. "Flight Simulation", Cambridge University Press, 1986.

REFERENCES:

1. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001.
2. P.J.Swatton , "Ground studies for pilots' flight planning", Sixth edition, 2002.

OUTCOMES:

Students will be able to

- Understand the advanced concepts of Mathematical Modeling and Simulation to the engineers and to provide the necessary mathematical knowledge that are needed in modeling physical processes.
- Have an exposure on various topics such as System Models, probability concepts in simulation and flight simulators.
- Deploy these skills effectively in the understanding the concepts and working of a flight simulator.

Physics Elective Courses
(To be offered in II Semester)

PHCX 01 FUNDAMENTALS OF ENGINEERING MATERIALS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To familiarize students with basic ideas of nanomaterials and its electrical, electronic, mechanical and magnetic properties.
- To help students acquire the properties and applications of magnetic materials and dielectric materials.
- To familiarize students with basics ideas about the properties of dielectric and its applications
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 7

Conductors: properties, Fermi distribution function, Fermi energy in metals- density of states- conducting polymers-properties-applications, semiconductors: intrinsic and extrinsic semiconductors-carrier concentrations, conductivity and energy band gap, semiconducting polymers- properties- applications.

MODULE II DIELECTRIC MATERIALS 8

Polarization- dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – Internal field -Clausius Mosotti relation - dielectric loss – dielectric breakdown – applications of dielectric materials (capacitors and transformers) – Pyroelectricity, Piezoelectricity, ferroelectricity and applications in FERAM - multiferroic materials and its applications.

MODULE III MAGNETIC MATERIALS 7

Origin of magnetism-magnetic moment, susceptibility, permeability – Bohr magneton –Dia, Para and Ferro magnetism –Spontaneous magnetization- Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its application -Giant Magneto-resistance effect(GMR) - Magnetic resonance imaging(MRI).

MODULE IV NANOMATERIALS 8

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials –quantum well, quantum wire, quantum dot - nanoporous materials - carbon nanotubes, grapheme - nanocomposites – applications.

PRACTICALS

1. Determination of energy band gap of a semiconductor.
2. Determination of resistivity of metals by four point probe method.
3. Determination of dielectric constant of dielectric material.
4. Determination of time constant of a capacitor using RC circuit.
5. Determination of paramagnetic susceptibility of given liquid.
6. Determination of hysteresis loss in a transformer using BH curve.
7. Analysis of size effect on the absorption spectrum of nanomaterials.

L : 30 periods, P: 30 periods, Total: 60 periods

REFERENCES:

1. William D.Callister, Material Science and Engineering, Wiley Publications, 2006.
2. Raghavan, V., Materials Science and Engineering, 5th edition, Printice Hall of India Pvt Ltd. New Delhi, 2004.
3. Wahab.M.A, Solid State Physics: Structure and Properties of Materials, Narosa Publishing House Pvt. Ltd., New Delhi , 2nd Edition, 2010.
2. Pillai, S.O., Solid State Physics, New Age International, New Delhi, 2005.
3. Charles P.Poole and Frank J. Owens, ”Introduction to nanotechnology”, Wiley (India), 2009.
4. Pradeep. T., “Textbook of Nanoscience and Nanotechnology”, McGraw Hill Education (India) Private Limited, New York, 2012.

OUTCOMES:

On completion of this course, the student will be able to

- Differentiate between the properties of the nanomaterials compared to bulk materials.
- Comprehend the significance of properties of magnetic materials and derive these properties from synthesized materials.
- Apply the concepts of conducting and semiconducting materials for solid state devices.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 02	HEAT AND THERMODYNAMICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To familiarize students with basic concepts of heat.
- To help students acquire the fundamentals of heat conduction and radiation.
- To enable students acquaint with the basics of thermodynamic concepts.
- To make students understand the fundamentals of heat based experiments.

MODULE I CONCEPTS OF HEAT 10

Definition of temperature, thermal and thermodynamic equilibrium- relationship between temperature and kinetic energy- definition of solid, liquid, gas- Introduction to phase transitions, critical and triple points- definition of heat capacity, mechanical equivalent of heat -Joule's calorimeter- latent heat- Microscopic model of ideal gas-equation of state, internal energy, equipartition theorem- equation of state for non-ideal gases.

MODULE II CONDUCTION AND RADIATION 10

Thermal conductivity – rectilinear flow of heat – thermal conductivity of a good conductor – Forbe’s method – thermal conductivity of a bad conductor – Lee’s disc method – conduction of heat through compound media-radiation – Planck’s law blackbody radiation – Wien’s law – Stefan’s law – Newton’s law of cooling from Stefan’s law – Solar constant – Pyrometry.

MODULE III FUNDAMENTALS OF THERMODYNAMICS 10

Thermodynamic equilibrium – zeroth law of thermodynamics – first law of thermodynamics – Reversible and irreversible processes – second law of thermodynamics -Heat engine – Carnot’s engine – Carnot’s theorem – Internal combustion engines – petrol and diesel engines(qualitative) – Entropy – entropy and available energy – temperature – entropy diagram for Carnot’s cycle - Third Law of thermodynamics(qualitative).

L : 30 periods

PRACTICALS

1. Determination of mechanical equivalent of heat by Joule’s calorimeter.
2. Relation between temperature of a body and time by plotting a cooling curve-Newton’s law of cooling.

3. Determination of specific heat capacity of liquid by cooling.
4. Determination of thermal conductivity of a bad conductor-Lee's disc method
5. Determination of thermal conductivity of a good conductor-Forbe's method

P: 30 periods

Total: 60 periods

REFERENCES :

1. Mathur. D.S, “Heat & Thermodynamics”, S.Chand & Co., 2009.
2. Brijlal & Subramaniam, “Heat and Thermodynamics”, S.Chand & Co, Delhi., 2010.
3. Gupta. A.B and Roy. H, “Thermal Physics”, Books and Allied Ltd., 2002.
4. Sharma. J.K and Sarkar. K.K, “Thermodynamics and statistical Physics”, Himalaya Publishing House, 1988.

OUTCOMES:

On completion of this course, the student will be able to

- Understand the concepts of heat and its properties.
- Comprehend the ideas governing the conduction and radiation processes.
- Understand and apply the ideas of laws of thermodynamics in thermodynamic systems.
- Perform heat based experiments and determine its various properties.

PHCX 03 INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY

L	T	P	C
2	0	2	3

OBJECTIVES:

- To acquire basic knowledge about the nanomaterials and applications.
- To learn about the imaging techniques of nanomaterials.
- To gain the basic concepts of fabrication techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I NANOMATERIALS AND APPLICATIONS 10

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials –quantum well, quantum wire, quantum dot- nanoporous materials-zeolite, mesoporous materials, carbon nanotubes, graphene- nanocomposites - applications (qualitative): Molecular electronics-nanoelectronics – nanophotonics - single electron transistor-drug delivery.

MODULE II SYNTHESIS AND IMAGING TECHNIQUES 12

Top-down and bottom up approaches – mechanical alloying and mechanical ball milling-sol-gel approach-hydrothermal method-precipitation method-spray pyrolysis-spin coating-self assembled monolayer (SAM)-Chemical vapour deposition method – Physical vapour deposition method: laser ablation method, sputtering method.
Optical microscopy – Phase contrast and interference microscopy –confocal microscopy- high resolution Scanning electron microscope (HRSEM)- high resolution Transmission electron microscope (HRTEM)-Atomic force microscope-Scanning Tunnelling microscope (STM).

MODULE III NANOFABRICATION 8

Photolithgraphy - electron beam lithography - X-ray and Ion beam lithography-nanoimprint lithography - soft lithograpy - nanoelectromechnical systems (NEMS) - nanoindentation principles.

L : 30 periods

PRACTICALS

1. Synthesis of nanomaterials by sol-gel method.

2. Synthesis of nanomaterials by hydrothermal method.
3. Synthesis of nanomaterials by solid state reaction method.
4. Synthesis of nanomaterials by chemical bath deposition method.
5. Synthesis of nanomaterials by co-precipitation method.
6. Synthesis of nano thin films by spray pyrolysis method.
7. Synthesis of nano thin films by pulsed laser deposition (PLD) method.
8. Analysis of size effect on the absorption spectrum of nanomaterials.
9. SEM characterization of nanomaterials.
10. AFM characterization of nano thin films.
11. Phase confirmation by XRD.

P: 30 period

Total: 60 periods

REFERENCES:

1. Charles P.Poole and Frank J. Owens, "Introduction to nanotechnology", Wiley (India), 2009.
2. Cao. G., "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2004.
3. Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., "Handbook of NanoScience, Engineering and Technology", CRC Press, 2002.
4. Pradeep. T., "Textbook of Nanoscience and Nanotechnology", McGraw Hill Education (India) Private Limited, New York, 2012.
5. Chris Mack, "Fundamental Principles of Optical Lithography: The Science of Microfabrication", John Wiley & Sons, 2008.
6. Bandyopadhyay A.K., "Nano Materials", New Age International Publishers, New Delhi, 2008.

OUTCOMES:

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

- Understand the importance and basic concepts of the nanomaterials.
- Comprehend the imaging techniques for nanomaterials.
- Illustrate the various nanofabrication techniques.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 04	**LASERS AND THEIR APPLICATIONS**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

OBJECTIVES

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

MODULE I LASER THEORY 8

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

MODULE II DIFFERENT LASER SYSTEMS 8

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

MODULE III METROLOGICAL AND MATERIAL PROCESSING APPLICATIONS 8

CW and Pulsed laser beam characteristics and its measurements - Beam focusing effects - spot size - Power and Energy density Measurements - Distance measurement - Interferometric techniques - LIDARS - different experimental arrangements - Pollution monitoring by remote sensing - Laser gyroscope - Laser welding, drilling, machining and cutting - Laser surface treatment - Laser vapour deposition – Biophotonic applications.

MODULE IV LASER INSTRUMENTATION 6

Laser for measurement of length, current and voltage – Laser Doppler Velocimetry - Holography and speckle in displacement and deformation measurements - Laser for communication with fiber optics as channel.

L : 30 periods

PRACTICALS

1. Tuning of Dye Laser using DFDL Arrangement
2. Determination of Brewster Angle using He-Ne laser
3. Study of transversely Pumped Dye Lasers
4. Study of longitudinally Pumped Dye Lasers
5. Determination of power and wavelength using Distributed Feedback Dye Laser (DFDL)
6. Determination of fibre optic losses using semiconductor laser.
7. Bandgap determination of a semiconductor diode.

P: 30 periods
Total: 60 periods

REFERENCES:

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

OUTCOMES:

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

- To complement the knowledge acquired in the theory class.
- To work with dye lasers for tunability of laser wavelength
- To measure the loss of information involved in fibre optic communication
- To correlate the results for application.

PHCX 05	**MATERIALS SCIENCE**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

OBJECTIVES

- To gain basic knowledge in conducting and semiconducting materials and their properties.
- To provide a basis for understanding properties and applications of dielectric materials.
- To impart knowledge on magnetic and optical materials and their properties & applications.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 8

Quantum free electron theory of metals and its importance - Energy distribution of electrons in metals - Fermi distribution function - Density of energy states and carrier concentration in metals - Fermi energy – Classification of solids into conductors, semiconductors and insulators on the basis of Band theory – Introduction to Elemental and Compound semiconductors - Carrier concentration derivation for Intrinsic semiconductors - Density of electrons in conduction band & Density of holes in valence band- intrinsic carrier concentration - Fermi energy & Variation of Fermi energy level with temperature - Mobility and electrical conductivity - Band gap determination.

MODULE II DIELECTRIC MATERIALS 7

Introduction to dielectric materials & basic definitions – Electronic, Ionic, Orientation & space charge polarizations - Total polarization – Frequency and temperature dependence of polarization - Internal field in a dielectric material - Deduction of Clausius - Mosotti's relation - dielectric loss & loss tangent – Different types of dielectric breakdown – Applications of dielectric materials : Capacitors and Transformers.

MODULE III MAGNETIC MATERIALS 7

Introduction to magnetic materials & origin of magnetic moment - Different types of magnetic materials and their properties - Ferromagnetism & Domain theory of ferromagnetism - Hysteresis, Soft and Hard magnetic materials - Antiferromagnetic materials - Ferrites and its applications – Applications of magnetic materials : Data storage.

MODULE IV OPTICAL MATERIALS 8

Optical properties of semiconductors - Direct and Indirect bandgap semiconductors – Traps, recombination centre, color center and exciton – Luminescence : Fluorescence and Phosphorescence - Liquid crystal display : twisted nematic crystal display – Applications of Optical materials - Optical Sources : light emitting diode and laser diode - Photo detectors : PIN photodiode and Avalanche Photodiode - Pyroelectric devices - Electro optic effect : Kerr effect and Faraday effect.

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination dielectric constant of a given non-polar liquid.
5. Determination of magnetic susceptibility of a given paramagnetic liquid using Quincke's method.
6. Determination of energy loss of a given transformer core using hysteresis method.
7. To study the I-V characteristics of a photodiode.

L : 30 periods, P: 30 periods

Total: 60 periods

REFERENCES

1. Palanisamy P.K., ''Physics II'', Material Science for ECE, Scitech Publications (India) Pvt Ltd., 2006.
2. Kasap. S.O., ''Principles of Electronic materials and devices'', McGraw Hill Publishers, 3rd Edition, 2007.
3. Arumugam. M, "Physics II'', Material Science for ECE, Anuradha Publishers, 5th Edition, 2005.
4. Sze. S.M., ''Semiconductor Devices – Physics and Technology'', John Wiley, 2nd Edition. 2002.
5. Raghavan. V, ''Materials Science and Engineering'', Prentice Hall of India, 5th Edition, 2004.

OUTCOMES

On the completion of this course, the students will be able to

- Gain knowledge about fundamentals of conducting and semiconducting materials
- Understand the concepts and applications of Dielectric, Magnetic materials
- Familiarize Optical materials and their applications in Engineering and Medical fields.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 06	**NON-DESTRUCTIVE TESTING**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

OBJECTIVES:

- To study the process and applications of ultrasonic inspection method.
- To understand the basic concepts of radiographic inspection method.
- To acquire the knowledge about the various surface Non-Destructive Testing (NDT) techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I ULTRASONIC INSPECTION METHOD 10

Ultrasonic Testing- Principle of operations- types of sound waves -types of Transducers-transmission and pulse-echo method- straight beam and angle beam, instrumentation- calibration methods-ultrasonic testing technique- data representation, A Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction-thickness determination-, advantages, disadvantages and applications.

MODULE II RADIOGRAPHIC INSPECTION METHOD 10

Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography-method of generation-industrial radiography inspection techniques- Equipment-Exposure charts-Types of films-Fluoroscopy- Xero-Radiography –Limitations-Gamma radiography-Equipment, radiation sources- method of generation- film processing- interpretations of radiography-safety in industrial radiography.

MODULE III SURFACE NDT TECHNIQUES 10

Liquid Penetrant Testing – Principles, Characteristics and types of liquid penetrants-developers- advantages and disadvantages of various methods- Inspection Procedure and Interpretation of results. Applications of Liquid Penetrant testing.

Magnetic Particle Testing- Principle-magnetizing technique-procedure –equipment-Interpretation and evaluation of test indications-.applications and limitations-demagnetization.

L : 30 periods

PRACTICALS

1. Inspection of welds using solvent removable visible dye penetrant.
2. Inspection of welds using solvent removable fluorescent dye penetrant.

3. Inspection on non magnetic materials by eddy current method.
4. Inspection on magnetic materials by eddy current method.
5. Inspection of welds by Eddy current Testing.
6. Inspection of welds by Magnetic Particle Testing - Dry method.
7. Inspection of welds by Magnetic Particle Testing - Wet method.
8. Ultrasonic flaw detector- Inspection of defects.
9. Demonstration of Radiographic inspection.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Baldev Raj., Jayakumar T.,Thavasimuthu., "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash., "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.
3. ASM Metals Handbook of Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, Volume-17, 2000.
4. Paul E Mix.,"Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005.
5. Charles J., Hellier, "Handbook of Nondestructive evaluation", McGraw Hill, New York, 2001.

OUTCOMES:

Upon completion of this course, the students will be able to

- Illustrate the ultrasonic inspection methods of NDT.
- Understand the basic concept of radiographic inspection method.
- Test the surfaces by the various surface NDT techniques.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 07 PROPERTIES OF MATTER AND ACOUSTICS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To understand principles and properties of elasticity.
- To understand the basic concepts and application of viscosity.
- To analysis acoustic of building.
- To know about photoelasticity and its applications.

MODULE I ELASTICITY 8

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment - Cantilever–Expression for depression - Uniform bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II VISCOSITY 8

Viscosity- Newton’s formula for viscous flow- Streamline and turbulent motion- Reynolds number - Poiseuille's formula- Determination of coefficient of viscosity- factors affecting viscosity - capillary flow method - Stoke's formula- viscosity of highly viscous liquids – Stoke’s method - Lubricants and its applications –viscosity measurements- Viscometer- Variation of Viscosity with Temperature.

MODULE III ACOUSTICS OF BUILDING 7

Basic requirement for the acoustically good halls - Reverberation and time of reverberation – Sabine’s formula for reverberation time - Absorption coefficient and its measurement -Transmission of sound and transmission loss - Factors affecting the architectural acoustics and their remedy-sound absorbing materials-vibration and noise control systems for buildings.

MODULUE IV PHOTOELASTICITY 7

Polarization- double refraction-Theory of Plane, Circularly and Elliptically polarized light- Quarter wave plate and half wave plate- photo elasticity- Theory of photo-elasticity- Stress optic relations- model materials-analysis techniques- Photo elastic bench.- Three dimensional photo elasticity-Digital photo elasticity- Photo elastic coatings.

L : 30 periods

PRACTICALS

1. Determination of viscosity of liquid by Poiseuille's method.
2. Determination of viscosity of liquid by Stoke's method.
3. Analysis of stress by photo elastic method.
4. Verification of Hooke's law by spring method.
5. Determination of Young's modulus of the cantilever beam.
6. Determination of rigidity modulus by static torsion method.
7. Visit to acoustically good auditorium and identifying the sound absorbing materials in the auditorium.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Mathur D.S., "Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Gaur R.K., Gupta S.L.,"Engineering Physics", Dhanpat Rai Publishers, 2010.
3. Brijlal and Subramaniam.," Properties of Matter", Eurasia Publishing Co, New Delhi, 2002.
4. Smith C.J.," General Properties of Matter", Orient & Longman,1960.
5. Kenneth G. Budinski and Michel K., Budinski, "Engineering Materials Properties and Selection", Pearson, Singapore, 2002.

OUTCOMES:

Upon completion of this course, the students will be able to

- Understand the basic concepts of the elasticity of materials.
- Comprehend the concepts of viscosity of liquid and measurement.
- Demonstrate the acoustical aspects of building and its importance in construction.
- Illustrate the fundamental concept of photo elasticity and its use for the stress analysis of the object.

PHCX 08	PROPERTIES OF MATTER AND NONDESTRUCTIVE TESTING	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To impart knowledge about the principles and properties of elasticity.
- To learn the laws governing the dynamic of rigid bodies.
- To acquire the knowledge of the various techniques of Non-Destructive Testing (NDT) of materials.
- To understand the principle and basic concept of low temperature applications.

MODULE I ELASTICITY **8**

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment-Cantilever–Expression for depression - Uniform Bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II DYNAMICS OF RIGID BODIES **8**

Rigid bodies - angular acceleration - Torque on a particle - angular momentum - law of conservation of angular momentum - moment of inertia and its significance - Theorem of parallel and perpendicular axis - moment of inertia of a thin uniform bar - moment of inertia of a rectangular lamina - moment of inertia of uniform circular disc - Moment of inertia of hollow and solid cylinders – flywheel (qualitative) - kinetic energy of rotating body – Routh rule.

MODULE III NDT TECHNIQUES **6**

Ultrasonic Testing- types of Transducers-transmission and pulse-echo method-Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography-method of generation-industrial radiography inspection techniques- Liquid Penetrant Testing**-** Inspection Procedure and Interpretation of results.

MODULE IV LOW TEMPERATURE PHYSICS **8**

Definition of Refrigeration and Air-Conditioning - Types of **Refrigeration Systems-** Applications- Comfort Air Conditioning, Industrial Refrigeration, Food processing and food chain - **Cryogenic treatment - Low temperature properties of engineering materials: Mechanical properties, Thermal properties, Electrical properties.**

L : 30 periods

PRACTICALS

1. Verification of Hooke's law by spring method.
2. Determination of Young's modulus of the beam by bending method.
3. Inspection of welds using solvent removable visible dye penetrant.
4. Inspection of welds using solvent removable fluorescence dye penetrant.
5. Inspection of welds by Magnetic Particle Testing.
6. Determination of moment of inertia of the disc by torsion pendulum method.
7. Determination of moment of inertia of the disc by static torsion method.
8. Demonstration of working of flywheel.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Mathur D.S.,"Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Brijlal & Subramaniam," Properties of Matter", Eurasia Publishing Co, Delhi,2002.
3. Gaur R.K., Gupta S.L., "Engineering Physics" Dhanpat Rai Publishers, 2010.
4. Baldev Raj.,Jayakumar T., Thavasimuthu M.,"Practical Non-Destructive testing", Narosa Publishing House, 2009.
5. Brijlal & Subrahmanyam., "Heat and Thermodynamics" S.Chand & Company Ltd, 2002.
6. Paul E Mix.," Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition, New Jersey, 2005.
7. Charles J., Hellier.," Handbook of Nondestructive evaluation", McGraw Hill, New York, 2001.

OUTCOMES:

Upon completion of this course, the students will be able to

- understand the basic of concept of elasticity of materials.
- comprehend the basic concepts of motion of rigid bodies and its applications.
- Demonstrate the various NDT techniques and its importance.
- Illustrate the low temperature systems and its applications.

PHCX 09	SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand the Physics of Semiconductor devices.
- To make the students learn the fundamentals of Photoluminous - semiconductors, Optoelectronic devices, Optical modulators/detectors.
- To make them understand the technology behind latest Display devices like LCD, Plasma and LED Panels.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I PHYSICS OF SEMICONDUCTORS 8

Elemental and compound semiconductors – Drift and diffusion current - Intrinsic semiconductors – Carrier concentration (derivation) – Fermi energy – Variation of Fermi energy level with temperature – Mobility and electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductor (derivation) – Variation of Fermi level with temperature and impurity concentration – Variation of Electrical conductivity with temperature – Hall effect – Experiment and applications of Hall effect.

MODULE II OPTOELECTRONIC DEVICES 7

Light Emitting Diodes (LED) – power and efficiency - double hetero LED - LED structure - LED characteristics - White LED – Applications. Liquid crystal displays – Dynamic scattering and Twisted nematic display, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers.

MODULE III OPTICAL MODULATORS 7

Modulation of light – birefringence –Modulation Techniques - Electro optic effect – Electro optic materials –Types of Electro optic Modulators : Kerr and Pockel modulators –- Magneto optic effect - Magneto optic Modulators – Acousto Optic modulators.

MODULE IV OPTICAL DETECTORS 8

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode – Avalanche Photodiode (APD) characteristics - APD design of detector arrays –

Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells.

L : 30 periods

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination of the wavelength of a given laser source using diffraction grating.
5. Determination of Planck's constant using LED.
6. To study the I-V characteristics of photodiode and phototransistor.
7. To study the characteristics of a solar cell.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Arumugam. M, "Physics II", Anuradha Publishers, 5th Edition, 2005.
2. Sze. S.M., "Semiconductor Devices – Physics and Technology", 2nd edn. John Wiley, 2002.
3. Wilson & J.F.B. Hawkes, "Optoelectronics – An Introduction", Prentice Hall, India, 1996.
4. Bhattacharya, "Semiconductor optoelectronic devices", Second Edn, Pearson Education, 2002.
5. Safa O. Kasap, "Optoelectronics & Photonics:Principles & Practices", Second Edn, Pearson Education,2013.
6. Palanisamy P.K., "Semiconductor physics and optoelectronics" Scitech Publications, 2003.

OUTCOMES:

On completion of this course, the student will be able to

- Understand the principles of Physics behind semiconductor devices.
- Choose the correct semiconductors for electronic devices and display.
- Differentiate the working principle of LED and Diode Laser.
- Apply the knowledge of modulation of light for different types of optical modulators.
- Select suitable photodetectors for different types of applications.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

Chemistry Elective Courses
(To be offered II Semester)

CHCX01 ANALYTICAL INSTRUMENTATION

L	T	P	C
2	0	2	3

OBJECTIVES

To make the student conversant with

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

MODULE I ELECTROANALYTICAL TECHNIQUES 7

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

MODULE II CHROMATOGRAPHY 8

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

MODULE III SPECTROSCOPY 8

Absorption spectroscopy (principle, instrumentation and applications): Colorimetric analysis – UV-Visible spectroscopy – FTIR spectroscopy - Emission Spectroscopy (principle, instrumentation and applications): fluorescence, phosphorescence and chemiluminescence – Atomic absorption spectroscopy – flame emission spectroscopy.

MODULE IV THERMAL ANALYSIS 7

Principle, instrumentation and applications: Thermogravimetric analysis – Differential thermal analysis – Differential scanning calorimetry

L: 30 periods

PRACTICALS

1. Conductometric titrations: acid-base and precipitation titrations
2. Potentiometric titrations
3. Determination of pH of the unknown solution
4. Estimation of alkali metals using flame emission spectroscopy
5. Estimation of metal ions of coloured solutions using colorimetric analysis
6. Separation of compounds using gas chromatography
7. Separation of compounds using high performance liquid chromatography
8. Analysis of the given sample and interpretation of the data using IR, UV-Visible spectroscopy
9. Demonstration of TGA/DTA and DSC and interpretation of data.

P:30 periods

Total: 60 periods

REFERENCES

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8th Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.
3. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Prentice Hall, London, 2008.
4. Christian G.D., Analytical Chemistry, 6th Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

OUTCOMES

The student will be able to

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

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

OBJECTIVES

To make the student conversant with

- Basic concepts, principles and factors affecting corrosion
- Types and mechanism of corrosion
- Control measures of corrosion by material selection, proper design and by applying organic coatings
- Control of corrosion by applying inorganic coatings

MODULE I BASIC CONCEPTS OF CORROSION 8

Corrosion – causes and impacts of corrosion – mechanism of corrosion: Dry corrosion- oxidation corrosion - corrosion by other gases – Pilling-Bedworth rule-Corrosion by hydrogen: hydrogen blistering, hydrogen embritttlement, decarburization and hydrogen attack – corrosion of silver and copper by sulphur compounds – liquid metal corrosion (embritttlement or cracking) – Wet corrosion : hydrogen evolution – presence and absence of oxygen and absorption of oxygen – difference between dry and wet corrosion-factors influencing corrosion-polarization-passivity-emf series and galvanic series- corrosion current -rate of corrosion.

MODULE II FORMS OF CORROSION 7

Forms of corrosion-conditions for electrochemical corrosion –galvanic corrosion – differential aeration corrosion: pitting, water line, wire fencing, crevice and filiform corrosion – stress corrosion – Intergranular corrosion- erosion corrosion – soil corrosion – microbiological corrosion- fretting corrosion- corrosion in composites.

MODULE III CORROSION CONTROL AND ORGANIC COATINGS 8

Corrosion control – selection of materials and designing- cathodic protection – sacrificial anode and impressed current cathodic protection – corrosion inhibitors: anodic, cathodic and vapour phase inhibitors.

Organic protective coatings – paints: constituents – functions – varnishes : types-constituents – functions – lacquers : constituents – functions –enamels- constituents – functions – special paints : fire retardant, water repellant, heat resistant, temperature indicating and luminous paints.

MODULE IV INORGANIC COATINGS 7

Treatment of metal surface-inorganic coatings- classification- metallic coatings : anodic and cathodic coatings-hot dipping : galvanizing and tinning- electroplating—

electroless plating – cementation (diffusion) : sherardizing, calorizing and chromizing – metal cladding-metal spraying – non metallic coatings (chemical conversion coatings) : phosphate, chromate, oxide coatings and anodizing – comparison of anodic and cathodic protection.

L : 30 periods

PRACTICALS

1. Determination and comparison of rate of corrosion of metals in the presence of acid, base and neutral medium by weight loss method.
2. Determination of rate of corrosion of iron in the presence of various acids by weight loss method.
3. Determination of rate of corrosion of iron in the presence and absence of anodic Inhibitor by weight loss method.
4. Determination of rate of corrosion of iron in the presence and absence of cathodic Inhibitor by weight loss method.
5. Electroplating of base metal with copper.
6. Electrolessplating of base metal with copper
7. Chemical conversion coatings such as chromate and phosphate coatings.
8. Demonstration on the study of rate of corrosion by using cyclic voltametry.

P:30 periods

Total: 60 periods

REFERENCES

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.
3. M.G. Fontana and N.G. Green, Corrosion Engineering, McGraw Hill Book Company, NewYork, 1984.
4. S. Banerjee, A.K. Tyagi, Functional Materials- Preparation, Processing and Applications, ELSEVIER Publications, London ; Waltham, MA : 2011

OUTCOMES

The students will be able to

- explain the mechanism, compare and enumerate the factors affecting corrosion
- describe and identify the place and types for a given situation.
- choose and elaborate the suitable organic coating method for a given real time situation.
- apply a suitable metallic coating for a given situation

CHCX03 ELECTRICAL MATERIALS AND BATTERIES

L	T	P	C
2	0	2	3

OBJECTIVES

To make the student conversant with

- preparation, properties and applications of plastics used in electrical and electronic applications
- properties and uses of electrical engineering materials
- classification and description of different types of batteries.
- classification and types of fuel cells

MODULE I POLYMERS FOR ELECTRICAL AND ELECTRONIC APPLICATIONS 8

Preparation, properties and applications **:** polyethylene, polypropylene, EPDM, Nylon-6,6, PVC, PTFE, polycarbonates, ABS, phenol formaldehyde, urea formaldehyde, epoxy resins – polymer blends and alloys.

MODULE II ELECTRICAL ENGINEERING MATERIALS 7

Conductors**:** Silver, Copper, Gold, Aluminum **–** Semiconductors: Germanium, Silicon, Gallium Arsenic **–** Insulating Materials: Rubbers, Mica, Plastics, Ceramics, Insulating papers **–** Magnetic Materials**:** ferromagnetic materials, paramagnetic materials, diamagnetic materials, antiferromagnetic materials, ferrites

MODULE III BATTERIES 7

Electrochemical and electrolytic cell – batteries**:** types (primary, secondary and flow cell) – primary batteries**:** dry cells, alkaline batteries – secondary batteries**:** nickel-cadmium cell – lead acid storage cell, lithium battery**:** primary and secondary type – solar cell – dye sensitized solar cell.

MODULE IV FUEL CELLS 8

Difference between batteries and fuel cells - chemistry of fuel cells - types of fuel cell (based on temperature and electrolyte) – principle, characteristic features, advantages, disadvantages and applications of polymer electrolyte membrane or proton exchange membrane fuel cell (PEMFC), direct methanol fuel cell (DMFC), alkaline fuel cell (AFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC) and solid oxide fuel cells (SOFC).

L:30 periods

PRACTICALS

1. Free radical polymerization of styrene.
2. Free radical polymerization of PMMA.
3. Preparation of phenol-formaldehyde.
4. Preparation of urea-formaldehyde.
5. Synthesis of epoxy resin.
6. Demonstration of mechanical properties of insulating materials using UTM
7. Demonstration of electrical properties of insulating materials
8. Construction of batteries using natural resources
9. Measurement of EMF for different batteries.

P:30 periods

Total: 60 periods

REFERENCES

1. Jain P.C. and Renuka Jain, Engineering Chemistry, Dhanpat Rai Publication Co. (P) Ltd., New Delhi, 2013.
2. Michael L. Berins, Plastics Engineering Hand Book, 5^{th} Edition, Chapman and Hall, New York, 1991.
3. H.F. Mark and N. Gaylord, Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV Interscience, 2nd Ed. 1988.
4. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.
5. R.K. Rajput, A Textbook of Electrical Engineering Materials, Firewall Media, 2004
6. Vladimir S. Bagotsky, Fuel Cells: Problems and Solutions, 2^{nd} Edition, John Wiley and Sons, 2012.
7. B. Viswanathan and M. Aulice Scibioh, Fuel Cells: Principles and Applications, Taylor and Francis Group, 2007.

OUTCOMES

The student will be able to

- summarise the preparation, properties and applications of plastics used in electrical and electronic applications
- enumerate the properties and uses of electrical engineering materials
- illustrate various types of batteries with the aid of a diagram
- classify the fuel cells and elaborate the different types of fuel cells.

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

OBJECTIVES

To make the student conversant with

- properties and uses of different types of refractories and abrasives
- adhesives, cements and lime, setting of cements and their chemical behaviors.
- types, properties and uses of lubricants.
- various types of composite materials.

MODULE I REFRACTORIES AND ABRASIVES 8

Introduction refractory: -classification - based on chemical nature- characteristic and selection of good refractory - general manufacture of refractory- preparation properties and uses of: silica refractory - magnesite refractory - zirconia refractory, properties of refractories: refractoriness - refractoriness under load - thermal spalling - porosity and dimensional stability, Cermets - super refractory.

Abrasives : introduction - Moh's scale - natural abrasives: diamond – corundum – emery - garnet and quartz, synthetic abrasives: preparation properties and uses: carborundum (silicon carbide)– alundum - boron (norbide) carbide

MODULE II ADHESIVES AND BINDING MATERIALS 8

Introduction - classification of adhesives –advantage –limitation of adhesive bonding –development of adhesive- factors influencing adhesive action: chemical and physical, application techniques of adhesive – Lime: classification – manufacture - setting and hardening, Gypsum: -Manufacture and properties and uses - Cement : chemical composition- Manufacture – setting and hardening – concrete – weathering of cement and concrete and its prevention- special cements: high alumina cement - sorel cement - white portland cement – water proof cement.

MODULE III LUBRICANTS 7

Introduction –functions of lubricant- mechanism of lubrication - classification of lubricant – liquid lubricant: vegetable and animal oils – mineral oils, semisolid: grease(calcium, lithium, aluminium) – petroleum jelly, solid lubricant: graphite - molybdenum disulphide, Properties of lubricant: viscosity - viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue.

MODULE IV COMPOSITE MATERIALS 7

Introduction – advantageous characteristics of composites, applications of composites, main constituent of composites, types and applications of composites: RCC fibre-reinforced plastics (glass , carbon and aramid) - particulate composite - metal matrix composite - layered composites - failures in fibre-reinforced composites, ceramic matrix composites (CMC) – properties and applications.

L:30 periods

PRACTICALS

1. Preparation of refractory bricks
2. Preparation of abrasive papers/cloth
3. Preparation of simple adhesives
4. Estimation of alkalinity in cements
5. Determination of cloud point and pour point
6. Determination of flash point and fire point
7. Preparation of fibre-reinforced composite

P:30 periods

Total: 60 periods

REFERENCES

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. B.Sivasnakar, “Engineering Chemistry”, Tata McGrow-Hill Publication Limited, New Delhi, second reprint 2008.
3. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.

OUTCOMES

The student will be able to

- classify and describe the manufacture the refractories and enumerate the properties and uses of abrasive materials.
- elaborate the manufacture, properties and uses of various adhesives and binding materials.
- classify lubricants and describe the properties and uses of them
- enumerate the properties and uses of various composite materials.

CHCX05 FUELS AND COMBUSTION

L	T	P	C
2	0	2	3

OBJECTIVES

To make the students conversant with the

- three types of fuels available and the different processes involved in it.
- analysis of fuel characteristics and manufacture of fuels
- calculations involved in calorific values and minimum air requirement for complete combustion.
- classification, functions, mechanism and properties of lubricants.

MODULE I SOLID FUELS 7

Characteristics of good fuel. Solid fuel – Wood, Coal – Ranking of coal – selection of coal. Analysis of coal – Proximate analysis. Pulverized coal – Metallurgical coke – Carbonization of coal – types. Manufacture of metallurgical coke – Beehive oven and Otto Hoffman's by-product oven methods.

MODULE II LIQUID AND GASEOUS FUELS 8

Liquid fuel: Petroleum: Refining of petroleum, Liquid fuels derived from petroleum – Cracking: Thermal (Liquid and Vapour phase) – Catalytic (fixed bed and moving bed cracking – Synthetic petrol: Fischer-Tropsch method– Knocking in petrol and diesel engine: octane number and antiknocking – cetane number and improvement of cetane number – biodiesel (trans-esterification) – Gaseous fuels: Compressed natural gas (CNG) – LPG – oil gas – producer gas – water (blue) gas – biogas.

MODULE III COMBUSTION 8

Calorific value: Gross and net caloric value – Bomb Calorimeter, Gas calorimeter - Definition of combustion – calculation of minimum requirement of air (problems) – theoretical calculation of calorific values (Dulong's formula), Gross and net calorific values ((problems) – Analysis of flue gas: Orsat's gas analysis method, explosive range, Ignition temperature. Introduction to air pollution from IC (Internal combustion) engines, photochemical smog, primary and secondary pollutants.

MODULE IV LUBRICANTS 7

Friction and wear – lubricants: definition, functions and mechanism of lubrication (thick film and thin film) –classification: liquid lubricants: animal and vegetable origin, mineral oil, blended oils, lubricating emulsions and silicones – properties of lubricating oils: viscosity and viscosity index; Flash and fire-point, Cloud and pour point, oiliness, emulsification number, volatility, carbon residue, aniline point – semisolid lubricant: greases and waxes – solid lubricant: graphite and molybdenum disulphide –nanolubricants.

L:30 periods

PRACTICALS

1. Testing of fuels - proximate analysis (moisture, volatile matter, ash content and fixed carbon present in coal, coke, charcoal etc)
2. Ash content and carbon residue test
3. Biodiesel synthesis by trans-esterification method (from coconut, groundnut, mustard oil, palm oil)
4. Determination of calorific value of a solid fuel using Bomb calorimeter (coal, charcoal, coke etc)
5. Determination of calorific value of a liquid fuel using Bomb calorimeter (petrol, diesel, biodiesel etc)
6. Determination of cloud point and pour point of a lubricant
7. Determination of flash and fire point of diesel.
8. Aniline Point of diesel
9. Viscosity Index of lubricants and Fuels by Viscometer
10. Flue gas analysis by Orsat’s gas analysis method – Demonstration
11. Working of internal combustion engine - Demonstration

P:30 periods
Total: 60 periods

REFERENCES

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi, 2001.
2. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
3. John Griswold, Fuels Combustion and Furnaces, Mc-Graw Hill Book Company Inc. University of Michigan, 1946.
4. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill International Editions, 1989.
5. Bahl B.S., Tuli and Arun Bahl, Essentials of Physical Chemistry, S. Chand and Company Ltd., New Delhi, 2004.

OUTCOMES

The students will be able to

- compare and contrast the solid, liquid and gaseous fuels and also describe the processes involved in liquid and gaseous fuels.
- analyse the fuel properties such as moisture, votalite matter, ash content, calorific value etc
- calculate minimum air required for complete combustion and calorific values of fuels.
- categorize different lubricants into three types, explain the preparation and determine their properties.

CHCX06 FUNDAMENTALS OF PHYSICAL CHEMISTRY

L	T	P	C
2	0	2	3

OBJECTIVES

To make the student conversant with the

- various thermodynamic terms and relate the laws of thermodynamics in chemical processes
- molecularity and order of reaction and derive the rate constant for different order of reactions
- basics of adsorption of different materials and propose mechanisms and surface area measurement
- conditions for equilibrium and learn different components at equilibrium

MODULE I BASIC THERMODYNAMICS 8

Introduction - Thermodynamic terms - Thermodynamic equilibrium and processes - 1st law of thermodynamics: internal energy, enthalpy, heat capacity, isothermal and adiabatic expansion, Joule-Thomson effect - Zeroth law of thermodynamics: absolute temperature - 2nd law of thermodynamics: - spontaneous and cyclic process, Entropy in isothermal, isobaric and isochoric processes, work and free energy function, Maxwell's relation - 3rd law of thermodynamics

MODULE II CHEMICAL KINETICS 8

Rate of chemical reaction - order and molecularity of a reaction - Rate constant - kinetics of opposing, parallel and consecutive and chain reactions - isotope effects - effect of temperature on reaction rate - collision theory - absolute reaction rate theory - kinetics in enzyme catalysis

MODULE III SURFACE SCIENCE AND CATALYSIS 8

Adsorption - adsorption isotherms - uni and bimolecular adsorption reactions - parahydrogen conversion - factors affecting adsorption – Langmuir adsorption isotherm - Hinshelwood mechanism and *Eley-Rideal* mechanism with example - adsorption of gases on solids and surface area measurement by BET method - Terms in catalysis - homogeneous and heterogeneous and enzyme catalysis with example

MODULE IV PHASE RULE 6

Terms involved - Conditions for equilibrium - application of phase rule to water, lead-silver system, freezing mixtures, thermal analysis: cooling curves.

L:30 periods

PRACTICALS

1. Determination of the heat capacity of benzoic acid, internal energy of combustion of camphor using Bomb calorimeter. Calculation of enthalpy of combustion and formation for camphor.
2. Determination of adsorption isotherm of (i) acetic acid on charcoal (ii) oxalic acid on charcoal.
3. *Kinetics of first and second order reactions.*
4. Phase rule experiments with organic compounds: (i) naphthalene and p-dichloro benzene (ii) naphthalene and diphenyl (iii) m-dinitrobenzenzene and p-nitro toluene.

P:30 periods

Total: 60 periods

REFERENCES

1. Rajaram J. and Kuriacose J.C., Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson Education, India, 2013.
2. Samuel Glasstone, Thermodynamics for Chemists, Read Books, United Kingdom, 2007.
3. James E. House, Principles of Chemical Kinetics, 2nd Edition, Academic Press, United States of America, 2007.
4. Keith J. Laidler, Chemical Kinetics, Pearson Education, India, 1987.
5. Douglas M. Ruthven, Principles of Adsorption and Adsorption Processes, John Wiley & Sons, 1984.
6. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th Edition, Vishal Publishing Co. India, 2016.

OUTCOMES

The student will be able to

- calculate entropy, enthalpy and free energy change for different chemical processes
- calculate the rate constant for any chemical and biochemical processes
- differentiate the adsorption processes and calculate the surface area and predict the suitability of catalysts for different chemical processes
- predict the equilibrium conditions for water, alloys, freezing mixtures and draw the thermal curves for phase transition

CHCX07 GREEN TECHNOLOGY

L	T	P	C
2	0	2	3

OBJECTIVES

To make students conversant with the

- basic principles of green chemistry and green technology.
- wastes that causes hazards to human health
- chemicals that harms our environment
- need for green processes in various industries

MODULE I GREEN CHEMISTRY PROTOCOL **7**

Need – Significance – 12 Principles with examples – R4 model – Life cycle analysis – sustainable and cleaner production - Green Technology: definition, examples: CFC free refrigerants, green building, energy, 3D printers, nanotechnology – Awards for Green chemistry – organization promoting green chemistry.

MODULE II WASTE & WASTE MINIMISATION **8**

Source of wastes: domestic, industrial, medical, nuclear, e-waste; problems; prevention – economy of waste disposal – Waste minimization techniques: general waste treatment and recycling – alternate waste water treatment technologies: hybrid process – Green computing: goals, green cloud, green ICT - Pollution statistics from various industries (Industrial case studies).

MODULE III GREEN SYNTHESIS **7**

Introduction - Solvent free reactions - green reagents, green solvents in synthesis - microwave and ultrasound assisted reactions – supercritical fluid extraction – green oxidation and photochemical reactions – catalyst and biocatalysts.

MODULE IV GREEN INDUSTRIAL PROCESSES **8**

Polymer industry: biodegradable polymer - textile industry: greener approaches of dyeing, waste disposal – ecofriendly agrochemicals: biofertilizers, biopesticides – Pharmaceutical industry: atom economy, reduction of toxicity, use of biocatalyst, zero waste disposal – Leather industry: greener process in tanning, crusting, surface coating – ecofriendly batteries & fuel cells.

L:30 periods

PRACTICALS

1. Synthesis of an ionic liquids (Ex: imidazolium) and testing the solubility of organic chemicals.
2. Green bromination of stilbene (using pyridine hydrobromide).
3. Green synthesis: Photocatalytic reactions, solvent-free organic reaction – Aldol; green oxidation, green reduction.
4. Microwave assisted chemical reaction. (synthesis of aspirin, pinacol-pinacolone reaction, etc).
5. Comparison of conventional reaction with microwave assisted reactions (atom economy, solvent, etc) [Ex: aldehyde and ketones with hydrazines to give hydrazones].
6. Diels-Alder reaction in eucalyptus oil (green process).

P:30 periods

Total: 60 periods

REFERENCES

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
2. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
3. Paul Anastas, John C.Warner, John Warner Joint; Green Chemistry: Theory & Practice New Ed Edition; Oxford University press, USA, 2000.
4. Rashmi Sanghi, M. M. Srivastava, Green chemistry, Narosa publishers, New Delhi, 2003.

OUTCOMES

The students will be able to

- outline the principles and implications of green chemistry.
- comprehend the potential risks of waste generated and analyse the threats to human and environment.
- integrate information into design of molecules to avoid/eliminate toxic solvents & reagents or reduce toxic products.
- identify various alternate greener technologies for various industries.

CHCX08 ORGANIC CHEMISTRY OF BIOMOLECULES

L	T	P	C
2	0	2	3

OBJECTIVES

To make students conversant with the

- basic concepts in organic chemistry
- types and structure of carbohydrates and lipids
- formation of different structures of proteins from amino acid
- structure of nucleic acids

MODULE I BASIC CONCEPTS IN ORGANIC CHEMISTRY 8

Classification and IUPAC nomenclature of organic compounds – stereochemistry – optical, stereo and geometrical isomerism – types of reagents: electrophiles and nucleophiles – types of reactions: addition, substitution, elimination and rearrangement reactions.

MODULE II CARBOHYDRATES, LIPIDS AND VITAMINS 7

Structure and functions of carbohydrates: mono, di, oligo and polysaccharides – lipids: phospholipids, glycolipids, sphingolipids – cholesterol – steroids – Structure, functions and deficiency disorders of fat soluble vitamins: A, D, E & K - Water soluble vitamins B & C: Thiamine, riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid and ascorbic acid.

MODULE III AMINO ACIDS, PEPTIDES AND PROTEINS 7

Aminoacids: classification, properties - peptides – polypeptides – proteins: primary, secondary, tertiary and quaternary structure – glycoproteins – lipoproteins – Enzymes: classification and functions

MODULE IV NUCLEIC ACIDS 8

Nucleic acids – importance - structure of purines and pyrimidines – nucleotides – polynucleotides - RNA – types & structure - DNA – phosphodiester bonds – chemical, helical structure and functions – DNA replication – gene modification.

L: 30 periods

PRACTICALS

1. Qualitative tests to identify carbohydrates.
2. Quantitative estimation of carbohydrates.

3. Separation of sugars – TLC and/or paper chromatography.
4. Quantitative estimation of lipids.
5. Separation of amino acids – TLC and/or paper chromatography.
6. Quantitative estimation of proteins by Lowry’s method.

P:30 periods

Total: 60 periods

REFERENCES

1. V. K. Ahluwalia, Organic Reaction Mechanism, Narosa Publishers, New Delhi, 2002.
2. Johnson Arthur T., Biology for Engineers, CRC Press, Finland, 2011.
3. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
4. David L. Nelson, Michael M. Cox, Lehninger Principles of biochemistry, Macmillan press, London, 2010

OUTCOMES

The students will be able to

- classify organic compounds and explain the mechanism of various organic reactions.
- draw the structures and enumerate the functions of carbohydrate, lipids and vitamins.
- correlate the relationship among amino acids, peptides and proteins.
- recognize the role of nucleic acid in the formation of RNA & DNA and differentiate DNA & RNA using their structure and function.

CHCX09 POLYMER SCIENCE AND TECHNOLOGY L T P C
2 0 2 3

OBJECTIVES

To make the student conversant with the

- basic concepts of polymers, classification, types of polymerization and molecular weight & its distribution
- preparation, properties and applications of thermoplastics and introduction to biodegradable polymers
- properties and applications of thermosets, elastomers and FRP
- different types of moulding techniques

MODULE I BASIC CONCEPTS OF POLYMERS 8

Definitions**:** monomer, polymer, functionality, degree of polymerization – classification of polymers**:** source, structure, application, thermal processing behavior (thermoplastics and thermosets), composition and structure (addition and condensation), mechanism (chain growth and step-wise growth) – copolymer: types – Definition –nomenclature of polymers – tacticity – types of polymerization : free radical, cationic and anionic polymerization (concepts only) – average molecular weight of polymer**:** number, weight – molecular weight distribution (problems)

MODULE II THERMOPLASTICS AND BIODEGRADABLE POLYMERS 8

Preparation, properties and applications **:** LDPE, HDPE, polypropylene, PVC, PTFE, PET, polyamides (Nylon-6 and Nylon 6,6) and polycarbonates – polymer blends and alloys – basics of biodegradable polymers.

MODULE III THERMOSET RESINS, ELASTOMERS AND FRP 7

Thermoset resins **:** phenolic resins, amino resins (urea and melamine formaldehyde), epoxy resins, unsaturated polyesters – polyurethanes – elastomers **:** vulcanization of natural rubber, diene based elastomers –fibre reinforced plastics**:** glass, aramid and carbon.

MODULE IV MOULDING TECHNIQUES 7

Moulding constituents**:** functions – moulding techniques**:** compression, injection, extrusion (single screw), blow moulding, thermoforming, (mechanical and vacuum forming), lamination.

L: 30 periods

PRACTICALS

1. Determination of molecular weight and degree of polymerization using Oswald's viscometer.
2. Free radical polymerization of styrene.
3. Free radical polymerization of PMMA.
4. Preparation of phenol-formaldehyde.
5. Preparation of urea-formaldehyde.
6. Synthesis of epoxy resin.
7. Synthesis of unsaturated polyester.
8. Preparation of FRP laminates.
9. Demonstration of injection moulding, compression moulding and blow moulding.

P:30 periods

Total: 60 periods

REFERENCES

1. Billmeyer F.N., Text Book of Polymer Science, 3rd Edition, John Wiley and Sons, New York, 1994.
2. George Odian, Principles of Polymerisation, 3rd Edition, McGraw Hill Book Company, New York, 1991.
3. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
4. Jacqueline I., Kroschwitz, Concise Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, New York, 1998.
5. Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV, H.F. Mark and N. Gaylord, Interscience, 2nd Ed. 1988.
6. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.

OUTCOMES

The student will be able to

- classify various polymers, name the polymers and types of polymerization reactions, calculate molecular weight of polymers,
- summarise preparation, properties and applications of thermoplastics and give examples of biodegradable polymers
- elaborate the properties and applications of thermosets, elastomers and FRP
- select the appropriate moulding technique for a given polymer, based on the application

Maths Elective Courses
(to be offered in IV Semester)

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

OBJECTIVES:

The aims of this course are to

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

MODULE I PROPOSITIONAL CALCULUS 8

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

MODULE II PREDICATE CALCULUS 7+3

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

MODULE III FUNCTIONS 7+3

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

MODULE IV ALGEBRAIC SYSTEMS 8+2

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

MODULE V GRAPH THEORY 7+3

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

MODULE VI PATH AND CIRCUIT 8+2

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

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

- Trembly J.P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 30th Reprint 2011.
- Kenneth H.Rosen, “Discrete Mathematics and its Applications:, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, Special Indian Edition, 2011.

REFERENCES:

- Ralph.P.Grimaldi, “Discrete and Combinatorial Mathematics: An Introduction”, 4th Edition, Pearson Education Asia, Delhi, 2007.
- Thomas Koshy, “Discrete Mathematics with Applications”, Elsevier Publications, 2006.
- C.L.Liu, D.P.Mohapatra, “Elements of Discrete Mathematics”, 4th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2012.

OUTCOMES:

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

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

MACX 02	PROBABLITY AND STATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to impart the

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

MODULE I BASICS OF PROBABILITY AND STATISTICS 8+2

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

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

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

MODULE III TWO DIMENSIONAL RANDOM VARIABLES 8+2

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

MODULE IV SAMPLING AND ESTIMATION 7+3

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

MODULE V THEORY OF INFERENCE 8+2

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

MODULE VI DESIGN OF EXPERIMENTS 7+3

Analysis of variance – one way classification – two way classification – Completely Randomised Block Designs – Randomised Block Design – Latin square designs - Interpretations - case studies.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

- T.Veerarajan, “Probability and Statistics”, Tata McGraw-Hill Education, 2008.
- Miller, I., Miller, M.,Freund, J. E., “Mathematical statistics”, 7th Edition, Prentice Hall International, 1999.
- S.P.Gupta, “Applied Statistics”, Sultan Chand & Sons

REFERENCES:

- S.M.Ross, “Introduction to Probability and Statistics for Engineers and Scientists” Fifth Edition, Elesvier.
- S.C.Gupta and V.K.Kapoor, “Fundamentals of Mathematical Statistics” First edition, Sultan Chand and Sons.
- Arora and Arora, “Comphrensive Statistical Methods”, S. Chand, 2007

OUTCOMES:

On completion of the course, students will be able to

1. do basic problems on probability and descriptive statistics.
2. derive the probability mass / density function of a random variable.
3. calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.
4. calculate point and interval estimates.
5. apply some large sample tests and small sample tests.
6. carry out the data collection representation analysis and implications and the importance of inferences.

MACX 03	RANDOM PROCESSES	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of the course are to

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

MODULE I Basics of Probability 7+3

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

MODULE II One dimensional Random variable and Probability Distribution functions 7+3

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

MODULE III TWO DIMENSIONAL RANDOM VARIABLES 7+3

Joint, marginal, conditional probability distributions - covariance, correlation and regression lines - transformation of random variables.

MODULE IV RANDOM PROCESSES 8+2

Classification of Random process - Stationary process - WSS and SSS processes - Poisson process – Markov Chain and transition probabilities.

MODULE V CORRELATION FUNCTIONS 8+2

Autocorrelation function and its properties - Cross Correlation function and its properties - Linear system with random inputs – Ergodicity.

MODULE VI SPECTRAL DENSITY 8+2

Power spectral Density Function - Properties - System in the form of convolution -

Unit Impulse Response of the System – Weiner-Khinchine Theorem - Cross Power Density Spectrum.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1 Veerarajan T., "Probability, Statistics and Random Processes", Tata McGraw Hill,3rd edition, 2008.
2 Papoulis, "Probability, Random Variables and Stochastic Processes", 4th Edition, Tata McGraw Hill Company, 2002.
3 S.M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists" Fifth Edition, Elesvier

REFERENCES:

1 Scott L. Miller,Donald G. Childers, Probability and Random Processes, Academic Press,2009.
2 Trivedi K S, " Probability and Statistics with reliability, Queueing and Computer Science Applications",Prentice Hall of India,New Delhi,2nd revised edition, 2002

OUTCOMES:

On completion of the course, students will be able to

- do basic problems on probability.
- derive the probability mass / density function of a random variable.
- calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.
- identify and study the different random processes.
- compute correlation functions and related identities.
- compute power spectral density functions and apply Weiner-Khinchine formula.

MACX 04	APPLIED NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of the course are to

- introduce basic computational methods for analyzing problems that arise in engineering and physical sciences.
- acquire knowledge about approximation theory and convergence analysis associated with numerical computation.

MODULE I NUMERICAL SOLUTIONS OF EQUATIONS 7+3

Bisection method - Regula Falsi method – Secant method - Fixed point iteration method - Newton's Raphson method –Gauss Elimination method - Gauss-Jordon method – Gauss Jacobi method - Gauss-Seidel method.

MODULE II INTERPOLATION 8+2

Finite difference operators – Gregory Newton's forward and backward interpolations – Cubic spline interpolation - Lagrange interpolation - Newton's divided difference formula.

MODULE III NUMERICAL DIFFERENTIATION AND INTEGRATION 8+2

Numerical differentiation using Newton's forward and backward formulae – Numerical integration : Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Gaussian Two Point and Three Point Quadrature formulae – Double integrals using Trapezoidal and Simpson's 1/3 rule.

MODULE IV INITIAL VALUE PROBLEMS FOR FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 7+3

Numerical solutions by Taylor's Series method, Euler's method, Modified Euler's Method - Runge – Kutta Method of fourth order – Milne's and Adam's Bashforth Predictor and Corrector methods

MODULE V INITIAL AND BOUNDARY VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 8+2

Numerical solutions by Taylor's Series method - Runge – Kutta Method of fourth order of second order ODE. Finite difference methods.

MODULE VI BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 7+3

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

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Grewal, B.S., “Numerical methods in Engineering and Science”, 7th edition, Khanna
   Publishers, 2007.
2. C.F.Gerald, P.O.Wheatley, “Applied Numerical Analysis” ,Pearson Education, New Delhi, 2002.

REFERENCES:

1. Chapra S.C, Canale R.P. “Numerical Methods for Engineers”, 5th Ed., McGraw Hill, 2006.
2. M.K.Jain, S.R.K.Iyengar, R.K.Jain, “Numerical methods for Scientific and Engineering Computation”, New Age International Publishers, New Delhi, 2003

OUTCOMES:

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

1. solve algebraic, transcendental and system of equations.
2. apply interpolation techniques.
3. carry out numerical differentiation and integration using different methods.
4. solve first order ODE using single and multi step methods.
5. solve second order ODE, initial and boundary value problems.
6. solve the boundary value problems in PDE.

Maths Elective Courses
(To be offered in VI Semester)

MACX 05	**MATHEMATICAL PROGRAMMING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

OBJECTIVES:

The aims of the course are to

- acquire knowledge and training in optimization techniques.
- obtain knowledge about optimization in utilization of resources.
- understand and apply operations research techniques to industrial operations.

MODULE I LINEAR PROGRAMMING PROBLEM 10

Linear programming – formulation of the problem - graphical interpretation of optimality - Simplex method – to obtain basic feasible solution – types of linear programming solution – complications and their resolution.

MODULE II ADVANCED LINEAR PROGRAMMING PROBLEMS 8

Artificial variable - Big M method – Two phase method – alternative optimal solution – unbounded solution - Duality – primal dual relationships.

MODULE III TRANSPORTATION PROBLEM 7

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

MODULE IV ASSIGNMENT PROBLEM 5

Assignment problem – Minimization and Maximization type of problems by Hungarian method.

Total Hours –30

TEXT BOOKS:

1. Hamdy A Taha, “Operations Research - An introduction”, 8th edition, Phil Pearson, 2007.
2. Winston.W.L., “Operations Research”, 4th edition, Thompson-Brooks/Cole, 2003.

REFERENCES:

1. Wayne.L. Winston, “Operations Research Applications and Algorithms”, 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald J Lieberman, “Operations Research Concepts and Cases”, 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.
3. A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research: Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.
4. Robertazzi. T.G., “Computer networks and systems-Queuing theory and performance evaluation”, 3rd edition, Springer, 2002.

OUTCOMES:

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

1. formulate industrial problems as mathematical programming problems.
2. solve linear programming problems by different methods.
3. solve transportation problems by different methods.
4. solve assignment problems by Hungarian method.

MACX 06	STATISTICAL METHODS FOR DATA ANALYSIS	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aim of the course is to

- introduce statistical quality control tools.

MODULE I TESTS OF HYPOTHESES AND STATISTICAL INFERENCES 8

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

MODULE II DESIGN OF EXPERIMENTS 7

Analysis of variance – one way classification – two way classification – Completely Randomised Block Designs – Randomised Block Design – Latin square designs - Statistical analysis -Interpretations - case studies.

MODULE III STATISTICAL QUALITY CONTROL-I 8

Quality improvement and statistics –Statistical quality control- statistical process control – control charts – design of control charts –analysis of patterns on control charts - X bar chart, R chart and S chart.

MODULE IV STATISTICAL QUALITY CONTROL-II 7

Process and product control – attribute charts – P, np and C charts – control charts performance.

Total Hours –30

TEXT BOOKS:

1. Douglas C.Montgomery, George C. Runger "Applied Statistics and probability for Engineers" V Edition – John Wiley & Sons Inc.
2. Miller, I., Miller, M., Freund, J. E. "Mathematical statistics" 7th Edition. Prentice Hall International, 1999.

REFERENCES:

1. Dekking, F.M., Kraaikamp, C., Lopuhaä, H.P., Meester, L.E. "A Modern Introduction to Probability and Statistics" Springer, 2nd Edition.

2. Chin Long chiang “Statistical Methods of Analysis “World Scientific Books, 2003.
3. S.C.Gupta and V.K. Kapoor, “Mathematical Statistics” , Sultan Chand publications.
4. Veerarajan “Fundamentals of Mathematical Statistics” I Edition, Yes Dee Publishing Pvt. Ltd., 2017.

OUTCOMES:

On completion of the course, students will be able to

1. develop and test hypothesis for different statistical tests
2. design an experiment and case study the experiment with different data.
3. analyze the industrial data using quality control design tools statistically.
4. analyze the industrial data using process and product control tools statistically.

		L	T	P	C
MACX 07	**NUMERICAL METHODS FOR INTEGRATION AND DIFFERENTIAL EQUATIONS**	**2**	**0**	**0**	**2**

OBJECTIVES:

1. This course aims to solve numerically integral and differential equations.

MODULE I NUMERICAL INTEGRATION 8

Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two Point and Three point Gaussian quadrature formulae.

MODULE II NUMERICAL DOUBLE INTEGRATION 6

Double integrals using trapezoidal and Simpson's 1/3 rules

MODULE III NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 8

Milne's Predictor and Corrector Method – Adam's Predictor-Corrector Method - Finite difference methods for two – point Boundary Value problems for Ordinary Differential Equations.

MODULE IV BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 8

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

Total Hours –30

TEXT BOOKS:

- M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003.
- Grewal, B.S., "Numerical methods in Engineering and Science" 7^{th} edition, Khanna Publishers, 2007

REFERENCES:

1. C.F.Gerald, P.O.Wheatley, "Applied Numerical Analysis" Pearson Education, New Delhi 2002.
2. P.Dechaumphai, N. Wansophark, "Numerical Methods in Engineering", Narosa Publications, 2012.

OUTCOMES:

At the end of the course students will be able to

- solve the integration by numerical methods.
- solve the double integration by numerical methods
- find numerical solution of ordinary differential equations in engineering problems.
- find numerical solution of partial differential equations in engineering problems.

MACX 08 MATHEMATICAL MODELLING

L	T	P	C
2	0	0	2

OBJECTIVES:

The aims of the course are to

1. provide basic idea of formation and use of Mathematical models for different purposes.
2. 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:

- G . Ledder , “Calculus, modelling , probability and dynamic systems”, Springer 2013
- Kei Velten, “Mathematical modelling and simulation”, J. Wiley and sons,2009

REFERENCES:

1. Michael D Alder, “An introduction to Mathematical modelling”, Heaven for Books.com

2. Alfio Quarteroni, “Mathematical models in science and engineering”, Notices of AMS
3. J.N. Kapur, “Mathematical models in Biology and Medicine”, Affiliated East-West Press Private Limited, New Delhi, 1992.

OUTCOMES:

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

- identify the relationship between real world and mathematical models
- Classify the data and choose the appropriate model
- Distinguish between linear and nonlinear models
- identify the relationship between empirical and mechanistic models

MACX 09	GRAPH THEORY	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aims of this course are to

- represent the real life situations diagrammatically.
- appraise different methods to find solutions to graph theory problems.

MODULE I INTRODUCTION TO GRAPH THEORY 8

Graphs - finite and infinite graphs - Incident and degree-isolated vertex, pendent vertex and null vertex.

MODULE II PATH AND CIRCUIT 8

Isomorphism – sub graphs-walks, paths and circuits – connected and disconnected graphs- Euler graphs – operation on a graph.

MODULE III TREES AND FUNDAMENTAL CIRCUITS 7

Trees- some properties of trees- pendent vertices in a tree – rooted binary tree- spanning trees-fundamental circuits.

MODULE IV CUT SETS AND CUT VERTICES

Cut sets – some properties of cut sets- fundamental circuits and cut sets- network flows.

Total Hours –30

TEXT BOOKS:

1. NARSINGH DEO, Graph theory with applications to Engineering and Computer Science, Prentice Hall INC, New Delhi,
2. J.A. Pondy and U.S.R. Murthy, North Holland, Oxford, New York Graph theory with applications

REFERENCES:

1. Trembly J.P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 30th Reprint 2011
2. Kenneth H.Rosen, “Discrete Mathematics and its Applications”, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, Special Indian Edition, 2011

3. Md. Saidur Rahman, “Basic graph theory”, Springer, 2017

OUTCOMES:

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

- demonstrate the basic concepts of Graph theory.
- explore connected and disconnected graphs.
- identify the real life problems with trees and circuits.
- bring out the cut set properties and network flows properties.

Humanities Elective I

(To be offered in III Semester)

SSCXO1	FUNDAMENTALS OF ECONOMICS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To identify and present the basic concepts of demand, supply and equilibrium.
- To explain and discuss the types and concepts of national income and inflation.
- To illustrate the fundamental concepts of money, banking and public finance.
- To apprise the students about Indian economy and the role of engineers in economic development.

MODULE I DEMAND AND SUPPLY ANALYSIS 8

Classification of economy – open and closed economy, Demand - Types of demand - Determinants of demand – Law of Demand - Demand elasticity - Supply - Determinants of Supply – Law of Supply - Supply elasticity - Pricing strategies.

MODULE II NATIONAL INCOME AND INFLATION 7

Concepts of National income and measurement – Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – meaning of inflation- types - causes and preventive measures

MODULE III MONEY, BANKING AND PUBLIC FINANCE 9

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and Expenditures – Fiscal policy - Its objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) .

MODULE IV INDIAN ECONOMY AND THE ROLE OF ENGINEERS 6

Economic reforms – Liberalization, Privatization and Globalization - challenges and opportunities, Engineers – Engineers’ contributions to the economic growth.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Dutt and Sundharam (2013), *Indian Economy*, S. Chand & Company Pvt. Ltd, New Delhi.
- Hussain, Moon Moon (2015), *Economics for Engineers*, Himalaya Publishing House, New Delhi.

REFERENCES:

- Cleaver Tony (2004), "*Economics: The Basics*", Routledge, London.
- Mell Andrew and Walker Oliver (2014), "*The Rough Guide to Economics*", Rough Guide Ltd.

OUTCOMES:

On successful completion of this course,

- Students will have had exposure to the basic concepts of demand, supply and various pricing strategies.
- Students will have understood the macroeconomic concepts of national income and inflation.
- Students will be able to apply the knowledge of money, banking and public finance in their real life situations.
- Students will have an overview of the economic reforms introduced in Indian economy.

SSCXO2	PRINCIPLES OF SOCIOLOGY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To acquaint the students with Concepts and perspectives of Sociology
- To explain the reflection of society in Individuals and vice versa
- To describe the hierarchical arrangement of individuals and groups in society
- To explicate the dimensions, forms and factors of Social change.
- To examine the context, impact and agencies of Globalization

MODULE I THE FOUNDATIONAL CANON 8

Sociology-Definition, scope and importance; Major theoretical perspectives-Functionalism, Conflict Theorising and Interactionism; Elements of social formation-Society, Community, Groups and Association; Associative Social Process- Co-operation, Accommodation and Assimilation; Dissociative Social Process-Competition and Conflict.

MODULE II INDIVIDUAL AND SOCIETY 7

Culture-definition, characteristics, functions, types, cultural lag and civilization, Socialization – definition, process, stages, agencies and anticipatory socialization; Social Control- definition, characteristics, importance, types & agencies.

MODULE III SOCIAL INEQUALITY AND STRATIFICATION 7

Concepts- inequality, hierarchy, differentiation, Social Exclusion, and Social Stratification. Forms of Social Stratification- Caste, Class and Estate. Gender and Social Stratification- sex and gender, patriarchy, factors perpetuating gender stratification; Globalization and gender inequality

MODULE IV SOCIAL CHANGE AND GLOBALIZATION 8

Social Change-definition, nature, direction; Forms- evolution, development, progress and transformation; Factors of social change- demography, economy, technology, polity and culture. Globalization- definition, characteristics, historical and social context and Impact, agencies of globalization- IGOs, INGOs, Nation-State, MNEs and Media

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Giddens A. 1989. “Sociology” Cambridge: Polity Press.
- Heald Haralambos, R.M(2014) . ‘‘Sociology Themes and Perspectives”, Oxford, New Delhi-92
- Bhushan Vidya and D.R. Sachdeva (2012). ‘‘Fundamental of Sociology”, Pearson, Delhi.

REFERENCES:

- Das Gupta, Samir and Paulomi Saha (2012), ‘‘An Introduction to Sociology”, Pearson, Delhi
- Bottomore, T.B. 1972. *Sociology- A Guide to Literature and Problems*, New Delhi,

OUTCOMES:

On successful completion of this course,

- Students will have exposure to the fundamentals tenets of Sociology.
- Students will be trained to understand social reality with sociological perspective.
- Students will be oriented to constructively analyze human interactions, social relationship and social issues
- Students will gain exposure to the dynamics of human society with special reference to the contemporary trends of globalization.

SSCXO3	SOCIOLOGY OF INDIAN SOCIETY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To present a portrayal of the components of the Indian Social structure
- To describe the nature and contemporary structure of Indian social Institutions.
- To examine the causality and magnitude of social problem facing the contemporary India.
- To elucidate the processes forms and impact of change and development in Indian society

MODULE I INDIAN SOCIAL STRUCTURE 7

Unity and Diversity; Concepts of unity and diversity- racial, religious, ethnic and linguistic composition of India. Types of communities-rural, urban and tribal; Social backwardness- OBC, SC and ST; Indian minorities- religious, ethnic, linguistic and LGBT

MODULE II INDIAN SOCIAL INSTITUTIONS 7

Family- definition, types, characteristics, functions of family; Joint Family- definition features, utility, changes; Marriage- definition, characteristics, marriage as sacrament or contract. Caste- definition, principles, contemporary changes, dominant caste, caste -class interface.

MODULE III SOCIAL PROBLEMS IN INDIA 8

Social Problem-definition, nature, social disorganization; Population explosion- causes, effects, relationship with development; Child Labour- causes, magnitude and consequences; Unemployment-nature , types, causes and effects; Gender issues- social status of women, violence against women and women in work place; Contemporary issues- communalism, terrorism and corruption.

MODULE IV SOCIAL CHANGE AND DEVELOPMENT IN INDIA 8

Socio-cultural Change- Sanskritization, Westernization, Secularization, Modernization;

Processes of Social change- Industrialization, Urbanization, Globalization; Development- definition, elements, role of government, industry and corporate sector. Technology and change- invention and innovation, impact of technology on social institutions, technology and development.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Sharma,K.L.2008. *Indian Social Structure and Change*. Jaipur: Rawat Publications,.
- Shah, A.M. 1998. *The Family in India: Critical Essays*. New Delhi: Orient Longman,
- Ahuja Ram. 1999. *Social problems in India*, Rawat Publication: New Delhi.
- Ahuja Ram. 2014. *Society in India,*, Rawat Publication: New Delhi.

REFERENCES:

1. Jayapalan, N.(2001), **"**Indian Society and Social Institutions" Atlantic Publishers & Distri,
2. Atal, yogesh (2006), "Changing Indian Society" Rawat Publications, Jaipur

OUTCOMES:

On successful completion of this course,

1. Students will gain an in-depth understanding of the social structure and social institutions that constitute society in India.
2. Students will be sensitized to the various categories ,Inequalities and their challenges
3. Students will be exposed to the social problems encountered in contemporary India.
4. Students will gain knowledge about the various forms and trends of the social change.
5. Students will become aware about the challenges in the path of progress of Indian society and realize relevance of their role in bringing about development

Humanities Elective II
(To be offered in IV Semester)

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

OBJECTIVES:

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

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 7

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components.

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 8

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

MODULE III GLOBALIZATION AND ENVIRONMENT SUSTAINABILITY 8

Impact of Globalization on sustainable development, Co - existence of globalization and Environment sustainability, Globalization and Global Governance.Green economy - Renewable energy, sustainable transport, sustainable construction, land and water management, waste management.

MODULE IV POLICIES FOR ACHIEVING SUSTAINABLE DEVELOPMENT 7

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

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Anderson, David A (2010), "*Environmental Economics and Natural Resource Management*", Routledge, 3rd edition.
2. Karpagam M (1999), "*Environmental Economics: A Textbook*", Sterling Publishers Pvt. Ltd, New Delhi.

REFERENCES:

1. Karpagam M and Jaikumar Geetha (2010), "*Green Management Theory and Applications*", Ane Books Pvt. Ltd, New Delhi.
2. Sengupta Ramprasad (2004), "*Ecology and Economics: An Approach to Sustainable Development*", Oxford University Press, New Delhi.

OUTCOMES:

On successful completion of this course,

- The students will have understood the concepts and components of sustainable development.
- The students will have a holistic overview on the challenges of sustainable development and International responses to environmental challenges.
- The students will have gained knowledge on the global environment issues and demonstrate responsible globalization through global governance.
- The students will have developed awareness of the ethical, economic, social and political dimensions that influence sustainable development.

SSCXO5 INDUSTRIAL SOCIOLOGY

	L	T	P	C
	2	0	0	2

OBJECTIVES:

- To introduce sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.
- To explain the structure and functions of industrial organizations.
- To elucidate the dynamics of organizational behavior, leadership and communication.
- To inculcate professional ethics and values to equip students to work in organizational settings.

MODULE I INTRODUCTION 8

Industrial Sociology- definition, scope and importance; Theoretical approaches- scientific management, human relations approach, theory of bureaucracy, Fordism and post-fordism; Production system- concept and characteristics of factory system, automation and rationalization; Industrial conflict- strike , lockout and trade unions.

MODULE II INDUSTRIAL ORGANIZATION 7

Formal organization- definition, features, utility; Informal organization- definition, characteristics, types and relevance; Structure of industrial organization- features and functions of line organization, characteristics and roles of staff organization, distinction;

Industrial hierarchy-white collar, blue collar, supervisors and managers.

MODULE III DYNAMICS OF INDUSTRIAL RELATIONS 8

Group dynamics- Definition, Group behaviour model, Group decision making process, group cohesiveness; Leadership- definitions, style and effective supervision; Communication- concepts, types, model barriers; Job satisfaction- nature, employee compensation and job satisfaction.

MODULE IV PROFESSIONAL ETHICS AND VALUES 7

Concepts- values- morals, and ethics, Integrity, work ethics , service learning - Civic Virtue - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - commitment - empathy - Self-Confidence - Environmental Ethics, Cyber issues - computer ethics, cyber crimes, plagiarism Ethical living-concept of harmony in life.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
2. Gisbert Pascal, Fundamentals of Industrial Sociology, Tata Mc. Graw Hill Publishing Co., New Delhi, 1972
3. Schneider Engeno. V, Industrial Sociology 2nd Edition, Mc. Graw Hill Publishing Co., New Delhi, 1979.

REFERENCES:

- Robbins, Stephen, Organizational Behaviour , Prentice Hall of India PVT ltd new Delhi, 1985
- Devis Keith , Human Behaviour at work place, Mc. Graw Hill Publishing Co., New Delhi,1984

OUTCOMES:

On successful completion of this course,

1. Students will have acclimatized with sociological perspectives for dealing with social relationships in production and service organizations.
2. Students will be familiar with structure of authority, roles and responsibility in organizational settings.
3. Students will imbibe leadership, communication and behavioral acumen to govern organization
4. Students will be sensitized to standards of desirable behavior to engage in industrial and corporate sector.

SSCXO6 **LAW FOR ENGINEERS**

L	T	P	C
2	0	0	2

OBJECTIVES:

1. To understand the Constitution and Governance of our country.
2. To apprise the students of human rights - local and international anc redressal mechanism.
3. To have an insight into the industrial, corporate and labour laws of our country.
4. To establish a clear understanding about the importance of intellectual property related laws.

MODULE I INDIAN CONSTITUTION AND GOVERNANCE 8

Constitution – salient features, Preamble, Citizenship, Fundamental rights, Fundamental duties, Directive principles, Union executive, Legislature – Union – State and union territories – Election Commission – Election for parliament and state legislature, Judiciary- basic functioning of the Supreme Court and High Courts, Right to information Act 2005 – evolution – concept – practice.

MODULE II HUMAN RIGHTS 7

Human rights – meaning and significance, Covenant on civil and political rights, Covenant on Economic, Social and Cultural rights, UN mechanism and agencies, The Protection of Human Rights Act, 1993 – watch on human rights and enforcement.

MODULE III INDUSTRIAL, CORPORATE AND LABOUR LAWS 8

Corporate laws – meaning and scope, Companies Act 1956 – Indian Contract Act 1872 - Principles of Arbitration - Industrial Employment (Standing Orders) Act 1946 - Industrial Disputes Act 1947 - Workmen's Compensation Act 1923 - The Factories Act, 1948.

MODULE IV LAWS RELATED TO IPR 7

IPR – meaning and scope, International organization – WIPO – TRIPS, Major Indian IPR Acts – Copyright laws, Patent and Design Act, Trademarks Act, Trade Secret Act, Geographical Indicator.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. M.P. Jain (2005) *Indian Constitutional Law*, Wadhwa & Co.
2. H. D, Agarwal (2008), *International Law and Human Rights,* Central Law Publications,
3. Rao, Meena (2006), *Fundamental Concepts in Law of Contract*, 3rd edn., Professional offset.
4. Ramappa (2010), *Intellectual Property Rights Law in India*, Asia Law House.
5. Singh, Avtar (2007), *Company Law*, Eastern Book Co.
6. R.F, Rustamji (1967), *Introduction to the Law of Industrial Disputes*, Asia Publishing House.

REFERENCES:

1. Acts: Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act.

OUTCOMES:

On successful completion of this course,

1. Students will `be able to apply the basic concepts of Indian Constitution, Governance and power in their real life situation.
2. Students will have gained knowledge in human rights, cultural, social and political rights.
3. Students will have synthesized knowledge about industrial, corporate and labour laws of our country.
4. Students will have an overview of IPRs and laws related to Intellectual Property Rights.

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

GECX101	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of various environmental hazards and its management measures.
- To give exposure on the natural disasters causes and prevention strategies.
- To give exposure on various man-made disasters causes and prevention strategies.
- To make them understand the different segments of disaster management.
- To introduce the concept of different relief measures to be adopted in the time of disaster.
- To give exposure to various environmental policies & programs in India for disaster management

MODULE I ENVIRONMENTAL HAZARDS 7

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

MODULE II NATURAL DISASTERS 7

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

MODULE III MAN-MADE DISASTERS 7

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

MODULE IV DISASTER MANAGEMENT 8

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

MODULE V NATURAL DISASTER REDUCTION & MANAGEMENT 8

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

MODULE VI ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA 8

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

Total Hours –45

REFERENCES:

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

OUTCOMES:

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

- Describe the origin, changes and management of environmental hazards.
- Develop the knowledge on natural disasters.
- Develop the knowledge on man-made disasters.
- Discuss the different segments of disaster management.
- Explain the concept of different disaster relief measures.
- Achieve sufficient knowledge on the National Policy on Disaster Management.

GECX102 TOTAL QUALITY MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

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

MODULE I INTRODUCTION 8

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

MODULE II TQM PRINCIPLES 7

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

MODULE III TQM IMPROVEMENT PROCESS 8

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

MODULE IV STATISTICAL PROCESS CONTROL (SPC) 8

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

MODULE V TQM TOOLS 7

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss

Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

MODULE VI QUALITY SYSTEMS 7

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

Total Hours –45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

The student should be able to

- Apply the various statistical tools and approaches for Quality control.
- Achieve continuous process improvement through TQM.

GECX103	ENERGY STUDIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I GLOBAL AND NATIONAL ENERGY SCENARIO 7

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

MODULE II SOLAR ENERGY 8

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

MODULE III OTHER RENEWABLE ENERGY SOURCES 8

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

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

Cogeneration principles- topping and bottoming cycles, role in process industries. Energy from wastes- waste heat recovery- heat recovery from industrial processes. Heat exchange systems – recuperative and regenerative heat exchangers – commercially available waste heat recovery devices. Combined cycle plants – concept, need and advantages, different combinations and practical scope.

MODULE V ENERGY CONSERVATION AND MANAGEMENT 7

Need for energy conservation – use of energy efficient equipment. Energy conservation opportunities - in educational institutions, residential, transport, municipal, industrial and commercial sectors – concept of green building. Energy audit in industries – need, principle and advantages. Case studies.

MODULE VI GLOBAL ENERGY ISSUES AND CARBON CREDITS 7

Energy crisis, fossil consumption and its impact on environmental climate change. Energy treaties – Montreal and Kyoto protocols - Transition from carbon rich and nuclear to carbon free technologies, carbon foot print – credits – clean development mechanism.

L – 45; Total Hours –45

TEXT BOOKS:

1. S.S. Rao and B.B. Parulekar, "Energy Technology", 3rd Edition, Khanna Publishers, New Delhi, 2011.
2. O. Callaghn. P.W., "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.

REFERENCES:

1. G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2. Archie, W Culp. "Principles of Energy Conservation", McGraw Hill, 1991.
3. D Patrick and S W Fardo, "Energy Management and Conservation", PHI,1990
4. P. O'Callaghan: "Energy Management", McGraw - Hill Book Company, 1993.
5. Kenney, W. F., "Energy Conservation in Process Industries", Academic Press, 1983.

OUTCOMES:

The student should be able to

- Realize the global and national energy status and need to switch over to renewable energy technology.
- Energy audit and suggest methodologies for energy savings.
- Utilize the available resources in an optimal way.
- Concern about the global environmental issues & promote carbon credits.

GECX104	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I **8**

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

MODULE II ROBOT DRIVES AND CONTROL **8**

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

MODULE III ROBOT SENSORS **8**

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

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

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

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

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

MODULE VI ROBOT KINEMATICS AND DYNAMICS 7

Forward and inverse Kinematic equations, Denvit – Hartenbers representations Fundamental problems with D-H representation, differential motion and velocity of frames - Dynamic equations for sing, double and multiple DOF robots – static force analysis of robots.

L – 45; Total Hours –45

REFERENCES:

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

OUTCOMES:

Students would be able to

- Understand about the robots, its various components.
- Design Robots for industrial applications.
- Do programming for robots and apply them in real time applications.

GECX105	TRANSPORT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I INTRODUCTION 7

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

MODULE II ORGANISATION AND MANAGEMENT 7

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

MODULE III TRANSPORT SYSTEMS 9

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

MODULE IV SCHEDULING AND FARE STRUCTURE 8

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

MODULE V MOTOR VEHICLE ACT 7

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

MODULE VI MAINTENANCE 7

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

L – 45; Total Hours –45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

Upon completion of the course, students will

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

GECX106	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I BASIC CONCEPTS AND SYSTEM REPRESENTATION 8

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

MODULE II TIME RESPONSE ANALYSIS AND DESIGN 8

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

MODULE III FREQUENCY RESPONSE ANALYSIS AND DESIGN 7

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

MODULE IV STABILITY 8

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

MODULE V COMPENSATOR DESIGN 8

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

MODULE VI CONTROL SYSTEM COMPONENTS AND APPLICATION OF CONTROL SYSTEMS 6

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

L – 45; Total Hours –45

REFERENCES:

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
3. C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.
4. I.J.Nagarath and M.Gopal, "Control System Engineering", Wiley Eastern Ltd., Reprint, 1995.
5. R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley (MATLAB Reference), 1995.

OUTCOMES:

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

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

GECX107	INTRODUCTION TO VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Basic concepts of HDL.
- Verilog language and its syntax constructs.
- Programmable Logic Devices and FPGAs
- MOS devices theory
- CMOS based combinational and sequential circuits

PREREQUISITES:

Fundamentals of Electronics

Basics knowledge in Digital Electronics.

MODULE I REVIEW OF BASIC DIGITAL SYSTEMS 7

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

MODULE II LOGIC DESIGN USING VERILOG HDL 8

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

MODULE III LANGUAGE CONSTRUCTS OF VERILOG HDL 7

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

MODULE IV BUILDING BLOCKS OF DIGITAL VLSI SYSTEMS 8

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

MODULE V TRANSISTOR THEORY 7

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

MODULE VI BASICS OF DIGITAL CMOS DESIGN 8

NMOS & PMOS Logic Gate, CMOS Logic Gate, Basic layout design of simple gate-stick diagram, CMOS Logic Structures-full adder, multiplexers.

Total Hours –45

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

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

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

GECX 108	PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I INTRODUCTION OF PLANTS 7

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

MODULE II ELEMENTS OF PLANT 8

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

MODULE III DETAIL ENGINEERING 10

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

MODULE IV SUPPORT FROM OTHER DISCIPLINE 8

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

MODULE V INSTALLATION AND COMMISSIONING 7

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

MODULE VI CASE STUDIES 5

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

L – 45; Total Hours –45

REFERENCES:

1. Duncan C Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto,2014 McGraw-Hill Education
2. Gabriel Salvendy, Handbook of Industrial Engineering – Technology and operations Management, John Wiley & Sons, 2001.
3. Robert C Rosaler , Standard Handbook of Plant Engineering, Mc Graw Hill third Edition, 2004
4. R. Keith Mobley, Plant Engineer's Handbook, Technology and Engineering, 2001.

OUTCOMES:

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

- Review and correct P&IDs
- Do installation and commissioning of new plants
- Apply plant engineering in design and maintenance of water treatment plant / power plant etc

GECX109	NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students should be able to

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

MODULE I INTRODUCTION 6

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

MODULE II SYMMETRIC ENCRYPTION AND MESSAGE CONFIDENTIALITY 7

Symmetric Encryption Principles - Symmetric Block Encryption Algorithms - Random and Pseudorandom Numbers - Stream Ciphers and RC4 - Cipher Block Modes of Operation

MODULE III PUBLIC KEY CRYPTOGRAPHY AND MESSAGE AUTHENTICATION 8

Approaches to Message Authentication - Secure Hash Functions - Message Authentication Codes - Public-Key Cryptography Principles - Public-Key Cryptography Algorithms - Digital Signatures

MODULE IV KEY DISTRIBUTION ,USER AUTHENTICATION AND TRANSPORT-LEVEL SECURITY 8

Symmetric Key Distribution Using Symmetric Encryption - Kerberos - Key Distribution Using Asymmetric Encryption - X.509 Certificates - Public-Key

Infrastructure -Federated Identity Management - Web Security Considerations - Secure Socket Layer and Transport Layer Security - Transport Layer Security

MODULE V WIRELESS NETWORK SECURITY, ELECTRONIC MAIL SECURITY AND IP SECURITY 8

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

MODULE VI SYSTEM SECURITY 8

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

L – 45; Total Hours –45

REFERENCES:

1. William Stallings,”Network security Essentials:Applications and standards“, Prentice Hall, Fifth Edition , ISBN-13: 978-0134527338, 2013
2. William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson, ISBN-13:978-0-273-79335-9,2013
3. Behrouz Forouzan, Debdeep Mukhopadhyay,Cryptography and network security (sie) 2nd edition, ISBN-13: 978-0070702080, 2016
4. Wikipedia, “Network Security and Management” , https://en.wikipedia.org/wiki/Book:Network Security and Management, 2014.
5. Nitesh Dhanjani, Justin Clarke, “Network Security Tools”, O'Reilly Media, ISBN-13: 9780596007942, 2005.

OUTCOMES:

Students who complete this course will be able to

- Recognize the computer security concepts, architecture attacks and model
- Distinguish the symmetric and asymmetric encryption techniques
- Apply the cryptographic algorithms in different applications
- Express the network security designs using available secure solutions such as PGP,SSL, IPSec, etc.
- Describe the firewalls principles and different types of firewalls applied in organization
- Identify abnormalities within the network caused by worms, viruses and Network related security treats**.**

GECX110	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit knowledge of highly mobile individual employees.
- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's knowledge base.
- Brings out the paradigm in terms of information technology and intellectual capital.

MODULE I KNOWLEDGE MANAGEMENT 6

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

MODULE III CAPTURING KNOWLEDGE AND SHARING 9

Tacit knowledge capture - Explicit knowledge codification – Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

MODULE IV KNOWLEDGE MANAGEMENT TOOLS 9

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery – Content management tools - Knowledge sharing and dissemination tools – Group ware and Collaboration tools - Intelligent filtering tools.

MODULE V KNOWLEDGE APPLICATION 6

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels – Knowledge repositories - Knowledge reuse -Case study: e-learning.

MODULE VI VALUE OF KNOWLEDGE MANAGEMENT 6

KM return on investment and metrics - Benchmarking method – Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

L – 45; Total Hours –45

TEXT BOOKS:

1. Elias M. Awad, Hassan M. Ghaziri, “Knowledge Management”, Prentice Hall, 2nd Edition, 2010.
2. Jay Liebowitz, “Handbooks on Knowledge Management”, 2nd Edition, 2012.
3. Irma Becerra-Fernandez, Rajiv Sabherwal, ”Knowledge Management: Systems and Processes”, 2010.

OUTCOMES:

Students who complete this course will be able to

- Describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
- Explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
- Critically evaluate current trends in knowledge management and apply it for e-learning

GECX111 CYBER SECURITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of Cyber Security Standards and Policies.
- To know the legal, ethical and professional issues in Cybersecurity.
- TounderstandCyberFraudsandAbuseanditsSecurityMeasures.
- To know the technological aspects of CyberSecurity.

MODULE I FUNDAMENTALS OF CYBER SECURITY 7

Securityproblemincomputing–CryptographyBasics–HistoryofEncryption– Modern Methods – Legitimate versus Fraudulent Encryption methods– EncryptionusedinInternet.

MODULE II CYBERCRIME AND CYBEROFFENSES 8

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

MODULE III CYBERCRIME: MOBILE AND WIRELESS DEVICES 8

Proliferation of Mobile and Wireless Devices – Trends in Mobility – Credit card frauds in Mobile and Wireless Computing – Security Challenges – Authentication Service Security – Attacks on Mobile Phones.

MODULE IV TOOLS AND METHODS USED IN CYBERCRIME 8

Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers and Spywares – Virus and Worms – Trojan Horses and Backdoors – Steganography – DoS and DDoS Attacks.

MODULE V SECURITY POLICIES 7

Introduction - Defining User Policies – Passwords – Internet Use – Email Usage – Installing/ Uninstalling Software – Instant Messaging – Defining System Administrative Policies – Defining Access Control Developmental Policies Standards, Guidelines and Procedures – Basics of assessing a system

MODULE VI COMPUTER FORENSICS 7

General Guidelines – Finding Evidence on the PC - Finding Evidence in System Logs – Windows Logs – Linux Logs – Getting Back Deleted Files – Operating System Utilities – The Windows Registry.

L – 45; Total Hours –45

TEXT BOOKS:

1. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley, 2011.
2. Chuck Easttom, "Computer Security Fundamentals", 2nd Edition, Pearson Education,2012.

REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing",3rdEdition, Pearson Education,2003.
2. WilliamStallings,"CryptographyandNetworkSecurity–Principlesand Practices", 3rd Edition, Pearson Education,2003.
3. AtulKahate,"CryptographyandNetworkSecurity",TataMcGrawHill,2000.

OUTCOMES:

Uponcompletionofthiscourse, students will be able to

- Explain the general security issues.
- Discuss various cybercrimes and offenses.
- Outline the occurrence of Cybercrime in mobile and wireless environment.
- Use relevant tools and methods in cybercrime
- Apply security policies in cyber forensics.
- Outline the strategies adopted in computer forensics.

GECX112	GENETIC ENGINEERING	L	T	P	C
		4	0	0	4

OBJECTIVES:

- The course aims to provide an advanced understanding of the core principles and topics of Cell and Organism reproduction and the Principles of heredity and their experimental basis, and to enable students to be able to apply these principles in assessment of pedigrees to identify genotypes and predict the mating outcomes.

MODULE I GENETICS AND ORGANISM 10

Genetics and human affairs, Genetics and Biology, Genes and Environment, Techniques of genetic analysis, The chromosome theory of heredity, Sex chromosomes, Sex linkage, The parallel behaviour of autosomal genes and chromosomes.

MODULE II MENDELISM AND LINKAGE 12

Mendel's laws of inheritance, Interaction of genes, Variations on dominance, Multiple alleles, Lethal alleles, Several genes affecting the same character, Penetrance and expressivity, Linkage- Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Examples of linkage maps.

MODULE III FINE STRUCTURE OF GENES 10

The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. The concept of extranuclear genome in higher plants and animals, Overview of mitochondrial genome, Chloroplast genome.

MODULE IV RECOMBINATION IN BACTERIA AND VIRUSES 10

Conjugation recombination and mapping the E.coli chromosomes, Transformation, Transduction, Chromosome mapping. Population genetics: Darwin's revolution, Variation and its modulation, The effect of sexual reproduction on variation, The sources of variation, Selection quantitative genetics

MODULE V PRINCIPLES OF PLANT BREEDING 9

Objectives, Selfing and crossing techniques, Male sterility,Incompatability, Hybrid vigour.

MODULE VI HUMAN GENOME PROJECT 9

Genetic diseases in humans, Genetics and society

L – 45; T – 15; Total Hours –60

REFERENCES:

1. In Introduction to genetic analysis, Griffiths, Miller, Suzuki, Lewontin and Gelbart, Freeman and Company.
2. Genetics, A.V.S.S. Sambamurty, Narosa Publishing House.
3. Concepts of Genetics, Klug & Cummings, Prientice Hall.
4. Molecular Cloning, Moniatisetal, Cold Spring Harbor Laboratory.

OUTCOMES:

At the end of the course students will be able to

- Describe the structure, function and replication of DNA as the genetic materialDescribe gene structure, expression and regulation
- Describe the chromosomal basis of inheritance and how alterations in chromosome number or structure may arise during mitosis and meiosis

GECX113	FUNDAMENTALS OF PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students would gain knowledge on

- Technicalities attached to Project Management and Significance of Quality Consideration
- Project management methodologies – tools and techniques, supplemented with examples from case studies
- The importance of Efficient HR team and role of Communication in executing Projects.
- Managing Risks in Project Management

MODULE I INTRODUCTION TO PROJECT MANAGEMENT 9

Introduction to Project and Project Management-Project Management as a Career-Project Management Skill Sets-Project Scope Management: Project Charter, Scope Creep, Scope Validation, Scope Change Control-Type of Organization: Organization Structure-Influence of Organization Structure on Project, Project Stakeholders and Organizational Productivity.

MODULE II PROJECT MANAGEMENT PROCESS, TOOLS AND TECHNIQUES 8

Project life cycle-Initiation, Planning, Execution, Monitoring and Closing Phase; - Link between project management process, process groups and knowledge areas; Project management tools and techniques- Project Stakeholders description and mapping - Stakeholder Management Process

MODULE III PROJECT QUALITY, COST AND SCHEDULE MANAGEMENT 10

Triple constraints of project-quality, cost and schedule-Quality Planning, Quality Assurance and Quality Control, Process Control, Cost of Quality, Seven Tools of Quality Control- Cost Management: Cost Estimating Methods, Estimating Completion Cost, Earned Value Management, Budgeting, Life-Cycle Cost analysis- Project Time Management: Duration Estimation Method, FS/FF/SS/ SF Relations, Lead/Lag, Arrow Diagram Method and Precedence Diagram Method for Scheduling-Resource Allocation

MODULE IV PROJECT HR MANAGEMENT 5

Organizational Goals- (MBO/MBE/MBP)-Responsibility Assignment Matrix (RAM)-Types of Powers- Manage or Lead-Conflict management Techniques-Performance Evaluation Process-Motivation Theories and its Application for execution of Projects-Leadership Styles-Project Team Building-Project Staffing Constraints/Policies

MODULE V COMMUNICATION MANAGEMENT 5

Communication Management: Understanding Body languages of Project Personnel-Effective Communications- Interpersonal Skills for project Managers-PMIS-Communicating with the Customer-Communicating with Management-Formal vs. Informal Communications-Written, Verbal and Non-Verbal Communications.

MODULE VI PROJECT PROCUREMENT & RISK MANAGEMENT 8

Introduction to Project Procure Management: Soliciting RFQ/RFP-Contract Proposals-Contract Negotiation-Contract Closure-Risk Management: Defining risks-Risk management process-Risk identification-Qualitative and Quantitative Risk-Probability and Decision trees-Risk Response strategies / methods-Expected monetary value-Risk vs. life cycle phases

L – 45; Total Hours –45

REFERENCES:

1. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015
2. Bob Hughes, Mike Cotterrel “Software Project Management”, Tata McGraw-Hill, 2009

OUTCOMES:

- Learners will be able to identify the Key Knowledge Areas and apply PM process in hypothetical project assignments given as continuous assessment.
- They would be able to suitably recognize tools and techniques required for various phases included in a project.
- They would also be able to manage scope, time, cost and other major components that would help them to execute the project efficiently.

GECX114	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge and training in optimization techniques.
- To get knowledge about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations

MODULE I LINEAR PROGRAMMING PROBLEM 8

Linear programming – formulation of the problem - graphical interpretation of optimality - Simplex method – to obtain basic feasible solution – types of linear programming solution – complications and their resolution.

MODULE II ARTIFICIAL VARIABLE AND TWO PHASE METHOD, DUALITY 6

Artificial variable - Big M method – Two phase method – alternative optimal solution – unbounded solution - Duality – primal dual relationships - rules of constructing the dual from primal.

MODULE III TRANSPORTATION PROBLEM & ASSIGNMENT PROBLE 8

Transportation problems – Initial basic feasible solutions, MODI method, Unbalance in transportation, Degeneracy in transportation models, Assignment problem – Minimization and Maximization type of problems by Hungarian method.

MODULE IV NETWORK AND SEQUENCING PROBLEMS 8

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

MODULE V QUEUING THEORY & SIMULATION 7

Poisson arrivals and exponential service times – characteristics of Queuing models – single channel – Introduction to multi channel models – Random number generation – Monte Carlo Simulation.

MODULE VI INVENTORY CONTROL, REPLACEMENT MODELS AND GAME THEORY 8

Types of inventory- Inventory cost - EOQ - Deterministic inventory problems – Introduction to probabilistic models & system level inventory control - Replacement models – Replacement of items that deteriorate with time – value of money changing with time – not changing with time – Individual and group replacement policy - Game theory – simple games.

L – 45; Total Hours –45

TEXT BOOKS:

1. Hamdy ATaha, "Operations Research an introduction", 8th edition, Phil Pearson, 2007.
2. Winston.W.L., "Operations Research", 4th edition, Thompson-Brooks/Cole, 2003.

REFERENCES:

1. Wayne.L. Winston, "Operations Research applications and algorithms", 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald.J.Lieberman, "Operations Research concepts and cases", 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.

A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research:Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.

3. Robertazzi. T.G., "Computer networks and systems-Queuing theory and performance evaluation", 3rd edition, Springer, 2002.

OUTCOMES:

At the end of the course students will be able to

- solve linear programming problems
- solve transportation and assignment problems.
- solve network and sequencing problems.
- apply the operations research techniques to solve industrial problems.

GECX115	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I INTRODUCTION & CLASSIFICATION OF NANOMATERIALS 9

Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic,transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

MODULE II TYPES OF NANOMATERIALS 9

Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

MODULE III PRODUCTION OF NANOPARTICLES 7

Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV CARBON BASED NANOMATERIALS 6

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

MODULE V NANOPHOTONICS 7

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

MODULE VI CHARACTERISATION TECHNIQUES 7

Basic principles of scanning Electron Microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

L – 45; Total Hours –45

TEXT BOOKS:

1. Hari Singh Nalwa, “Handbook of Nanostructured Materials and Nanotechnology”, Academic Press, 2000.
2. Guozhong Cao, “Nanostructures and Nano materials-Synthesis, Properties and Applications”, Imperial College Press (2011).
3. Zhong Lin Wang, “Handbook of Nanophase and Nanomaterials (Vol 1 and II)”, Springer, 2002.
4. Mick Wilson, Kamali Kannangara, Geoff smith, “Nanotechnology: Basic Science and Emerging Technologies”, Overseas press, 2005.

REFERENCES:

1. A. Nabok, “Organic and Inorganic Nanostructures”, Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: “Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, “Nano Technology – Basic Science and Emerging Technologies”, 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, “Nanoscience and Nanotechnology: Fundamentals to Frontiers”, Wiley, 2013.

OUTCOMES:

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

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

GECX116	VEHICLE MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS 7

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

MODULE II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE 8

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls.

MODULE III TRANSMISSION AND DRIVELINE MAINTENANCE 8

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

MODULE IV STEERING AND SUSPENSION MAINTENANCE 7

Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, and power steering system.

MODULE V BRAKE AND WHEEL MAINTENANCE 7

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, parking brake. Bleeding of brakes. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation.

MODULE VI AUTO ELECTRICAL AND AIR CONDITIOING MAINTENANCE 8

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

L – 45; Total Hours –45

TEXT BOOKS:

1. Ed May, "Automotive Mechanics Volume One" , Mc Graw Hill Publications, 2003
2. Ed May, "Automotive Mechanics Volume Two" , Mc Graw Hill Publications, 2003
3. Vehicle Service Manuals of reputed manufacturers
4. Vehicle maintenance and garage practice by Jigar A.Doshi Dhru U.Panchal,Jayesh P.Maniar. 2014
5. A Practical Approach to Motor Vehicle Engineering and Maintenance 3rd Edition by Allan Bonnick.

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition, 2004.
2. Advanced Automotive Fault Diagnosis by Tom Denton 2011.
3. Nissan Patrol Automotive Repair Manual: 1998-2014 by Haynes Manuals Inc.
4. Automobile electrical manual a comprehensive guide by Haynes manual car repair.

OUTCOMES:

On completion of the course student should be able to

- Prepare maintenance schedules and procedures with appropriate tools.
- Demonstrate the procedure and methods to repair and calibrate the engine.
- Analyze the causes and remedies for fault in transmission and drive line systems.
- Analyze the causes and remedies of steering and suspension systems.
- Analyze the causes and remedies of brake system.
- Demonstrate the procedure for wheel alignment and wheel balanced.

GECX117	**FUNDAMENTALS OF DIGITAL IMAGE PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- Describe and explain basic principles of digital image processing
- Design and implement algorithms that perform basic image processing
- Design and implement algorithms for advanced image analysis
- Assess the performance of image processing algorithms and systems

PRE-REQUISITES:

- Basic knowledge of transforms in Mathematics

MODULE I DIGITAL IMAGE FUNDAMENTALS 8

Elements of Image Processing System, Fundamentals steps in Digital Image Processing, Image Sampling & Quantization, Spatial and Gray Level Resolution.

MODULE II COLOR IMAGE PROCESSING 8

Fundamental of color image processing, color models- RGB, CMY, HIS, Pseudo color image processing

MODULE III IMAGE ENHANCEMENT 7

Basic gray level Transformations, Histogram Processing, Spatial Filtering

MODULE IV IMAGE TRANSFORMS 7

2D-DFT, DCT, Haar Transform,Fundamentals of 2D-wavelet transform, sub-band coding

MODULE V IMAGE SEGMENTATION AND RESTORATION 8

Point, line and edge detection methods ,Image Segmentation and its types, Restoration: Noise model, Inverse filter and Wiener filter.

MODULE VI IMAGE COMPRESSION 7

Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, JPEG and MPEG Compression standards.

TOTAL HOURS : 45

TEXT BOOKS

1. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
2. Anil. K. Jain, "Fundamentals of Digital Image Processing"; 4th Edition, PHI, 2007

REFERENCES

1. Pratt William, "Digital Image Processing", John Wiley & Sons, 2007.
2. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", PHI, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Explain the fundamental concepts of digital image processing.
- Discuss about color image processing
- Recognize & apply various image enhancement techniques.
- Apply various transforms for image processing.
- Apply various techniques for image segmentation and restoration.
- Identify and use appropriate image compression techniques

Group II courses
(To be offered in VII Semester)

GECX201	GREEN DESIGN AND SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the concepts of sustainable development and fundamentals of socio economic systems.
- To understand the basics of green building and frame work for the attainment of sustainability.
- To enhance the student's interest in the design of green building and energy efficient measures in a buildings.

MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 7

Objectives of Sustainable Development - Need for sustainable development- Environment and development linkages - Globalisation and environment- Population, poverty and pollution- global, regional and local environment issues- Green house gases and climate change.

MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 8

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth-Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

MODULE III FRAME WORK FOR ACHIEVING SUSTAINBAILITY 7

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

MODULE IV GREEN BUILDINGS 8

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

MODULE V ENERGY CONSERVATION AND EFFICIENCY 7

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation- Energy conservation measures for buildings- Energy wastage- impact to the environment.

MODULE VI GREEN BUILDINGS DESIGN 8

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

Total Hours –45

TEXT BOOKS:

1. Kirby, J., Okeefe, P., and Timber lake, “Sustainable Development”, Earthscan Publication, London, 1995.

REFERENCES:

1. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 2^{nd} Edition, John Wiley and sons, 2007.

OUTCOMES:

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

- explain the objective, need for the sustainability and also the link between the globalization and environment.
- Address the economic, environmental, and social concerns in the sustainable development.
- Acquire knowledge on the performance indicators, constraints and barrier for sustainability.
- Explain the relationship between sustainability and emergence of green building practices.
- Recommend relevant energy conservation measures in a building
- describe the elements in green building design and suggest ideas for attainting sustainability in building.

GECX202	APPROPRIATE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of appropriate technology and expose the students to the basics of financial analysis and energy fundamentals.
- To create awareness on the appropriate technology with relevant to building design, water, sanitation and waste management.
- To enhance student's interest in energy efficient techniques and impart knowledge on relevant policies.

MODULE I BASICS CONCEPTS 7

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

MODULE II APPROPRIATE TECHNOLOGY WITH REFERENCE TO BUILDING DESIGN 7

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

MODULE III WATER, HEALTH AND SANITATION MANAGEMENT 7

Water Storage: Designing Dams and Pipelines, Appropriate Selection for Sanitation Technique, Sewerage, Communal Health and Waste Water Recycling.

MODULE IV WASTE MANAGEMENT 8

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

MODULE V ENERGY EFFICIENT TECHNIQUES 8

Green building concepts-renewable energy sources- Solar – Steam and wind-Biofuels - Biogas – Electricity.

MODULE VI TECHNOLOGY POLICY 8

Government Policies- Energy Policy-Appropriate technology Development Centre-its function and responsibilities-Building policies-Case Studies.

Total Hours –45

TEXT BOOKS:

1. Barrett Hazeltine and Christopher Bull, “Appropriate Technology: Tools Choices and Implications”, Academic Press, Orlando, USA, 1998.
2. Ken Darrow and Mike Saxenian, “Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology”, Stanford, 1986.

REFERENCES:

1. Richard Heeks, “Technology and Developing Countries: Practical Applications Theoretical Issues”, 1995.
2. John Pickford, “The Worth of Water : Technical Briefs on Health, Water and Sanitation”, Intermediate Technology Publications, 1998.

OUTCOMES:

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

- describe about the tools, choices of appropriate technology along with concepts of energy fundamentals
- conceptualize the techniques to be adopted in building design for saving energy and water.
- acquire knowledge about the techniques for water, health and sanitation management
- explain the classification, collection dispose and recycling systems adopted in waste management.
- elucidate the concepts of green building and renewable energy sources.
- express the polices relevant to technology and recommend an appropriate technology for an sustainable development.

GECX203	ENGINEERING SYSTEM MODELLING AND SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts, techniques, tools for modeling and simulation systems and environments through the use of computers.
- To study the various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

MODULE I INTRODUCTION 6

Systems – Modelling – types – systems components – Steps in model building-Simulation Algorithms and Heuristics; Simulation Languages.

MODULE II RANDOM NUMBERS / VARIATES 7

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc. – Testing of Random variates – Monte Carlo Simulation.

MODULE III MODELLING PROCESS 7

Primitive Models : Establishing relationships via physical laws; Establishing relationships via curve fitting; Parameters estimation problems; Elementary state transition models.

MODULE IV DESIGN OF SIMULATION EXPERIMENTS 9

Steps on Design of Simulation Experiments – Development of models using of Highlevel language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

MODULE V SIMULATION LANGUAGES 10

Need for simulation Languages – Comparisons & Selection of Languages – GPSSARENA- EXTEND – Study of any one of the languages.

MODULE VI CASE STUDIES USING SIMULATION LANGUAGES 6

Case Study using simulation languages

L – 45; Total Hours –45

REFERENCES:

1. Law, A.M., & W.D. Kelton, “Simulation Modelling and Analysis”, McGraw Hill, Singapore, 2000.
2. Harrel, C.R., et. al., “System Improvement Using Simulation”, 3rd Edition, JMI Consulting Group and ProModel Corporation, 1995.
3. Harrel, C.R. & T. Kerim, “Simulation Made Easy, A Manager’s Guide”, IIE Press, 1995.
4. Geoffrey Gordon, “Systems Simulation”, Prentice Hall, 2002.
5. David Kelton, Rondall P Sadowski, David T Sturrock, “Simulation with Arena”, Mc Graw Hill, 2004.

OUTCOMES:

The student should be able to

- Model and simulate systems and environments through the use of computers.
- Conduct experiments with discrete dynamic, stochastic system models on a computer.

GECX204	VALUE ANALYSIS AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get acquainted with value analysis and engineering tool for productivity improvement.
- To understand and analyze the theory and methodology of Value Engineering.

MODULE I VALUE ENGINEERING BASICS 8

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity In Value Engineering.

MODULE II VALUE ENGINEERING JOB PLAN AND PROCESS 6

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

MODULE III ORIENTATION AND INFORMATION PHASES 8

Launching Value Engineering project work - Objectives and Targets - VE Project work: a time-bound programme - Projects and Teams - Time Schedule - Co-ordination - Consultant. Technical data - Marketing related information - Competition profile - Cost data - Materials Management related information - Quality related information - Manufacturing data.

MODULE IV FUNCTION ANALYSIS AND CREATIVE PHASES 9

Objectives - Function definition - Classification of functions - Higher level functions – Function – Cost – Function – Worth - Value Gap - Value index - How to carry out Function Analysis? – Fast Diagraming - Cost Modelling.

Creativity - How to improve creativity of an individual? – How to promote creativity in the organisation? - Obstacles to Creativity - Mental road blocks - Creativity killer phrases. Positive thinking - Ideas stimulators - Creativity techniques - Brainstorming.

MODULE V EVALUATION, INVESTIGATION AND RECOMMENDATION 6

Paired comparison and Evaluation Matrix techniques - Criteria for selection of VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES 8

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

L – 45; Total Hours –45

TEXT BOOKS:

1. Mudge, Arthur E. “Value Engineering- A systematic approach”, McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), “Value Engineering”, Narosa Publishing House, 2005.

REFERENCES:

1. Park RJ, “Value Engineering: A Plan for Invention”, St.Lucie Press, New York, 1999.
2. Lawrence, D.M., “Techniques of Value Analysis and Engineering”, McGraw Hill 1988.
3. George, E.D., “Engineering Design: a Material and Processing Approach”, McGraw Hill, 1991.
4. Heller, D.E., “Value Management, Value Engineering and Cost Reduction”, Addison Wesley, 1988.

OUTCOMES:

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.

GECX205	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various safety measures to be taken in different industrial environments.

MODULE I SAFETY MANAGEMENT 7

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

MODULE II SAFETY IN MANUFACTURING 7

Safety in metal working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

MODULE III SAFETY IN CONSTRUCTION 8

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

MODULE IV ELECTRICAL SAFETY 8

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

MODULE V SAFETY IN MATERIAL HANDLING 8

General safety consideration in material handling devices - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.
Storage and Retrieval of common goods of shapes and sizes in a general store of a big industry.

MODULE VI SAFETY EDUCATION AND TRAINING 7

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

L – 45; Total Hours –45

REFERENCES:

1. Krishnan N.V, “Safety Management in Industry”, Jaico Publishing House, Bombay, 1997.
2. Blake R.B., “Industrial Safety”, Prentice Hall, Inc., New Jersey, 1973.
3. Fulman J.B., “Construction Safety, Security, and Loss Prevention”, John Wiley and Sons, 1979.
4. Fordham Cooper W., “Electrical Safety Engineering”, Butterworths, London, 1986.
5. Alexandrov M.P., “Material Handling Equipment”, Mir Publishers, Moscow, 1981.

OUTCOMES:

Students would be able to

- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.

GECX206	**ADVANCED OPTIMIZATION TECHNIQUES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce the various advanced optimization tools.
- To provide an understanding to deal with ill identified and fuzzy problems.

MODULE I INTRODUCTION 7

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

MODULE II HEURISTICS METHODS 8

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming – Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing.

MODULE III GENETIC ALGORITHM 7

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation -genetic algorithms in search, optimization and machine learning-practical genetic algorithms.

MODULE IV ANT COLONY OPTIMIZATION 8

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History – The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring – Advantages & Disadvantages

MODULE V FUZZY LOGIC AND ANN 8

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations

– Design example – Biological foundations to intelligent systems: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

MODULE VI IMPLEMENTATIONS & APPLICATIONS 7

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

L – 45; Total Hours –45

REFERENCES:

1. Singiresu S. Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1996.
2. Ravindran – Phillips –Solberg, "Operations Research – Principles and Practice, John Wiley and Sons, 1987.
3. Fredrick S.Hillier and G.J.Liberman, "Introduction to Operations Research", McGraw Hill Inc. 1995.
4. Kalymanoy Deb, "Optimization for Engineering Design", PHI, 2003
5. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006

OUTCOMES:

At the end of the course student will be able to

- Formulate a real life situation as an optimization the problem.
- Identify the appropriate solution methodology and provide a solution

GECX 207	MATLAB SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

MODULE I INTRODUCTION MATLAB DATA PRESENTATION 7

Vectors, Matrices -Vector/Matrix Operations & Manipulation- Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically- Least squares regression -Curve fitting.

MODULE II MATLAB PLOT FUNCTION 7

Introduction- Plot Function – Animation- 3D Plots-Customizing Plots – Plot Applications- Saving &Painting Plots.

MODULE III ROOT FINDING AND COMPUTER REPRESENTATION OF NUMBERS 7

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

MODULE IV ORDINARY DIFFERENTIAL EQUATIONS 8

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

MODULE V NON-LINEAR DIFFERENTIAL EQUATIONS 8

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

MODULE VI INTRODUCTION OF SIMULINK 8

Simulink & its relations to MATLAB – Modeling a Electrical Circuit- Modeling a fourth order differential equations- Modeling the solution of three equations with three unknowns- Representing a model as a subsystem-Simulink demos.

L – 45; Total Hours –45

REFERENCES:

1. Griffiths D V and Smith I M, Numerical Methods for Engineers, Blackwell, 1991.
2. Laurene Fausett, Applied Numerical Analysis Using MATLAB, Pearson 2008.
3. Moin P, Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB. CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving , Mathematical Exploration with MATLAB, Cambridge University Press, 1999.

OUTCOMES:

At the end of this unit students will be able to:

- Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
- Write programs using first principles without automatic use of built-in ones.
- Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
- Be fluent in exploring Matlab's capabilities, such as using matrices as the fundamental data-storage unit, array manipulation, control flow, script and function m-files, function handles, graphical output.
- Make use of Maltab visual capabilities for all engineering applications.
- An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering fields

GECX208	EMBEDDED SYSTEMS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a detailed overview of embedded system.
- To equip students with the software development skills necessary for practitioners in the embedded systems field.
- To understand entire software development lifecycle and examine the various issues involved in developing software for embedded systems.

MODULE I EMBEDDED SYSTEMS OVERVIEW 8

Introduction –Embedded Systems vs. General computing systems- Fundamental Components of embedded systems- Characteristics- Challenges-Examples-Embedded System design process.

MODULE II EMBEDDED COMPUTING PLATFORM 8

Overview of Processors and hardware units in an embedded system-CPU buses – Memory devices –Memory types- I/O devices – Designing with computing platforms-Consumer electronics architecture-Design example: Alarm clock.

MODULE III REAL TIME EMBEDDED SYSTEMS 8

Programming embedded systems in assembly and C – Real time systems – Hard and Soft real time systems- Need for RTOS in Embedded Systems- Multiple tasks and processes –Context switching-Scheduling policies- Interprocess communication and synchronization.

MODULE IV EMBEDDED SOFTWARE DEVELOPMENT PROCESS 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:

1. Marilyn Wolf , "Computers as components", Elsevier 2012.
2. Shibu. K.V, “Introduction to Embedded Systems”, Tata Mcgraw Hill,2009.
3. Rajkamal, "Embedded Systems Architecture, Programming and Design",1st Reprint,Tata McGraw-Hill, 2003
4. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons,2002.

REFERENCES:

1. Sriram V Iyer and PankajGupta ,”Embedded Realtime Systems Programming ”TataMcGraw-Hill,2008
2. Qing Li and Carolyn Yao," Real-Time Concepts for Embedded Systems",CMPBooks, 2003
3. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003

OUTCOMES:

On completion of this course, the students will be able to

- Identify the suitable processor and peripherals in embedded applications
- Develop embedded programs in assembly and c
- Choose the right platform for designing an embedded system
- Explore different scheduling mechanism in rtos
- Design the program model for embedded applications.
- Analyze different domain specific applications in embedded systems.

GECX209 USABILITY ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

MODULE I INTRODUCTION 6

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

MODULE II USER INTERFACES 8

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

MODULE III INTERACTION DESIGN 8

Process of Interaction Design - Establishing Requirements – Design,Prototyping and Construction - Evaluation and Framework.

MODULE IV USABILITY TESTING 8

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

MODULE V USABILITY ASSESSMENT METHODS 8

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual Use, User Feedback, Usability Methods – Interface Standards - National, International and Vendor Standards, Producing Usable In-House Standards.

MODULE VI USER INTERFACES 7

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces – Future Developments – Case Study.

L – 45; Total Hours –45

TEXT BOOKS:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, “Interaction Design: Beyond Human - Computer Interaction”, John Wiley & Sons, 3rd Edition, 2011 (Module I, II, III).
2. Jakob Nielsen, “Usability Engineering”, Morgan Kaufmann Academic Press, 1994. (Module I – VI).

REFERENCES:

1. Ben Shneiderman, Plaisant, Cohen, Jacobs, “Designing the User Interface: Strategies for Effective Human Interaction”, Pearson Education, 5th Edition, 2010.
2. Laura M. Leventhal, Julie A. Barnes, “Usability Engineering: Process, Products, and Examples”, Pearson/Prentice Hall, 2008

OUTCOMES:

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

GECX210	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

MODULE I INTRODUCTION TO SUPPLY CHAIN 7

Understanding Supply Chain - Decision phases - Supply chain performance - Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

MODULE II SUPPLY CHAIN DRIVERS AND DESIGN 7

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

MODULE III AGGREGATE PLANNING AND MANAGING SUPPLY, DEMAND AND INVENTORY 8

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

MODULE IV MANAGING INVENTORY IN SUPPLY CHAIN 8

Managing Economies of Scale in a Supply Chain : Cycle Inventory- Managing uncertainty in a Supply Chain Safety Inventory- Determining optimal level of Product Availability

MODULE V SOURCING AND TRANSPORTATION 8

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers - Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

MODULE VI INFORMATION TECHNOLOGY IN A SUPPLY CHAIN 7

Information technology in a supply chain – CRM, ISCM, SRM in supply chain - Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

L – 45; Total Hours –45

REFERENCES:

1. Sunil Chopra and Peter Meindl, “Supply Chain Management-Strategy Planning and Operation”, Pearson Education, 5th Indian Reprint, 2013.
2. Jananth Shah “Supply Chain Management – Text and Cases“ Pearson Education, 2008.
3. Altekar Rahul V, “Supply Chain Management-Concept and Cases”, Prentice Hall India, 2005.
4. Monczka et al., “Purchasing and Supply Chain Management”, Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

OUTCOMES:

- After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.
- The student decision making capability specific to supply chain issues in an industry is improved.
- The student can plan a well defined execution of supply chain strategy in companies.
- The student will be able to design a optimal distribution network as per the demands of the industry.
- The student can also determine the most favorable transportation plan for a company.
- The student will also be able to bring in company from paper environment to paperless environment.

GECX211	SYSTEMS ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the phases of the systems development life cycle
- To teach the automated tools for system development
- To develop and evaluate system requirements.
- To explain the organizational issues in system implementation
- To teach the usability testing and electronic data interchange
- To elucidate the importance of System analysis and design in electronic commerce.

MODULE I FUNDAMENTALS OF SYSTEM DEVELOPMENT 8

System Concept – Characteristics – Elements of System – Types of System – Modern Approach to System Analysis and Design – System Development Life Cycle – Approaches to Improving Development – Tools for System Development – Succeeding as a System Analyst – Skills – Managing the Project.

MODULE II AUTOMATED TOOLS FOR SYSTEMS DEVELOPMENT 7

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

MODULE III SYSTEM ANALYSIS 8

Determining System Requirements – Traditional Methods - Modern Methods – Radical Methods – Structuring System Requirements – Process Modeling – Data Flow Diagramming – Logic Modeling – Conceptual Data Modeling – E-R Modeling.

MODULE IV SYSTEM DESIGN 8

System Implementation – Software Application Testing – Installation – Documentation – Training and Support – Organizational Issues in Systems Implementation – Maintaining Information System – Conducting System

Maintenance.

MODULE V USABILITY AND MEASURING USER SATISFACTION 7

Usability Testing-User satisfaction test- A tool for analyzing user satisfaction – Unified Modeling Language(UML)- Case study: System Design: Application in Human Resource-Financial Applications

MODULE VI SAD IN E-COMMERCE 7

Systems analysis and design in the era of electronic commerce: B2B, B2C and C2C e-commerce -advantages and disadvantages of e-commerce. E-commerce system architecture – physical networks, logical network, World Wide Web, web-services - HTML, XML - case studies-El electronic data interchange: EDI standards - virtual private networks - XML and EDI

L – 45; Total Hours –45

REFERENCES:

1. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, “Modern Systems Analysis and Design”,Fifth Edition, Prentice Hall,March 2007.
2. Ned Kock, “Systems Analysis & Design Fundamentals” Sage South Asia, May 2008.
3. Joseph S. Valacich, Jeffrey A. Hoffer, Joey F. George, “Essentials Of System Analysis And Design” Prentice Hall , August 2005.
4. Rumbaugh et al, “Succeeding with Booch and Rambaugh Methods”, Addisson Wesley, second Edition, 1998.
5. Larman, C.,” Applying UML and Patterns. An introduction to Object-Oriented Analysis and Design”. Prentice-Hall PTR, 2002.

OUTCOMES:

- List the characteristics of the system and specify the approaches in the development of the system.
- Summarize the phases of the software life cycle
- Differentiate Corporate Strategic Planning and Information Systems Planning.
- Illustrate the system requirements through various modeling diagrams.
- Use tools and techniques for process and data modeling.
- Solve realistic systems analysis problems and perform user satisfaction test.

GECX212	**ADVANCED MATERIALS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

To make the student conversant with

- Dielectric materials
- Magnetic materials
- Energy materials
- Nano materials
- Semi conductors
- Smart materials

MODULE I **8**

Dielectric Materials- Polarization and Mechanism-Internal or local field-Clausius-Mossotti relation- Dielectric loss- Temperature and Frequency effect-Measurement of Dielectric constant and loss using Scherring bridge- electric break down- ferro, piezo, pyroelectric materials and its application.

MODULE II **8**

Magnetic Materials- Terminology and classification of magnetic materials (Dia, Para, Ferro & Ferri) – Magnetic moments due to electrospin – Domain theory of Hysteresis – Heisenberg theory of Exchange Interaction (without derivation)-Structure and properties of Ferrites- Properties of Soft and Hard Magnetic Materials- Application: floppy disk, CD ROM, Magneto optical recording.

MODULE III **8**

Energy Materials (Nuclear) - Introduction to nuclear materials- Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials- Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers-Radiation proof materials- Brief discussion of safety and radioactive waste disposal.

MODULE IV **7**

Nano Materials- The nanosize range- classification of nanomaterials-processing of nanomaterials-properties of nanomaterials- mechanical, electrical, magnetic properties- other properties- carbon based nanomaterials- other nanomaterials and its application.

MODULE V **7**

Semiconductors- The energy gap in solids-Extrinsic Semiconductors- Intrinsic Semiconductors- Hall Effect in semiconductors- Application of Hall Effect- Basic ideas of compound semiconductors -Semiconductor materials- Fabrication of Integrated Circuits- Some semiconductor Devices

MODULE VI **7**

Smart materials- aerospace materials Ni and Co based super alloys, Special steels, Titanium alloys, Intermetallics, ceramics and their composites, New High strength material, Properties of Materials, Materials in Medical Applications, Stainless steel alloys,Cobalt based alloys, titanium based alloys, polymers

L – 45; Total Hours –45

REFERENCES:

1. Materials science and Engineering: A first course by V. RAGHAVAN, 6th ed., Eastern Economy edition,Prentice Hall of India,2015
2. Materials science and Engineering: An Introduction by William D. Callister Jr., 7th ed. John Wiley & Sons Inc. 2007
3. Material science by Dr.M.Arumugam, Anurasha agencies ,third revised edition ,2002

OUTCOMES:

Students will be able to know

- significance of dielectric materials
- types and applications of magnetic materials
- applications of nuclear materials for energy harvesting
- applications of nano materials
- significance of semi conductor devices
- applications of smart materials

GECX213	NATIONAL SERVICE SCHEME	L	T	P	C
		2	0	0	2

OBJECTIVES:

Primary Objective: Personality development through community service.
To achieve the above objective, the following should be adhered:

- To provide an understanding about the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- To develop certain basic skills for personality development through community development.
- Understand the community in which they work and their relation
- Identify the needs and problems of the community and involve them in problem-solving and
- Practice national integration and social harmony.

MODULE I INTRODUCTION TO NSS 8

Orientation and structure of NSS,-Aims and Objectives of National Service Scheme-The history of NSS- Symbol and meaning- NSS hierarchy from national to college level – Role and responsibilities of various NSS functionaries

MODULE II PERSONALITY AND COMMUNITY DEVELOPMENT SKILLS 8

Importance of youth Leadership, Traits of Good Leadership and Personality Development. Role of youth in creating awareness through NSS Programmes on Health & Hygiene; Environmental Conservation and Enrichment for Sustainable Development; Sanitation and Swachh Bharat.

MODULE III UNDERSTANDING YOUTH 7

Definition and Profiles of youth categories, Youth Issues, Challenges and Opportunities for Youth, Youth as agent of social change & Community Mobilization Role of Youth in Nation Building. National Youth Policy.

MODULE IV SOCIAL HARMONY AND NATIONAL INTEGRATION 7

National Integration, Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc. Role of youth in Peace building and conflict resolution-Globalization and its Economic Social Political and

Cultural impacts.

L – 30; Total Hours –30

TEXT BOOKS:

- National Service Scheme – A Youth Volunteers Programme for Under Graduate students as per UGC guidelines J.D.S.Panwar et al. Astral International. New Delhi.
- National Service Scheme Revised Manual, 2006.Govt. of India. Ministry of Youth Affairs & Sports. New Delhi.
- Social Problems in India, *Ram Ahuja.*

REFERENCES:

1. National Youth Policy-2014. Ministry of Youth Affairs & Sports. .Govt. of India

OUTCOMES:

On successful completion of this course-

- Students will have exposure to the the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- Students will be trained to skills for personality development through community development.
- Students will gain knowledge about national integration and social harmony.
- Students will be exposed to the role of youths in Nation building Students will gain

GECX214	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To have a fair knowledge in automotive pollution control.
- To understand the concept of formation and control techniques of pollutants like UBHC, CO, NOx, particulate matter and smoke for both SI and CI engine will be taught to the students.
- To know about the instruments for measurement of pollutants
- To get introduced about emission standards

MODULE I EMISSION FROM AUTOMOBILES 8

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of ollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

MODULE II SI ENGINE EMISSIONS AND CONTROL 9

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, Positive Crank case ventilation system, Secondary air injection, thermal reactor

MODULE III CI ENGINE EMISSION AND CONTROL 8

Formation of White, Blue, and Black Smokes, NOx, soot, Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

MODULE IV NOISE POLLUTION FROM AUTOMOBILES 8

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aerodynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction —Silencer Design.

MODULE V TEST PROCEDURES 6

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dynamometers - Seven mode and thirteen mode cycles for Emission Sampling.

MODULE VI EMISSION MEASUREMENTS 6

Emission analysers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

L – 45; Total Hours –45

TEXT BOOKS:

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company., Newyork 1993.

REFERENCES:

1. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York. 1986.
2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.
3. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
4. C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.
5. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise',
6. Applied science publisher ltd., London,1987.

OUTCOMES:

On completion of the course student should be able to

- Identify the sources of emission from vehicles.
- Analyse the causes and effects of emissions.
- Analyse causes and effects of noise pollution
- Bring out solutions for control of emissions.
- Demonstrate the test procedures and emission norms.
- Select suitable instruments for measurement of emissions.

GECX215 MOTOR VEHICLE ACT, INSURANCE AND POLICY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about basic act and regulation followed for road vehicle
- To learn about systematic steps involved to get licence and registration of motor vehicle
- To learn arbour various types of motor vehicle polices and insurances

MODULE I BASIC RULES FOR ROAD VEHICLE 8

Display and Use of Number Plates- Attachment of number plates- Number plates in horizontal position- Removal of number plates on transfer- Hours prescribed for lighted lamps- Mounting of lamps and reflectors- Multiple beam headlamps- Daytime running lamps- Auxiliary driving lamps- Parking lamps- Brakes- Stopping distances- Emergency or parking brakes- Horn- Muffler- Mirrors- Inspection of motor vehicles- Standards of safety and repair

MODULE II LICENSING OF DRIVERS OF MOTOR VEHICLES 8

Necessity of driving licence- Age limit in connection with driving of motor vehicle-Responsibility of owners of motor vehicles-Restriction on the holding of driving licence-Grant of learner's licence-Grant of driving licence-Addition to driving licence- Renewal of driving licence-Revocation of driving licence on grounds of disease or disability-Driving licence to drive motor vehicle belonging to the central government- power of court to disqualify- suspension of driving licence in certain cases- suspension or cancellation of driving licence on convection- Endorsement.

MODULE III REGISTRATION OF MOTOR VEHICLE 7

Necessity for registration – Registration Where and how to be made- Special provision for registration of motor vehicle of diplomatic officers-Temporary registration- Production of vehicle at the time of registration- Refusal of registration- renewal of certificate of registration- effectiveness in India of registration- Change of residence or place of business-transfer of ownership- Suspension of registration – cancellation of registration suspended under section 53- certificate of fitness of transport vehicle-cancellation of registration.

MODULE IV INSURANCE OF MOTOR VEHICLE 8

Necessity for insurance against third party – Requirements of policies and limits of liability- - Duty of insurers to satisfy judgements and awards against person insured in respect of third party risks-Duty to give information as to insurance-Settlement between insurers and insured persons- transfer of certificate of insurance-production of certain certificates, licences and permit in certain cases-Special provisions as to compensation in case of hit and run motor accident – Types of motor polices

MODULE V CONTROL OF TRANSPORT VEHICLES 7

Power to State Government to control road transport- Transport authorities-General provision as to applications for permits- Application for stage carriage permit- Procedure of Regional Transport Authority in considering application for stage carriage permit- Scheme for renting of motor cabs- Application for private service vehicle permit- Procedure in applying for and granting permits- Duration and renewal of permits- Transfer of permit- Replacement of vehicles-Temporary permits

MODULE VI OFFENCES AND PUNISHMENT 7

Driving without holding an effective driving licence- Driving by an under-aged person (Minor driving vehicle)- Holding of a driving licence permitting it to be used by other person.- Driving a vehicle at an excessive speed- Driving or permitting to drive a vehicle carrying excess load- Driving dangerously / its Abetment Driving an uninsured vehicle
Rider and pillion rider failing to wear protective head gear (Helmet) -Violation of Mandatory Signs -.e-challan and spot challan

L – 45; Total Hours –45

TEXT BOOKS:

1. The motor vehicle act 1988, Universal law publishing co.cpvt ltd. Newdelhi 2011
2. A Commentary On The Motor Vehicles Act, 1988 by SUKHDEV AGGARWAL The Bright Law House, New Delhi

REFERENCES:

1. The Motor Vehicles Act, 1988 Along with Latest Case Law, Notifications & Table of Offences and Punishments Asia Law House; 15th edition (2014)
2. Assessment of Compensation in Accidents under Motor Vehicles Act by Karkara Delhi Law House (2013)

OUTCOMES:

On completion of the course students should be able to

- Explain the analysis of rules and regulations for road vehicles
- Analyze the procedure for getting driving license for vehicles at national and international level
- Analyze the procedure for registration of vehicles.
- Analyze the procedure for Insurance of vehicles and claims.
- Analyze the procedure for obtaining Government Permits and renewal
- Analyze the consequences of not following the rules and regulations

GECX216	PRINCIPLES OF COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the analog and digital modulation techniques.
- To elaborate the working of communication receivers in the presence of noise.
- To give an overview of various communication systems.

MODULE I LINEAR MODULATION 8

Baseband signals, Amplitude Modulation – Modulation Index, Power Transmitted, Double Side Band and Single Side Band AM, AM Modulators and AM Receivers, AM Radio systems, Frequency Division Multiplexing.

MODULE II ANGLE MODULATION 8

Frequency Modulation and Phase Modulation, Frequency deviation and modulation index, Bandwidth of FM, FM Modulators and FM receivers, FM Radio and FM Stereo Systems

MODULE III SAMPLING AND PULSE MODULATION 7

Sampling, Nyquist's Sampling Theorem, Pulse Modulations - PAM, PPM and PWM, Time Division Multiplexing, Bandwidth of TDM systems.

MODULE IV DIGITAL COMMUNICATION 7

Digital baseband data,Digital Modulations – ASK, FSK, PSK and QPSK. Digital Communication Transmitters and Receivers.

MODULE V NOISE 8

Sources of Noise, Thermal Noise, shot noise, White noise, Narrow band Noise, Effect of noise in communication, SNR, Receiver Noise Temperature and Noise Equivalent Bandwidth.

MODULE VI COMMUNICATION SYSTEMS & NETWORK 7

FM Radio Systems, Cellular Mobile network, Satellite Communications, Optical Fiber Communication.

L – 45; T – 0; Total Hours – 45

TEXT BOOKS:

1. A.Bruce Carlson, Paul B. Crilly, “Communication Systems”, 5th Edition, McGraw Hill Int., 2011.
2. B.P. Lathi, Zhi Ding, Hari M. Gupta, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2017.

REFERENCES:

1. Herbert Taub, Donald L. Schilling, Goutam Saha, “Principles of Communication Systems” 4th Edition, McGraw Hill Int. 2013.
2. Simon Haykin, “An Introduction To Analog And Digital Communications”, 1st Edition, Wiley India, 2010.
3. Simon Haykin , “Communications Systems” 4th Edition, Wiley India, 2006.
4. Hwei P. Hsu, “Analog and Digital Communications” 3rd Edition,

OUTCOMES:

On completion of the course students will be able to

- Identify various communication systems and the corresponding modulation schemes.
- Predict the characteristics of various analog and digital modulation schemes.
- Interpret the effect of noise and bandwidth in a communication systems
- Apply the Nyquist criteria for a given baseband signals.
- Evaluate the performance of communication receivers.
- Demonstrate the applications of common communication systems.

GECX 217	LEAN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of the Course to make the student know about

- The basics of leanproduction management,
- How Lean principles are applied to the Construction industry to improve the operation management and product development.

MODULE I **7**

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

MODULE II **8**

Manufacturing systems – an overview of manufacturing strategies. Job shops, batch flow, and flexible manufacturing systems Flow production and lean production systems

MODULE III **7**

Value stream mapping in process design and product development Waste reduction - lead time reduction

Process cycle time and value-added vs. non-value added activities Optimum lot sizing

MODULE IV **8**

Lean production processes, approaches and techniques.—Importance of focusing upon flow. Tools -. Workplace organization – 5S. - Stability. - Just-In-Time – One piece flow – Pull. - . Cellular systems. - . Quick change and set-up reduction methods. f. Total productive maintenance. -. Poka-Yoke – mistake proofing, quality improvement. Standards. - . Leveling. - . Visual management. Just-in-time techniques – SMED and Takt Times - Standard work processes and line balancing Poka-yoke and pull systems material handling reduction and facilities planning

MODULE V **8**

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

MODULE VI **7**

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

Total Hours –45

TEXT BOOKS:

1. The Toyota Way Field book, Jeffrey Liker and David Meier, McGraw-Hill, 2006. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.
2. Womack, James P., and Daniel T. Jones. Lean Thinking. New York, NY: Simon and Schuster, 2003. ISBN: 0743249275.
3. Murman, Earll. Lean Enterprise Value. New York, NY: Palgrave Macmillan, 2002. ISBN: 0333976975.

REFERENCES:

1. Readings athttp://www.leanconstruction.org/readings.htm
2. Hopp,W.J.,andSpearman,M.L.(2011).FactoryPhysics,ThirdEdition, WavelandPress,LongGrove,Il. 720pp.

OUTCOMES:

The student will be able to

- Describe the manufacturing approaches employed and the background and philosophy of lean production.
- Illustrate the concept of waste reduction
- Apply evaluation techniques that can be used in preparation for and use in learn production activities.
- Select the tools that can be used implementing lean production in production operations.
- Discuss the importance of workplace organization, pull production, cellular arrangement and employee involvement, need for employee creativity
- Describe about the Methods for promoting success in implementing lean transformations

GECX218	SPATIAL DATA MODELING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the fundamental representation and analysis of geospatial phenomena and provides the various methods and algorithms used in GIS analysis.
- To focus in terrain modeling, geomorphometry, watershed analysis and introductory GIS-based modeling of landscape processes (water, sediment). The course includes analysis from lidar data, coastal change assessment and 3D visualization.

MODULE I INTRODUCTION TO GEOSPATIAL DATA 7

Mapping natural phenomena –Concept of continuous fields and discrete sampling – Units, projections, coordinate transformation – Georeferencing, geospatial formats, conversions, geospatial data abstraction library – Raster and vector representation, raster and vector conversions and resampling.

MODULE II DATA DISPLAY AND VISUALIZATION 7

Display of continuous and discrete data, use of color, shading, symbols, to extract the spatial pattern and relationships – 3D visualization: multiple surfaces and volumes, 3D vector objects – visualization for data analysis (lighting, scaling, transparency, cutting planes, animations) – view/create maps/post your data on-line (Google Earth/Maps, GPS visualizer)

MODULE III GEOSPATIAL ANALYSIS 7

Foundations for analysis of continuous and discrete phenomena – neighborhood operations and buffers – analysis and modeling with map algebra – cost surfaces and least cost path – spatial interpolation and approximation (gridding)

MODULE IV TERRAIN MODELING AND ANALYSIS 9

terrain and bathymetry mapping – mathematical and digital representations (point clouds, contour, raster, TIN) – DEM and DSM, working with multiple return lidar data – spatial interpolation of elevation data and topographic analysis, line of sight, view shed analysis – solar irradiation, photovoltaic energy potential, time series of elevation data, analysis of coastal change.

MODULE V FLOW TRACING, WATERSHED ANALYSIS AND LANDFORMS 8

Methods for flow routing and flow accumulation – Extraction of stream networks – Extraction of watershed boundaries and building watershed hierarchies – feature extraction, types of landforms.

MODULE VI MODELING OF GEOSPATIAL PROCESSES 7

Model formulation, input data processing – introduction to GIS-based hydrologic, erosion and environmental modeling – Geocomputational methods, including agent-based modeling, artificial neural networks and evolutionary computing.

Total Hours –45

TEXT BOOKS:

1. Hassan A, Karimi (2017), Geospatial Data Science Techniques and Applications, CRS Press & Co.
2. Sudipto Banerjee, Bradley P, Carlin, Alan E. Gelfand (2014), Hierarchical Modeling and Analysis for Spatial Data, CRS Press & Co.

REFERENCES:

1. Maguire, D., M. Batty, and M. Goodchild. 2015. GIS, Spatial analysis, and modeling. ESRI Press (G70.212 .G584 2005)
2. Zeiler, M. 2010. Modeling Our World: The ESRI Guide to Geodatabase Design. Second Ed. ESRI Press, Redlands, California

OUTCOMES:

On successful completion of this course, students will be able to

- apply the basic concepts of Conceptualize models as representations of real life systems with inputs, outputs, and processes.
- employ the spatial tools to make simulations and predictions of real life phenomena.
- integrate and develop models with geospatial data through GIS.
- evaluate models in terms of accuracy, sensitivity, and uncertainty.
- perform a system-based approach for problem solving, with an emphasis on sustainability.
- execute the hydrological, erosion and environmental modeling through GIS.

GECX 219	ADVANCED ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop an entrepreneurial mindset.
- To learn the tools and methods for achieving sustainable growth.
- To explore various funds for a business and to get know about importance of a good team.
- To select public image branding and examine all channel types.
- To identify technology needs and establish key metrics to measure progress the business.
- To know about legal issues, regulations of starting and operating a venture and capstone presentation on practice venture.

Course Pre-requisites	Completion of Social Entrepreneurship CourseAccess to Learnwise Platform

MODULE I ENTREPRENEURSHIP BASICS & REFINING BUSINESS MODEL 8

EntrepreneurshipBasics - Recap of Key Concepts, Introduction to First Venture, Recap of idea selection and Lean Canvas, Revisit product/service, Business model, Team formation**. Refining Business Model –**Pivoting, Types of Business Model, Refining Business Models, Evaluate business model, Identify additional customer segments, Analyze Business Model of Competitors, Importance of Product Management.

MODULE II BUSINESS PLANNING & REVENUE 8

Business Planning – Introduction to Business Plan, Make a Sales Plan, Hiring Sales Team, Make a People Plan for Venture, Financial Planning and Forecasting Template, Revisit Business Model, Create a Procurement Plan, Negotiation. **Revenue** –Exploring ways to Increase Revenue, Understanding Primary Revenue Source, Customer Lifecycle for Growing Customers, Exploring Secondary Sources of Revenue.

MODULE III FUNDING GROWTH & BUILDING A-TEAM 7

Funding Growth – Funding Options for an Entrepreneur, Explore the Right Funding Options, Exploring crowd funding platforms, Create Your Funding Plan, Pitch Practice. **Building A-Team** – Intro to Building an A-Team, Defining roles and responsibilities, Pitching to Attract Talent, Setting Your Team Up for Success, Defining Role of a New Hire

.

MODULE IV BRANDING AND CHANNEL STRATEGY 7

Branding and Channel Strategy– Intro to Branding, Draw your Venture's Golden Circle, Define Your Values, Positioning Statements, Selecting Brand Name, Social Media Handle, Logo and Mobile app names forYour Venture, Creating online public profiles, Bulls Eye Framework and other traditional channel types, Identify your Right Channel using Bulls Eye Framework.

MODULE V LEVERAGING TECHNOLOGIES AND AVAILABLE PLATFORMS & MEASURING PROGRESS 8

Leveraging Technologies and Available Platforms – Leaping Ahead with Technology, Digital Marketing for Your Startup, Plan a Social Media Campaign, Digital Collaboration, Store Your Documents Online, Other Platforms, Make Your Tech Plan and Platform Wish List. Measuring Progress – Metrics for Customer Retention and Satisfaction, Find your CAC, CLV, and ARPU, Key Financial Metrics, How to Communicate Your Metrics, Find New Revenue Streams based on Your Key Financial Metrics, Re-forecast your Financial Plan to Increase Margin.

MODULE VI LEGAL MATTERS & SEEKING SUPPORT & FINAL PROJECT 7

Legal Matters – Identify the Professional Help and Legal and Compliance Requirements for Your Venture, Conduct a Trademark Search for Your Company/Brand Name. **Seeking Support** – How Mentors Help to Create Successful Startups, Identify Mentors and Advisors, Scout for Board of Directors.**Final Project –** Capstone Project Presentation.

Total Periods- 45

TEXT BOOKS

1. Learn wise platform - Wadhwani Foundation, 2018.
2. All Lessons are delivered as Online videos accessible using Wadhwani Foundation's Learnwise Platform - https://lms.learnwise.wfglobal.org

OUTCOMES:

On completion of the course, students will be able to

- Achieve sustainable growth by pivoting, refining business models, expand customer segments, and business planning for developing early customer traction into a repeatable business.
- Develop strategies to grow revenues and markets.
- Develop an A-Team, brand strategy and create digital presence.
- Develop brand and channel strategy for customer outreach
- Leverage social media to reach new customers cost effectively.
- Explore licensing and franchising for business expansion.

GECX220	**ELECTRIC VEHICLES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce the concept of Electric Vehicles.
- To familiarize the basic energy transfer processes that govern existing and proposed methods of power generation for Electric Vehicles.
- To familiarize with the traditional and non-traditional sources for Electric Vehicles in terms of energy content, accessibility, required processing steps and projected remaining reserves

MODULE I INTRODUCTION 8

A Brief History - Types of Electric Vehicle in Use Today : Battery electric vehicles - The IC engine/electric hybrid vehicle - Fuelled electric vehicles - Electric vehicles using supply lines - Solar powered vehicles - Electric vehicles which use flywheels or super capacitors - Ultra Capacitor – Ultra high Speed Flywheels.

MODULE II BATTERIES 7

Battery Parameters - Lead Acid Batteries - Nickel-based Batteries - Sodium-based Batteries - Lithium Batteries - Metal Air Batteries - Battery Charging - Choice of Battery - Use of Batteries in Hybrid Vehicles - Battery Modeling.

MODULE III FUEL CELLS 8

Hydrogen Fuel Cells - Fuel Cell Thermodynamics - Connecting Cells in Series - Water Management in the PEM Fuel Cell - Thermal Management of the PEM Fuel Cell - A Complete Fuel Cell System - Hydrogen Supply - Fuel Reforming - Hydrogen Storage.

MODULE IV ELECTRIC VEHICLE MODELLING AND DESIGN CONSIDERATIONS 7

Tractive Effort - Modeling Vehicle Acceleration - Modelling Electric Vehicle Range - Aerodynamic Considerations - Transmission Efficiency - Electric Vehicle Chassis and Body Design - General Issues in Design.

MODULE V DESIGN OF ANCILLARY SYSTEMS 7

Heating and Cooling Systems - Design of the Controls - Power Steering - Choice of Tyres - Wing Mirrors, Aerials and Luggage Racks - Electric Vehicle Recharging and Refueling Systems.

MODULE VI ENVIRONMENTAL IMPACT AND ENERGY STORAGE 8

Vehicle Pollution - The Effects - A Quantitative Analysis - Vehicle Pollution in Context - Alternative and Sustainable Energy Used via the Grid Hybridization of Energy Storages - Energy Consumption in Braking - Brake System of EVs and HEVs - Antilock Brake System.

Total Hours – 45

REFERENCES:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained”,John Wiley & Sons Ltd, 2nd edition, 2015.
2. M. Ehsani, Y. Gao, Stefano Lango, K.M.Ebrahimi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 3rd Edition,2018.
3. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition, CRC Press, 2016.
4. Tom Denton, “Electric and Hybrid Vehicles” Routledge Publishers, 1st edition, March 2016.

OUTCOMES:

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

- Identify and quantify the important energy transfer for Batteries and fuel cell schemes.
- Identify the opportunities and challenges of advances in Electric Vehicles.
- Choose a suitable drive scheme for developing an electric hybrid vehicle depending on Resources
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
- Choose proper energy storage systems for vehicles
- Identify the current industry activities by car makers, electricity utilities, parts, suppliers (motors and batteries), including joint ventures, product announcements and pilot projects.

GECX 221	ARTIFICIAL INTELLIGENCE AND EVOLUTIONARY COMPUTING USING MATLAB	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.
- To teach about the concept of fuzziness involved in various systems.
- To provide adequate knowledge about fuzzy set theory.
- To provide comprehensive knowledge of fuzzy logic control and its application to real time systems.
- To expose the ideas of GA and EP in optimization and control.

MODULE I FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORKS 9

Objectives,history, biologicalinspiration, neuron model, McCulloch-Pitts neuron model, single-input neuron, multi-input neuron, network architectures, perceptron architecture, single-neuron perceptron, multi-neuron perceptron, perceptron learning rule, constructing learning rules, training multiple-neuron perceptron

MODULE II ASSOCIATIVE NETWORKS 9

Simple associative networks, auto-associative and hetero-associative nets, learning in neural nets, supervised and unsupervised learning, unsupervised Hebb rule, Kohonen rule, ADALINE and MADALINE network, back propagation neural networks,Hopfield networks, adaptive networks, applications using Neural Network toolbox in Matlab.

MODULE III FUZZY SET THEORY 6

Fuzzy versus crisp, crisp sets, fuzzy sets, operations and properties, membership function, crisp relations, fuzzyrelations.

MODULE IV FUZZY SYSTEMS 6

Crisp logic – fuzzy logic – fuzzy rule-based system- defuzzification methods – applications – Greg Viot’s fuzzy cruise controller - fuzzy logic control using FIS in Matlab

MODULE V FUNDAMENTALS OF GENETIC ALGORITHMS 7

Genetic algorithms, history, basic concepts, working principle, encoding, fitness function, reproduction

MODULE VI GENETIC MODELING AND APPLICATIONS 8

Genetic operators, cross over types, mutation operator, coding steps of GA, convergence characteristics, applications of AI techniques in various domains using GATOOL in matlab

Total Hours –45

REFERENCES:

1. Laurance Fausett, Englewood cliffs, N.J., ‘Fundamentals of Neural Networks’,Pearson Education, 1992.
2. Timothy J. Ross, ‘Fuzzy Logic with Engineering Applications’, Tata McGraw Hill,1997.
3. David Goldberg, “Genetic Algorithms and Machine learning”, PHI
4. Wassermann, P. D. "Neural Computing" Van Reinhold, 1988.
5. Zimmermann, H. J., 'Fuzzy Set Theory and Its Applications', 2nd Edition,Kluwer Academic Publishers.
6. Martin T. Hogan, Howard B.Demuth. M,’Neural network design’4th edition
7. Zureda, J.M.,’Introduction to Artificial Neural Systems’, Jaico publishing house Bombay, 1994.
8. Bose N.K, Liang P. 'Neural Network Fundamentals with graphs, Algorithms and applications', TMH Pub. Co. Ltd, 2001.
9. S.Rajasekaran, G.A.Vijayalaksmi Pai , Neural Networks, Fuzzy logic and Genetic algorithms Synthesis and Applications , PHI private learning Ltd.,.New Delhi, 2011.

OUTCOMES:

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

- Enumerate the theoretical basis of soft computing.
- Discuss the neural networks and supervised and unsupervised learning networks
- Design suitable neural networks, fuzzy systems, genetic representations with appropriate fitness functions for simple problems
- Apply the most appropriate soft computing algorithm for a given situation
- Know the key issues in using these techniques for search of difficult search-spaces
- Be aware of the different approaches and different applications in the field.